



The mediating role of self-regulated online learning behaviors: Exploring the impact of personality traits on student engagement

Ahmet Kara¹ · Funda Ergulec² · Esra Eren²

Received: 15 September 2023 / Accepted: 30 April 2024 / Published online: 28 May 2024
© The Author(s) 2024

Abstract

Online learning environments have become increasingly prevalent in higher education, necessitating an understanding of factors influencing student engagement. This study examines the mediating role of self-regulated online learning in the relationship between five-factor personality traits and student engagement among university students. A sample of 437 university students from educational sciences, social sciences, and health sciences disciplines participated in the study. Data were collected using ‘The Big Five Inventory’ to assess personality traits, the ‘Self-Regulated Online Learning Questionnaire’ to measure self-regulated online learning, and the ‘Student Engagement Scale in the Online Learning Environment’ to evaluate student engagement. Structural equation modeling with bootstrap analysis was employed to analyze the data. The study findings indicate that the five factor personality traits significantly predict self-regulated online learning. Furthermore, self-regulated online learning is a significant predictor of students’ engagement in the online learning environment. Additionally, the five factor personality traits are found to be significant predictors of student engagement in the online learning environment. Lastly, self-regulated online learning plays a partially mediating role in the relationship between the five factor personality traits and student engagement in the online learning environment. This study underscores the importance of considering individual differences in personality traits and fostering self-regulated learning strategies to enhance student engagement in online learning environments. Understanding these dynamics can inform the design of effective interventions aimed at improving student outcomes in online education.

Keywords Five-factor personality traits · Self-regulated learning · Online environment · Student engagement · Bootstrap analysis

1 Introduction

While the usage of online learning strategies has grown over the past few decades, the pandemic has compelled all academic institutions to move online learning environments. The landscape of higher education has witnessed a significant shift towards online learning environments, propelled further by the global COVID-19 pandemic. This paradigmatic change underscores the pressing need to explore and understand the intricacies of student engagement within these digital contexts. While prior research has examined various factors influencing student engagement in traditional educational settings, the unique dynamics of online learning environments necessitate a nuanced investigation that considers the interplay between individual differences, self-regulated learning strategies, and engagement. This study seeks to address this gap by delving into the mediating role of self-regulated online learning in the relationship between five-factor personality traits and student engagement among university students. While previous studies have explored the influence of personality traits and self-regulation on academic outcomes, few have specifically focused on their impact within the context of online learning environments. By examining these relationships, this study contributes to the existing literature by providing novel insights into the mechanisms underlying student engagement in online education. Furthermore, this study builds upon recent literature that highlights the importance of considering individual differences and self-regulated learning strategies in online learning contexts (e.g., Smith et al., 2021; Xu et al., 2022). By incorporating these more recent studies, this study aims to provide a comprehensive understanding of the factors shaping student engagement in the digital age.

1.1 Student engagement

Regardless of the delivery method, much educational research has been concerned about student involvement since it is crucial for students' academic success (Whitehill et al., 2014; Bond et al., 2020). Student engagement is found to be a key factor in students' academic progress as well as their overall positive study experiences (Carini et al., 2006). Student engagement can be explained with behavioral, cognitive and emotional engagement (Fredricks et al., 2004): Behavioral engagement happens when students actively engage in educational activities. Cognitive engagement happens when students exhibit a desire to study and demonstrate self-regulation in their learning. Emotional engagement happens when students have favorable attitudes in the learning environment. As Fredricks et al. (2004) stated, teachers and other stakeholders have the chance to develop teaching strategies that make the most of students' learning behaviors when they are aware of students' academic involvement. In addition, existing research suggests that self-regulated learning (SRL) and student engagement are critical to students' academic achievement (Fredricks et al., 2004; Panadero, 2017; Zimmerman, 2000).

Despite the value of student engagement in academic achievement, there is relatively little research on student involvement in online education (Paulsen & McCormick, 2020). However, because of the nature of online learning environment, it is crucial to study and understand the factors influencing online student engagement. Thus, it's important to comprehend what motivates students to participate in online learning activities.

1.2 Personality traits and self-regulated learning

Self-regulated learning is the process by which learners achieve personal learning goals (Zimmerman, 1989). Self-regulation encompasses a learner's cognitive, meta-cognitive, behavioral, motivational, and emotional aspects. Proficient self-regulated learners can monitor their progress and adjust strategies as needed. Conversely, poor self-regulated learners often fail to employ effective learning strategies, leading to feelings of anxiety and fear of failure (Zimmerman, 1989).

A person's distinct and largely enduring way of reacting to situations is referred to as their personality (Passer & Smith, 2004). In terms of personality traits, the five-factor model (McCrae & Costa, 1989) has been found to be the most frequent and empirically solid model of personality studies, focusing on five traits (agreeableness, extraversion, conscientiousness, openness to experience, and neuroticism) (McCrae & Costa, 1989). Agreeableness evaluates attributes such as kindness, cooperativeness, and consideration, reflecting how an individual interacts with others. This dimension encompasses sub-dimensions including warmth, empathy, generosity, and morality (Goldberg, 1990). Extraversion evaluates an individual's sociability, enthusiasm, and enjoyment, with those classified as extraverts typically displaying traits such as optimism, a penchant for adventure, talkativeness, vitality, assertiveness, and an active disposition (McCrae & Costa, 1989). Conscientiousness pertains to an individual's effectiveness, accuracy, perseverance, organizational capabilities, coordination, and diligence (McCrae & Costa, 1989). One's openness to experience is evidenced by traits such as creativity, artistic inclination, intellectual depth, and insightful thinking (McCrae & Costa, 1989). Neuroticism, characterized by low emotional stability, is linked to diminished well-being, as individuals with emotional instability are prone to encountering negative emotions (McCrae & Costa, 1991).

Empirical research has investigated the relationship between students' personality traits and SRL strategies in different learning contexts. For instance, Dörrenbächer and Perels (2016) found that low neuroticism was a moderate predictor of SRL components found in students. The study also found that students employed moderate to high SRL techniques when compared to students with lower levels of openness, agreeableness, conscientiousness, and extraversion. In addition, Ghyasi et al. (2013) found that students' learning strategies were influenced by their personality traits. The researchers reported that high conscientious students were more likely to utilize all techniques, while individuals with high levels of extraversion were more inclined to use help-seeking techniques like peer learning, and those with low extraversion were more inclined to regulate their time and study space.

Apart from these studies examining the relationship between students' personality traits and their SRL strategies in regular education settings, there have been studies exploring the relationships between online education and self-regulation (e.g., Barak et al., 2016; Cho & Kim, 2013; Wilson & Narayan, 2016). Considering that a high level of learner autonomy is required for students' learning in online education environments and there is a low level of teacher presence, students' SRL behaviors gain particular importance in online learning environments

(Lehmann et al., 2014). Students must choose when to study and how to approach study materials on their own in online environments with limited teacher presence. Therefore, in such an environment, SRL behaviors become an important factor affecting students' learning. However, the studies conducted so far had not particularly investigated personality characteristics and the usage of SRL techniques in online learning. A recent study by Bruso et al. (2020) investigated these two concepts for online education, as one of the few studies carried out in the concept of online learning, and discovered that openness, extraversion, agreeableness, and conscientiousness, but not neuroticism, were correlated with a higher likelihood of using SRL methods.

1.3 Personality traits and student engagement

Numerous empirical studies have revealed a connection between personality traits and students' engagement. For instance, Qureshi et al. (2016) examined whether a student's personality can influence their involvement and attitude toward employability and found that student participation was linked to a variety of personality factors. Similarly, Caraway et al. (2003) found that students' engagement is influenced by their personality and self-efficacy. Additionally, previous research showed that engagement and academic progress were moderated by personality traits (Mahama et al., 2022; Ongore, 2014; Strauser et al., 2012; Qureshi et al., 2016).

While prior studies have focused on the effects of personality on engagement proxies, the aforementioned conclusions were reached in a regular classroom setting. Recently, Zhang et al. (2020) explored the impact of the group's personality composition on students' engagement, specifically in online discussions. The study found that the group's personalities may have an impact on student involvement, particularly affective engagement. Considering the study's findings, the researchers advised instructors to carefully evaluate the personality traits of the group members when organizing students' online discussions.

While there are studies exploring the relationship between personality traits and student engagement in face-to-face education, studies are limited in the online context. SRL and student engagement have been studied in conjunction with students' personality traits in several different contexts (Ghyasi et al., 2013; Jensen, 2015; Mahama et al., 2022; Ozan et al., 2012; Qureshi et al., 2016). The studies found that students' learning strategies were influenced by their personality types as well as their academic engagement (Ghyasi et al., 2013; Jensen, 2015). In addition, there have been studies that focused on only two of these concepts in online learning. For example, personality traits and SRL in online education (e.g., Bruso et al., 2020); personality traits and student engagement in online education (e.g., Zhang et al., 2020) have been studied by a few researchers. However, there has been no research into the impact of personality traits on students' self-regulation and engagement in the context of online education. Thus, the study intends to explore the relationship between students' personality traits, self-regulated learning, and academic engagement in online education to produce data that will contribute to the field and fill the gap in the literature.

1.4 Purpose of the study

The unprecedented disruptions caused by the COVID-19 pandemic have underscored the importance of understanding the impact of external factors on online learning. The transition to remote learning has introduced new challenges, such as technological barriers, social isolation, and heightened academic stress, which may influence students' engagement in online courses (Joubert et al., 2023; Sari & Mediatati, 2023). This study aims to provide timely insights into mitigating these challenges and optimizing student engagement in online learning environments. The notion of self-regulation, rooted in the theoretical foundations of Bandura's Social Cognitive Theory (Bandura, 1986), involves an individual's ability to achieve the intended behavior by interacting with their environment. Social cognitive theory provides a comprehensive framework for understanding human behavior by emphasizing the reciprocal interaction between personal factors, environmental influences, and behavior. In the context of online learning, this theory suggests that students' engagement is influenced not only by their inherent personality traits but also by their perceptions of the online learning environment and their ability to regulate their learning process. In the context of online learning, students' engagement may be influenced by their perceptions of the effectiveness of online instructional methods, the availability of social support networks, and their own beliefs in their ability to succeed in the online environment. Considering social cognitive theory, this study seeks to explore how students' personality traits and self-regulatory processes interact to influence their engagement in online learning. By understanding the underlying mechanisms driving student engagement, we can identify strategies to optimize the online learning experience and promote student success in online learning environments.

The general aim of this study is to determine the mediating role of self-regulated online learning in the effect of five factor personality traits on student's engagement in online learning environment among university students (see Fig. 1). The study fills existing gaps in the literature by elucidating the complex interplay between personality traits, self-regulated online learning, and student engagement in online education. By clarifying the novelty and innovation of the study, articulating its theoretical foundations, and incorporating recent literature, the study aims to contribute to a deeper understanding of how to promote effective online learning experiences for university students. In this direction, the following hypotheses were formed.

H1: Five factor personality traits are a significant predictor of self-regulated online learning behaviors.

Recognizing the unique demands of online education, where high learner autonomy is essential due to limited teacher presence, emphasizes the importance of students' SRL strategies in online learning environments (Lehmann et al., 2014). Given the necessity for students to independently manage their study schedules and approach study materials, SRL behaviors become pivotal in online environments. Additionally, in the educational context, each student brings a unique blend of personality traits, preferences, and abilities. These components have the potential to influence how adeptly learners utilize skills and strategies to achieve their academic goals. Therefore,

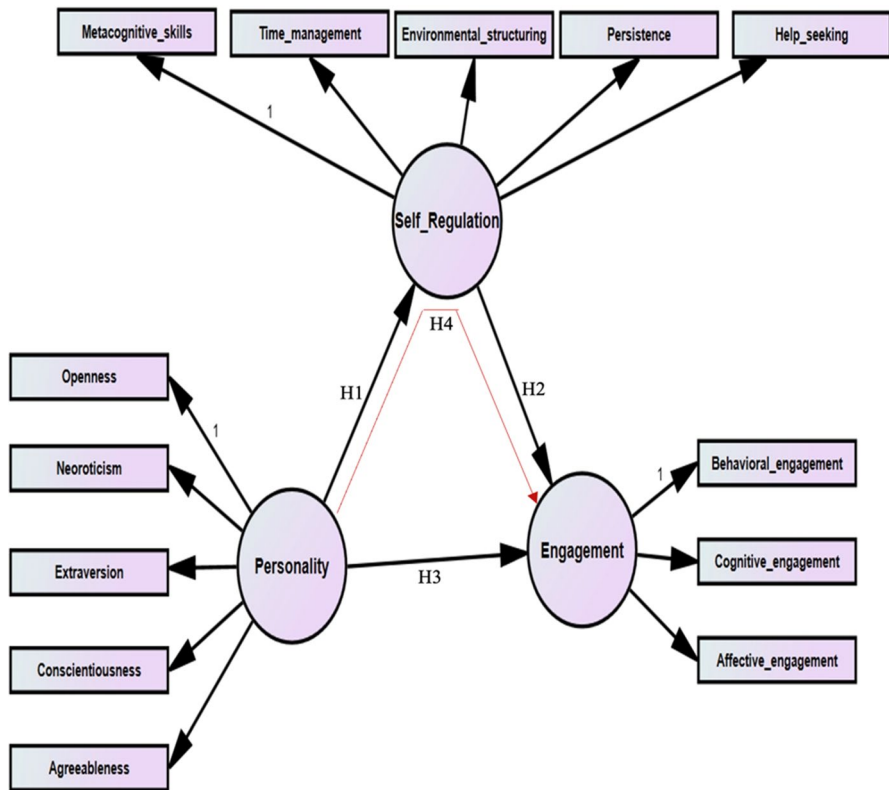


Fig. 1 Hypothetical model. Note. Personality: Five factor personality traits; Self-Regulation: Self-Regulation Online Learning. Engagement: Student's Engagement in Online Learning Environment

personality traits may play a significant role in predicting individuals' self-regulated learning behaviors within the distinctive context of online education.

H2: Self-regulated online learning behaviors are a significant predictor of student's engagement in online learning environment.

While prior research contributes to the understanding of SRL profiles and the relationship between learner's self-regulatory activities and their achievement or performance in traditional settings (Barnard-Brak et al., 2010; Pintrich, 2004), a gap exists in understanding the relationship between self-regulated online learning behaviors and student's engagement especially in higher education settings and online environments. Additionally, it is important to understand the relationships between the dimensions of engagement (behavioral, cognitive, and emotional) and students' self-regulated online learning behaviors.

H3: Five-factor personality traits are a significant predictor of students' engagement in the online learning environment.

Existing studies have primarily focused on the relationship between personality traits and students' engagement in traditional learning environments (Mahama et al., 2022; Ongore, 2014; Strauser et al., 2012; Qureshi et al., 2016). Nevertheless, there has been limited attention given to the associations between students' personality traits and their engagement in the online learning environment. It is crucial to comprehend the relationships between the dimensions of personality traits (agreeableness, openness to experience, neuroticism, extraversion, and conscientiousness) and students' engagement in the online learning environment.

H4: The mediation effect of self-regulated online learning behaviors is significant in the relationship between five factor personality traits and students' engagement in online learning environment.

Acknowledging the uniqueness of the online learning environment, where autonomy and self-directedness are often emphasized (Azevedo & Hadwin, 2005; Chen et al., 2013), this study seeks to understand the mediation effect of self-regulated online learning on the relationship between five factor personality traits and students' engagement in the online learning environment.

2 Method

2.1 Participants and procedure

The study was conducted as part of an elective Information Technologies (IT) course designed to illustrate the practical application of IT within specific disciplines. The courses were conducted by two faculty members within the Department of Computer Education and Instructional Technologies. Consistency was maintained across all courses, utilizing the same structure and syllabus. Spanning 14 weeks, the course syllabus was meticulously crafted based on the requisite needs of the curriculum. Course materials aligned with the syllabus, and students were obliged to attend synchronous sessions while concurrently completing weekly assignments that pertained to the application of IT in their respective subject areas. The course, designed in a modular format, shares weekly assignments, readings, or practice files that need to be completed before the class. The students submitted their assignments weekly through the Learning Management System (LMS). The instructional approach encompassed synchronous one-hour sessions complemented by asynchronous activities throughout the semester.

The study comprised a cohort of 437 university students enrolled in IT courses at a public university in Turkey. Participants were selected through convenient sampling, and the recruitment process was facilitated using Google Forms. Out of the 525 students enrolled in the courses, 437 participated in the study. Among the participants, 333 (76.2%) identified as female, while 104 (23.8%) identified as male. The distribution by grade level revealed 137 (31.4%) freshmen, 95 (21.7%) sophomores, 50 (11.4%) juniors, and 155 (35.5%) seniors. Additionally, participants belonged to diverse fields of study, including educational sciences (e.g., guidance and psychological counseling, elementary education), health sciences (e.g., nursing), and social sciences (e.g., theology).

2.2 Data collection tools

2.2.1 The big five inventory (BFI)

The BFI, developed by Benet-Martínez and John (1998) and translated into Turkish by (Sümer et al., 2005), consists of five dimensions (agreeableness, openness to experience, neuroticism, extraversion, and conscientiousness) with 44 items. Confirmatory factor analysis indicated an acceptable level of fit ($\chi^2/df=3.3$, GFI=0.94, CFI=0.94, AGFI=0.97, and RMSEA=0.05) (Gökler & Taştan, 2018). In the current study, internal consistency was assessed through reliability analysis, revealing values of $\alpha=0.63$ for agreeableness, $\alpha=0.73$ for conscientiousness, $\alpha=0.76$ for extraversion, $\alpha=0.66$ for neuroticism, and $\alpha=0.78$ for openness. According to these findings, the internal consistencies of neuroticism and agreeableness dimensions were below 0.70, which can be interpreted as low measurement reliability (Nunnally, 1979).

2.2.2 Self-regulated online learning questionnaire (SOL-Q)

The SOL-Q, developed by Jansen et al. (2017), underwent adaptation to Turkish, along with validity and reliability studies conducted by Yavuzalp and Özdemir (2020). Comprising five dimensions (help-seeking, persistence, environmental structuring, metacognitive skills, and time management) with a 36-item structure, SOL-Q demonstrated robust psychometric properties. Exploratory factor analysis revealed a total explained variance of 62.06%, while confirmatory factor analysis indicated an acceptable level of fit ($\chi^2/df=4.21$, RMSEA=0.07, AGFI=0.79, NNFI=0.98, and CFI=0.99) (Yavuzalp & Özdemir, 2020). The internal consistency reliability analysis findings for the entire SOL-Q yielded $\alpha=0.96$ in the original study and $\alpha=0.97$ in the current study (Yavuzalp & Özdemir, 2020).

2.3 Student's engagements scale in online learning environment (SESOLE)

The SESOLE, developed by Sun and Rueda (2012), underwent adaptation to Turkish, including validity and reliability analyses conducted by Ergün and Usluel (2015). Comprising three dimensions (behavioral engagement, cognitive engagement, and affective engagement) with a total of 19 items, SESOLE demonstrated sound psychometric properties. Confirmatory factor analysis was employed for construct validity, yielding goodness-of-fit values at acceptable levels ($\chi^2 (84, N=398)=453.93$, GFI=0.90, NNFI=0.96, AGFI=0.86, and RMSEA=0.07) (Ergün & Usluel, 2015). Internal consistency reliability coefficients derived from the reliability study were found to be 0.62 for behavioral engagement, 0.90 for affective engagement, 0.86 for cognitive engagement, and 0.90 for the overall SESOLE (Ergün & Usluel, 2015). In the current study, internal consistency reliability analysis revealed $\alpha=0.61$ for behavioral engagement, $\alpha=0.91$ for affective engagement, $\alpha=0.90$ for cognitive engagement, and $\alpha=0.91$ for the overall SESOLE.

2.4 Data analysis

In this study, the assumptions of structural equation modeling were initially assessed, considering normality, bivariate correlations, and multicollinearity (Kline, 2015). Subsequently, a two-stage structural equation modeling approach was employed for data analysis (Anderson & Gerbing, 1988). To evaluate the accuracy of both the measurement and structural models, several metrics were considered, including Goodness of Fit Indices (χ^2/df , GFI, AGFI, IFI, CFI, and RMSEA), factor loads (non-standardized and standardized), and t-values. Moreover, mediation analysis was conducted following the steps proposed by Baron and Kenny (1986). The significance of the mediation analysis was ultimately confirmed through bootstrap analysis, demonstrating that the confidence intervals, formed by 1000 resampling, did not encompass zero (Hayes, 2017; Shrout & Bolger, 2002).

3 Results

3.1 Preliminary analysis

In this study, the initial step involved testing the assumptions of structural equation modeling. Firstly, the assumption of normality was scrutinized, revealing skewness values ranging between -0.80 and 0.20 , and kurtosis values between -1.02 and 0.62 (refer to Table 1). As these values fell below -1.5 and $+1.5$, respectively (Tabachnick & Fidell, 2007), it can be concluded that the normality assumption was satisfied. The multicollinearity assumption was then assessed. Tolerance values ranged from 0.31 to 0.82 , and VIF values ranged between 1.20 and 3.18 . Notably, no tolerance values approached zero, and the VIF values were below the threshold of 5 – 10 (Kline, 2015). Additionally, the correlation coefficient between the variables (see Table 2) did not reach 0.90 or above, indicating the absence of a multicollinearity problem.

3.2 Testing the two-stage structural equation modeling

3.2.1 Testing the measurement model (first stage)

The measurement model is represented by three latent variables: “five factor personality traits”, “self-regulation online learning”, “student’s engagement in online learning environment.” These are reflected by 13 observed variables: “neuroticism”, “agreeableness”, “extraversion”, “conscientiousness”, “openness”, “environmental structuring”, “persistence”, “time management”, “metacognitive skills”, “help seeking”, “behavioral engagement” cognitive engagement”, and affective engagement.”

The measurement model was assessed, and the goodness-of-fit values were found to be at an acceptable level (χ^2/df ($290.798/60$)= 4.84 , $p=.00$; GFI= 0.91 , AGFI= 0.86 , IFI= 0.90 , CFI= 0.90 , RMSEA= 0.09 (90) % = 0.083 – 0.105 . Furthermore, in the examination of the measurement model, standardized factor loads were found to range from -0.30 to 0.86 , and all t-values were found to be statistically significant.

Table 1 Descriptive statistics

Variables	Mean	Std. Deviation	Skewness	Kurtosis
Agreeableness	34.11	4.97	−0.35	−0.03
Conscientiousness	32.09	5.80	0.01	−0.59
Extraversion	26.05	5.95	−0.20	−0.19
Neuroticism	23.85	5.40	0.12	0.12
Openness	36.05	6.10	−0.21	−0.08
Metacognitive skills	68.02	24.86	−0.01	−0.71
Time management	13.60	3.48	−0.14	−0.07
Environmental structuring	23.48	8.56	−0.49	−0.82
Persistence	20.21	8.25	−0.07	−0.95
Help seeking	20.65	8.18	−0.29	−1.02
Behavioral engagement	17.97	3.35	−0.29	−0.01
Cognitive engagement	27.85	6.92	−0.80	0.62
Affective engagement	15.58	6.35	0.22	−0.73

Consequently, these results confirm the validation of the measurement model (see Fig. 2; Table 3).

3.2.2 Testing the structural model (second stage)

In the initial stage, the measurement model underwent validation, and subsequently, the two-stage structural model was assessed. Upon testing the structural model, the goodness-of-fit indices were within an acceptable range (χ^2/df (290.798/60)=4.84, $p=.00$; GFI=0.91, AGFI=0.86, IFI=0.90, CFI=0.90, RMSEA=0.09 (90%)=0.083–0.105) (see Table 4). Furthermore, Fig. 3 illustrates the standardized path coefficients of the structural model, while Table 5 provides details on the non-standardized path coefficients, standard error, and t values.

Upon examination of the results in Fig. 3, it is evident that a one-unit increase in five factor personality traits increases individuals' self-regulated online learning by 0.48 units ($t=5.76$; $p<.001$). In addition, a one-unit increase in self-regulated online learning increases individuals' student's engagement in online learning environment by 0.49 units ($t=8.55$; $p<.001$).

Finally, a one-unit increase in five factor personality traits increases individuals' student's engagement in online learning environment by 0.45 units ($t=5.43$; $p<.001$). In addition to these, when examining the explained variances, it is observed that five factor personality traits account for about 23% of self-regulated online learning. Furthermore, when considering both five-factor personality traits and self-regulated online learning, they collectively explain around 67% of students' engagement in the online learning environment.

Table 2 Bivariate correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Agreeableness	1												
2. Conscientiousness	0.43 ^{**}	1											
3. Extraversion	0.19 ^{**}	0.31 ^{**}	1										
4. Neuroticism	-0.23 ^{**}	-0.23 ^{**}	-0.29 ^{**}	1									
5. Openness	0.26 ^{**}	0.28 ^{**}	0.40 ^{**}	-0.06	1								
6. Metacognitive skills	0.21 ^{**}	0.34 ^{**}	0.13 ^{**}	-0.12 [*]	0.28 ^{**}	1							
7. Time management	0.19 ^{**}	0.32 ^{**}	0.08	-0.14 ^{**}	0.02	0.21 ^{**}	1						
8. Environmental structuring	0.18 ^{**}	0.35 ^{**}	0.03	-0.05	0.17 ^{**}	0.72 ^{**}	0.24 ^{**}	1					
9. Persistence	0.22 ^{**}	0.31 ^{**}	0.04	-0.05	0.22 ^{**}	0.75 ^{**}	0.18 ^{**}	0.73 ^{**}	1				
10. Help seeking	0.18 ^{**}	0.30 ^{**}	0.14 ^{**}	.01	0.24 ^{**}	0.65 ^{**}	0.11 [*]	0.69 ^{**}	0.66 ^{**}	1			
11. Behavioral engagement	0.31 ^{**}	0.49 ^{**}	0.18 ^{**}	-0.20 ^{**}	0.21 ^{**}	0.40 ^{**}	0.45 ^{**}	0.49 ^{**}	0.45 ^{**}	0.35 ^{**}	1		
12. Cognitive engagement	0.23 ^{**}	0.41 ^{**}	0.17 ^{**}	-0.08	0.34 ^{**}	0.53 ^{**}	0.28 ^{**}	0.46 ^{**}	0.48 ^{**}	0.45 ^{**}	0.61 ^{**}	1	
13. Affective engagement	0.13 ^{**}	0.21 ^{**}	0.11 [*]	-0.19 ^{**}	0.09	0.42 ^{**}	0.34 ^{**}	0.32 ^{**}	0.41 ^{**}	0.24 ^{**}	0.47 ^{**}	0.40 ^{**}	1

** $p < .01$, * $p < .05$

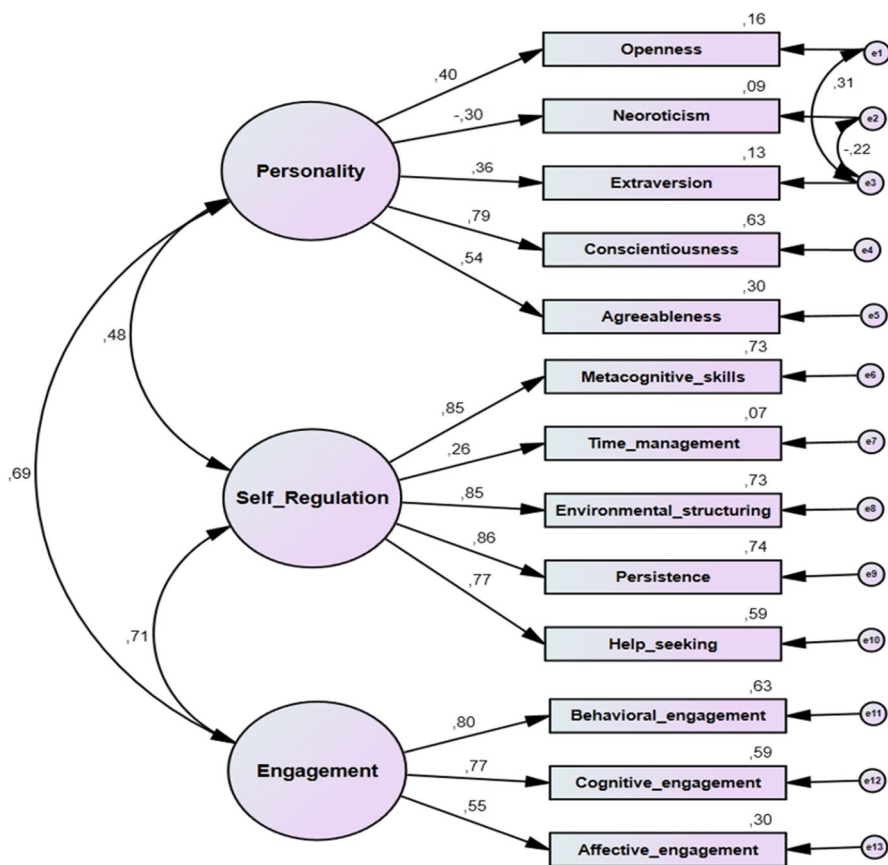


Fig. 2 Measurement Model. Note. *** $p < .001$; ** $p < .01$; * $p < .05$. Personality: Five factor personality traits; Self-Regulation: Self-Regulation Online Learning. Engagement: Student's Engagement in Online Learning Environment

3.2.3 Moderator analysis: The role of self-regulation online learning

Mediation analysis was conducted following the steps suggested by Baron and Kenny (1986). Initially, it was determined that the direct effect ($\beta = 68$; $t = 7.10$) of the independent variable (five-factor personality traits) on the dependent variable (student's engagement in the online learning environment) was significant ($p < .001$). When self-regulated online learning is introduced, the impact of the independent variable (five-factor personality traits) on the dependent variable (student engagement in the online learning environment) decreases ($\beta = 45$; $t = 5.43$) but remains statistically significant ($p < .001$). These findings provide evidence that the self-regulated online learning component mediates the effect of the independent variable (five-factor personality traits) on the dependent variable (student's engagement in the online learning environment).

The bootstrap analysis findings in Table 6 are presented. The direct impact of five factor personality traits in student's engagement in online environment is significant

Table 3 Measurement model (unstandardized factor loadings, standard errors, t-values)

Paths			Estimate	S.E.	C.R.	<i>p</i>
Openness	<---	Personality	1.00			
Neuroticism	<---	Personality	−0.66	0.15	−4.51	***
Extraversion	<---	Personality	0.89	0.14	6.23	***
Conscientiousness	<---	Personality	1.89	0.28	6.81	***
Agreeableness	<---	Personality	1.11	0.17	6.38	***
Metacognitive skills	<---	Self-Regulation	1.00			
Time management	<---	Self-Regulation	0.04	0.01	5.32	***
Environmental structuring	<---	Self-Regulation	0.34	0.02	22.19	***
Persistence	<---	Self-Regulation	0.33	0.01	22.42	***
Help seeking	<---	Self-Regulation	0.30	0.02	18.86	***
Behavioral engagement	<---	Engagement	1.00			
Cognitive engagement	<---	Engagement	1.99	0.13	14.87	***
Affective engagement	<---	Engagement	1.30	0.12	10.71	***

SE Standard Error, *Personality* Five factor personality traits, *Self-Regulation* Self-Regulation Online Learning, *Engagement* Student's Engagement in Online Learning Environment

*** $p < .001$

Table 4 Goodness of fit indices of structural model

Goodness of Fit Indices	Fit Criteria	Values of the Model	State of the Fit
¹ χ^2/sd	$0 \leq \chi^2/sd \leq 5$	4.84	Acceptable Fit
² RMSEA	$0 \leq RMSEA \leq 0.10$	0.09	Acceptable Fit
³ GFI	$0.90 \leq GFI \leq 0.95$	0.91	Acceptable Fit
⁴ CFI	$0.90 \leq CFI \leq 0.95$	0.90	Acceptable Fit
⁵ IFI	$0.90 \leq IFI \leq 0.95$	0.90	Acceptable Fit
⁶ AGFI	$0.85 \leq AGFI \leq 0.90$	0.86	Acceptable Fit

Source: ¹(Sümer, 2000), ²(MacCallum et al., 1996), ³ and ⁶(Schermelleh-Engel et al., 2003), ⁴(Hu & Bentler, 1999), ⁵ (Bentler & Bonnet, 1980)

$[\beta = 0.45, 95\% \text{ CI } (0.31, 57)]$. In addition, the partial mediation effect of self-regulation online learning is significant in the relationship between five factor personality traits and student's engagement in online learning environment $[\beta = 0.23, 95\% \text{ CI } (0.17, 32)]$. In conclusion, all these findings support the idea that self-regulation online learning has a partial mediation effect.

4 Discussion

The study aims to ascertain the mediating influence of self-regulated online learning in the relationship between five-factor personality traits and student engagement within the online learning environment among university students. Through

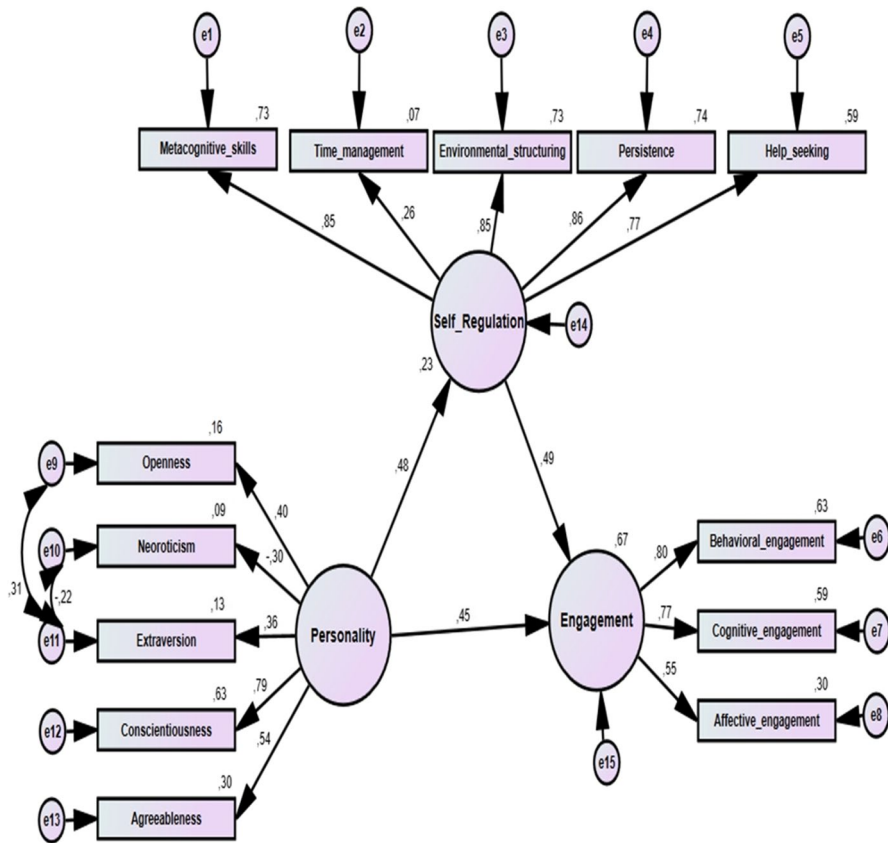


Fig. 3 Standardized path coefficient of the structural model. Note. *** $p < .001$; ** $p < .01$; * $p < .05$. Personality: Five factor personality traits; Self-Regulation: Self-Regulation Online Learning. Engagement: Student's Engagement in Online Learning Environment

mediation analysis conducted for this overarching goal, it was determined that self-regulated online learning exerted a partial mediation effect in connecting students' five-factor personality traits with their engagement in the online environment. The interpretation of the current working hypothesis is elaborated upon in the context of existing literature.

4.1 Personality traits and self-regulated online learning

The first hypothesis of the study (H1), "five factor personality traits is a significant predictor of self-regulated online learning," suggests that the personality traits of students participating in the research are determined to be a significant predictor of their online self-regulated learning behaviors, and the hypothesis has been confirmed. This finding aligns with earlier studies that have explored the correlation between personality traits and self-regulated learning behaviors (Babakhani, 2014;

Table 5 Structural model (unstandardized factor loadings, standard errors, t-values)

Paths			Estimate	S.E.	C.R.	p
Self_Regulation	<---	Personality	4.21	0.73	5.77	***
Engagement	<---	Personality	0.50	0.10	5.43	***
Engagement	<---	Self-Regulation	0.06	0.01	8.56	***
Openness	<---	Personality	1.00			
Conscientiousness	<---	Personality	1.89	0.28	6.81	***
Agreeableness	<---	Personality	1.11	0.17	6.38	***
Metacognitive skills	<---	Self-Regulation	1.00			
Time management	<---	Self-Regulation	0.04	0.01	5.32	***
Environmental structuring	<---	Self-Regulation	0.34	0.02	22.19	***
Persistence	<---	Self-Regulation	0.33	0.01	22.42	***
Behavioral engagement	<---	Engagement	1.00			
Cognitive engagement	<---	Engagement	1.99	0.13	14.87	***
Affective engagement	<---	Engagement	1.30	0.12	10.72	***
Extraversion	<---	Personality	0.89	0.14	6.23	***
Help seeking	<---	Self-Regulation	0.30	0.02	18.86	***
Neuroticism	<---	Personality	−0.66	0.15	−4.51	***

SE Standard Error, *Personality* Five factor personality traits, *Self-Regulation* Self-Regulation Online Learning, *Engagement* Student's Engagement in Online Learning Environment

*** $p < .001$

Bidjerano & Dai, 2007; Bruso et al., 2020; Chamorro-Premuzic & Furnham, 2003; De la Fuente et al., 2020; Dörrenbächer & Perels, 2016; Eilam et al., 2009; Ghyasi et al., 2013; Jensen, 2015; Mahama et al., 2022). Consequently, personal characteristics are identified as a pivotal factor influencing individuals' adoption of self-regulated learning behaviors.

The five-factor personality model (McCrae & Costa, 1989) was examined in terms of its dimensions, revealing a positive relationship between conscientiousness, agreeableness, openness to experience, extraversion, and self-regulated learning. Additionally, a negative relationship was observed between neuroticism and

Table 6 Bootstrap analysis

Model pathway	Bootstrap values		Bias %95CI		p
	(β)	SE	Lower	Upper	
Direct effect					
<i>Personality</i> → Engagement	0.45	0.06	0.31	0.57	0.00
Indirect effect					
<i>Personality</i> → <i>Self-Regulation</i> → Engagement	0.23	0.03	0.17	0.32	0.00

Personality Five factor personality traits, *Self-Regulation* Self-Regulation Online Learning, *Engagement* Student's Engagement in Online Learning Environment

self-regulated learning. Consequently, students possessing personality traits other than neuroticism tend to benefit from self-regulated learning behaviors in online environments. High levels of conscientiousness are associated with the extensive use of various self-regulated learning behaviors (metacognitive, time management, environmental structuring, effort regulation, and seeking help) compared to their less conscientious counterparts. Conscientiousness, which encompasses characteristics such as goal orientation, self-control, diligence, determination, regularity, and punctuality, constitutes the overarching domain of self-regulation (Koestner et al., 1992). Relevant literature indicates that students with high levels of conscientiousness frequently utilize strategies such as goal setting, adjusting appropriate study environments, managing time effectively, and putting effort into their learning (Bidjerano & Dai, 2007; Bruso et al., 2020; Komarraju & Karau, 2005). Even in unforeseen circumstances with limited control, individuals with high conscientiousness tend to maintain a more focused approach towards their goals (Morfaki & Skotis, 2023) and exhibit enhanced adaptation to online learning environments, as observed during events such as the Covid-19 pandemic (Besser et al., 2022).

Students who score high on the agreeableness personality dimension effectively utilize all self-regulated learning behaviors similarly to those with high levels of conscientiousness. The trait of agreeableness, characterized by harmony and cooperation, allows individuals to adjust their work habits based on the learning environment. This suggests that agreeable students are likely to voice fewer objections regarding learning environments and generally adhere more to teacher instructions (Vermetten et al., 2001). These individuals predominantly demonstrate self-regulated learning behaviors in collaborative learning environments (Bruso et al., 2020; De la Fuente et al., 2020; Eilam et al., 2009), with a particular emphasis on utilizing effort regulation, time management, and help-seeking strategies (Bidjerano & Dai, 2007; Bruso et al., 2020; Ghyasi et al., 2013).

Individuals who score high on the openness to experience personality dimension generally benefit from self-regulated learning behaviors. Open individuals possess strong problem-solving, critical thinking, and detailing skills, coupled with high metacognitive abilities (Bidjerano & Dai, 2007; Ghazi et al., 2013; Komarraju et al., 2011). These students, perceiving themselves as deep thinkers, intellectual, innovative, and imaginative, tend to exhibit better performance in the learning environment compared to those with low levels of openness to experience (Bidjerano & Dai, 2007; De la Fuente et al., 2020). However, students with this trait may face challenges in time management. Indeed, Ghazi et al. (2013) concluded that there is a negative relationship between openness to experience and self-regulation strategies involving time and study environment. While open individuals can concentrate intensely during their studies, characteristics such as their constant pursuit of new insights and deep thinking may lead them to lose track of time within a state of flow.

Extroverted individuals frequently use metacognitive and help-seeking strategies but show lower usage of time management, environmental structuring, and effort regulation strategies. This finding aligns with the results of other studies indicating that extroverted students predominantly utilize help-seeking strategies (Bidjerano & Dai, 2007; Bruso et al., 2020; Ghazi et al., 2013). Students with high levels of extroversion are academically more motivated and have higher learning goal orientations

compared to those with low levels of extroversion (Payne et al., 2007). However, when working independently, they tend to seek socially stimulating activities that can distract their attention (Bernard, 2010). These students may struggle with tasks that require self-study and reflection, as their sociability, impulsivity, and distractibility hinder effective time management and effort regulation (Bidjerano & Dai, 2007; Bruso et al., 2020; Ghazi et al., 2013). Considering the inclination of extroverted individuals to prioritize social needs over academic needs, it suggests that socially distant online learning environments may pose challenges for these students (Morfaki & Skotis, 2023).

A negative relationship was observed between neuroticism and self-regulated learning. Individuals with higher levels of neuroticism tend to be less successful in using self-regulation strategies. This outcome aligns with the expectations, as several studies have highlighted the association between self-regulation and low neuroticism (e.g., Babakhani, 2014; Eilam et al., 2009; Ghyasi et al., 2013; Jensen, 2015). In this study, despite differences in the utilization of the help-seeking strategy compared to other strategies, no significant positive relationship was found, contrary to other research indicating that these individuals tend to seek help more frequently than other personality types (Bidjerano & Dai, 2007; De la Fuente et al., 2020). The unique structural features of online learning, different from traditional face-to-face learning environments, or the instructional format of the course may have contributed to these individuals experiencing anxiety and displaying hesitancy in seeking help.

Conscientiousness and agreeableness in students correlate with proficiency in utilizing nearly all self-regulated learning behaviors. Students demonstrating openness to experience, in particular, tend to employ metacognitive, help-seeking, and effort regulation strategies, while extroverted students predominantly benefit from the help-seeking strategy. Conversely, students with a neurotic personality face challenges in employing self-regulated learning behaviors. Consequently, it can be inferred that the design of online learning environments should aim to enhance the existing learning strategies of each learner, considering diverse individual characteristics, and encourage them to utilize strategies they may use less frequently or not at all.

4.2 Self-regulated learning and engagement

The second hypothesis of the study (H2), “self-regulated online learning behaviors is a significant predictor of student’s engagement in the online learning environment,” was confirmed, indicating that the online self-regulated learning behaviors of participating students are a significant predictor of their commitment to the online learning environment. In other words, students with advanced self-regulated learning skills exhibit higher engagement levels in the learning process. This finding aligns with the outcomes of other research studies demonstrating a close relationship between self-regulated learning and student engagement in the online environment (Binali et al., 2021; Cho & Jonassen, 2009; Cho & Kim, 2013; Mahama et al., 2022; Salas-Pilco et al., 2022; Sun & Rueda, 2012). Zimmerman and Schunk (2001) emphasize that students who apply self-regulated learning skills can become active participants in their learning. Individuals with high self-regulated learning skills are more inclined

to explore, leading to increased engagement in the learning environment (Schwonke, 2015). According to Tao and colleagues (2020), students with low engagement levels invest less effort in the learning process and exhibit lower levels of self-regulated learning behaviors such as help-seeking, time management, task strategies, and self-assessment.

The dimensions that form the framework of both self-regulated learning and engagement are examined and discovered that the dimensions of the two variables overlap in many ways and are intertwined. Engagement is about learners' efforts to research, apply, receive feedback, analyze and solve problems (Kuh, 2003). In self-regulated learning, learners engage in their own learning processes motivationally and strategically in line with their metacognitive strategies (Zimmerman, 1990). Thus, the individual's effort is at the forefront in both self-regulated learning and engagement. Self-regulated learning is an umbrella concept that focuses on how students organize the behavioral, cognitive, affective, and motivational aspects of learning to achieve academic success (Pintrich, 2004). Commitment involves the active participation and involvement of students in activities related to success (Boekaerts, 2016), encompassing behavioral, cognitive, and emotional dimensions within a meta structure (Fredricks et al., 2004). Both conceptual frameworks are multidimensional and can be said to involve similar learning processes.

In this study, student engagement in online classes, a concept widely accepted in the literature, has been examined in three dimensions: behavioral, cognitive, and emotional (Fredricks et al., 2004). Behavioral engagement, which is the most researched type of engagement, encompasses participation in academic activities such as attending classes, dedicating time to academic tasks, and engaging in learning processes (asking questions, participating in discussions, etc.), as well as participation in social or extracurricular activities (Fredricks et al., 2004; Li & Lerner, 2013). Students who use self-regulated learning behaviors more frequently have demonstrated higher levels of behavioral engagement. Research results indicating that these students participate more frequently in online learning activities, spend more time in the learning environment by watching course videos or working with online materials (Salas-Pilco et al., 2022), support the findings of this study.

Cognitive engagement involves using self-regulated learning and making the necessary effort to understand complex ideas through deep learning strategies (Fredricks et al., 2004; Zimmerman, 1990). Although self-regulated learning and cognitive engagement are different constructs, they are intertwined concepts. Most self-regulated learning theories that rely on cyclical feedback systems to explain students' learning processes are inherently cognitive (Cleary & Zimmerman, 2012). In a model proposed by Li and Lajoie (2022) that integrates self-regulated learning with cognitive engagement, it is argued that there is a role for cognitive engagement in each stage of Zimmerman's (2000) three-stage self-regulated learning model (forethought, performance, and self-reflection). For instance, in the *forethought* stage, students plan the strategies to be used and the effort required to achieve their goals. In the *performance* stage, they choose cognitive strategies and control the level of using a strategy. In the *self-reflection* stage, students evaluate their current cognitive engagement to determine whether it is sufficient to achieve the expected

performance. This demonstrates that cognitive engagement and self-regulated learning are intertwined concepts at each stage of Zimmerman's model.

Emotional engagement refers to students' attitudes towards educators, peers, and courses, as well as their appreciation for the subject and learning conditions, satisfaction, and feeling good about themselves (Salas-Pilco et al., 2022). Online learning requires a higher level of internal motivation and self-discipline during the learning process compared to the classroom environment. Therefore, students who are more interested in online learning activities and are more capable of using various learning strategies tend to enjoy online learning more and have more positive learning experiences (Zhu et al., 2020).

An education program typically requires students to be busy with certain tasks and activities, and to make decisions about how much time, where and how to study, especially those studying in higher education (Kahn, 2014). According to Conrad and Donaldson (2011), student involvement in the online environment encourages them to take more ownership of their education. In addition to having effective learning techniques, successful learners also have a strong desire to learn. These students who are behaviorally, cognitively and emotionally involved in learning tasks can be called self-regulated learners (Fredricks et al., 2004). In a setting where students learn online, learners should be engaged by providing timely student-instructor interaction, creating a collaborative learning environment, and designing activities that enrich students' development (Robinson & Hullinger, 2008). The more responsibility students are given in the learning process and the more they are kept busy, the more their learning will improve, and engagement will increase (Bond et al., 2020). In addition, challenging tasks will encourage learners to use their metacognitive strategies (Babakhani, 2014; Ergulec & Agmaz, 2023).

4.3 Personality traits and engagement

The third hypothesis of the study (H3) states that “five factor personality traits is a significant predictor of student's engagement in online learning environment.” According to the research findings, it has been determined and confirmed that students' self-regulated learning behaviors are significant predictors of their commitment to the online learning environment. This finding is consistent with other research results that indicate learners' personality traits play a crucial role in their academic engagement (Ghyasi et al., 2013; Jensen, 2015; Keller & Karau, 2013; Komarraju & Karau, 2005; Mahama et al., 2022; Morfaki & Skotis, 2023; Ongore, 2014; Quigley et al., 2022; Qureshi et al., 2016; Strauser et al., 2012; Yu, 2021; Zhang et al., 2020).

The five-factor personality model (McCrae & Costa, 1989) was analyzed with respect to its dimensions, revealing a positive correlation between conscientiousness, agreeableness, openness to experience, extraversion, and self-regulated learning. Additionally, a negative correlation was observed between neuroticism and engagement. Accordingly, students possessing personality traits other than neuroticism tend to exhibit high levels of commitment to online classes. When examined by dimensions, especially students with characteristics of conscientiousness and agreeableness show higher levels of participation. Related studies

emphasized that conscientiousness and agreeableness from personality traits are important predictors of engagement (Keller & Karau, 2013; Quigley et al., 2022; Qureshi et al., 2016). High- conscientiousness students are expected to engage better by using strategies directly or indirectly related to academic progress, including assignment completion and question-asking (Caprara et al., 2011; Chamorro-Premuzic & Furnham, 2003). These individuals can plan, manage their time, organize their materials, and perform effectively (Jensen, 2015).

Characteristics associated with the agreeableness personality dimension encompass feelings of collaboration and obedience that enable students to follow instructions and pay attention to assignment deadlines (Bruso et al., 2020). Qureshi and colleagues (2016) assert that commitment to the course is linked to trust and attaching importance to the educational process; thus, adaptive traits such as self-sacrifice, honesty, and flexibility positively impact student engagement in the learning process. Morfaki and Skotis (2023) attribute the higher engagement of agreeable students in the online learning environment to the opportunities for more efficient work provided by isolation and the less competitive learning environment it creates for these students.

Individuals open to experience are inclined to ask questions and embrace new ideas (Babakhani, 2014), thereby becoming more engaged in the learning process (Komarraju & Karau, 2005). Their willingness to try different things, perceive new situations as positive and exciting rather than threatening, has facilitated their adaptation to the urgent remote learning process during the COVID-19 pandemic (Morfaki & Skotis, 2023). Consistent with the findings of this research, learners with personality traits characterized by responsibility, agreeableness, and openness to experience generally seem to outperform those with extraversion and neuroticism in the online learning environment (Keller & Karau, 2013; Mahama et al., 2022; Yu, 2021).

Despite demonstrating active participation in the online environment, extroverted learners generally do not reach the same level of commitment as conscientious and agreeable students. According to research, extroverted learners establish better connections with their peers and educators (Babakhani, 2014; Komarraju & Karau, 2005). On the other hand, these same students are more prone to engage in activities other than studying, leading to lower performance levels (Eysenck, 1992; Chamorro-Premuzic & Furnham, 2009). Since online learning is often an individual activity and may provide limited opportunities for social interaction, extroverted individuals may find social engagement in online environments insufficient and may not find it appealing (Keller & Karau, 2013).

Students exhibiting higher levels of neuroticism tend to display particularly lower levels of behavioral and emotional engagement in online environments. Those with high neuroticism levels experience anxiety and feel more vulnerable to emotional stress when living in an environment that changes from what they are accustomed to, such as online learning; therefore, they tend to avoid the stress of learning in unfamiliar situations (Watjatrakul, 2016). Considering the increased tendency for isolation and the risk of dropping out in students with higher neuroticism traits, it becomes essential to take additional measures to reduce their stress and anxiety levels and strengthen their commitment to learning.

Student engagement is affected by both personal and external factors (Kahu & Nelson, 2018; Martin & Borup, 2022). Engagement of learners can be facilitated or hindered by the online learning environment and personal environment as well as the personal characteristics of the learners (Borup et al., 2020). Thus, learners engage in the learning process in different ways according to their personality traits. While some students prefer a detailed structured learning environment regarding the tasks to be completed, some may prefer a flexible learning environment that will reveal their productivity (Payne, 2019). Therefore, it is recommended to use various teaching methods and adapt the online environment according to the student needs in order to ensure maximum participation of learners in activities (Komarraju & Karau, 2005; Kuh et al., 2008). In addition, individuals can be encouraged to develop themselves and share their ideas through activities in which a sense of belonging is felt in the educational setting (Komarraju & Karau, 2005).

4.4 Mediating role of self-regulated learning

The fourth hypothesis of the study (H4) posits that “The mediation effect of self-regulated online learning behaviors is significant between five-factor personality traits and students’ engagement in the online learning environment.” The results confirm that self-regulated online learning behaviors plays a mediating role in the relationship between students’ personality traits and their engagement in the online learning environment.

The partial mediation effect of self-regulated learning is important in the relationship between the five-factor personality traits and the student’s engagement in the online learning process. Self-regulated learning is a very important skill especially in the online environment where the learner is autonomous and for higher education students who are expected to take responsibility for learning. It is already known that self-regulated learning activities have a mediating role in learner success in the academic environment (Barnard-Brak et al., 2010; Pintrich, 2004), and research results show that they mediate the relationship between personal characteristics and academic achievement (Cho & Kim, 2013; Eilam et al., 2009).

In this study, it is found that learner engagement was affected by the fixed personal characteristics of the learners and the self-regulated learning skills that could change according to the context. In terms of social cognitive theory, the interplay of individual, behavioral, and environmental processes is what is referred to as self-regulation (Bandura, 1986). Similarly, Zimmerman (1998) draws attention to the fact that self-regulation should not be seen as a fixed feature of learners but as context-specific processes. Lizzio and colleagues (2002) mention the importance of the educational setting in increasing academic achievement and state that the changes to be made in the setting affect the learning approaches of the learners. Thus, any arrangement to be made in the design of the learning environment will support the use of students’ self-regulated learning skills, and accordingly, would facilitate engagement shaped by both internal and external factors such as self-regulated learning. Accordingly, in order to ensure effective engagement of students in the educational setting, there is a need for online learning environments that encourage self-regulated learning, considering individual differences.

There is empirical evidence showing that lesson structure is significantly related to learners' self-regulated learning (Cho & Kim, 2013). In particular towards the start of the teaching process, learners are expected to have information about the general view of the course, what is expected of them and what they must do to succeed in the course, and this would positively impact their motivation and behavior (Ergulec et al., 2022). Technologies such as course structure, directions and collaboration tools provide opportunities for students to learn the subject in depth through interactive activities (Järvelä et al., 2015). In Ma and colleagues (2015) study, the instructor's preparation for the lesson was significantly related to the students' involvement in the learning process and the guidance of the instructor has a major impact on how well learning activities are completed. Draus and colleagues (2014) concluded that instructor-created video content increased the frequency and length of students' discussion posts, thus increasing behavioral engagement. Guo and colleagues (2014) concluded that instructor-generated feedback positively affected cognitive engagement. Activities such as assignments that require inventive and critical thinking (Fredricks et al., 2004), interesting, challenging and authentic activities (Fredricks, 2011), clear instructions (Schindler et al., 2017), simultaneous discussion and discussion forums (Kanuka, 2005) can potentially facilitate students' self-regulation. Time management can be encouraged with gradable assignments in stages (Ergulec, 2019). Gamification tools such as badges and progress bars can motivate learners to complete their tasks (Bruso et al., 2020). Online learning makes it easier for learners to take more responsibility for their learning and to be active, thus making it easier for self-regulated learning strategies to work. It also offers more opportunities for learners to spend more time preparing for the lesson, interact and use different learning strategies (Paulsen & McCormick, 2020).

5 Conclusion

The study's conclusion highlights several significant relationships. Firstly, it establishes that five-factor personality traits serve as a significant predictor of self-regulated online learning behaviors. Additionally, self-regulated online learning behaviors emerges as a significant predictor of student engagement in the online learning environment. Moreover, the findings indicate that five-factor personality traits also significantly predict student engagement in the online learning environment. Lastly, the study reveals that self-regulated online learning behaviors plays a partial mediating role in the influence of five-factor personality traits on students' engagement in the online learning environment.

Learners with positive personality traits benefit uniquely from self-regulated learning strategies in online environments. Those with responsibility and adaptability skills particularly excel in utilizing these strategies. Thus, emphasizing the importance of self-management and fostering a sense of responsibility through structured online courses is vital. Moreover, personalized and flexible learning environments tailored to individual differences, alongside appropriate pedagogical approaches and technological tools, would enhance engagement.

Highly self-regulated learners exhibit increased behavioral, cognitive, and emotional engagement, employing strategies like goal setting and time management. Educators play a pivotal role in promoting these strategies, which in turn boosts student engagement. Detailed course outlines and effective guidance on self-regulated learning further support student involvement. Creating opportunities for opinion-sharing through forums and group work fosters social and emotional learning aspects, enhancing cognitive and behavioral engagement. While students vary in participation levels based on personality traits, personalized teaching approaches can bolster commitment, particularly among stressed or anxious students.

In distance education, where students bear greater responsibility for learning, fostering self-regulated learning becomes essential. Integrating tools that encourage active participation, alongside thoughtful course design, supports engagement. However, it's crucial not to rely solely on technology, as participation is influenced by internal and external factors. Ultimately, emphasizing real-life skill development, such as self-management and communication, alongside addressing social and emotional aspects of learning, enriches the overall learning experience for all students (Morfaki & Skotis, 2023).

The study primarily focused on a specific educational level, higher education, limiting the generalizability of the findings to a broader population. Future research endeavors could incorporate diverse variables across various educational levels to enhance the external validity of the results. Future research can broaden its scope by investigating self-regulated learning behaviors and student engagement across diverse educational levels. By comparing findings across different educational contexts, a more comprehensive understanding of how these variables interact and influence each other can be gained.

The study employed a cross-sectional design, capturing data at a single point in time. This design may restrict the establishment of causal relationships between variables. Future studies with longitudinal, experimental, or qualitative designs could provide a more robust understanding of the dynamics. Utilizing longitudinal designs would allow researchers to track changes in self-regulated learning behaviors and engagement over an extended period. By collecting data at multiple time points, researchers can establish temporal relationships between these variables and gain insights into how they evolve over time.

Experimental inquiries may be undertaken to elucidate the impact of self-regulated learning behaviors on student engagement. Conducting experimental studies can help elucidate causal relationships between specific interventions and changes in self-regulated learning behaviors and engagement. Researchers can design interventions aimed at enhancing self-regulated learning skills or modifying instructional strategies and measure their impact on student engagement.

Qualitative investigations can be formulated to comprehend the factors influencing the engagement of learners with distinct personal characteristics in online environments. Qualitative research methods, such as interviews and focus groups, can provide deeper insights into the underlying factors influencing student engagement in online learning environments. By exploring students' perceptions, experiences, and motivations, researchers can uncover nuanced understandings of how individual characteristics and contextual factors shape engagement.

Furthermore, the study was conducted within specific online learning courses with specific instructors, and the findings may not be applicable to other online educational environments with distinct features and structures. Replicating the study across various platforms would enhance the applicability of the results. Replicating the study across various online learning platforms and educational settings can enhance the generalizability of findings. Different platforms may have unique features and structures that influence how self-regulated learning behaviors are enacted and their impact on engagement. By comparing findings across platforms, researchers can identify common patterns and factors that contribute to effective online learning.

Additionally, external factors and contextual variables, such as technological infrastructure and varying levels of online learning experience, were not extensively considered. Future research should consider contextual factors such as technological infrastructure, access to resources, and prior online learning experience. Understanding how these factors interact with self-regulated learning behaviors and engagement can inform the development of tailored interventions and instructional strategies to support diverse learner populations. Incorporating these factors in future studies could provide a more comprehensive understanding of the dynamics influencing self-regulated learning and engagement. These inquiries would aim to ascertain the self-regulated learning behaviors favored by learners who engage differentially and at varying proficiency levels.

Author contributions Every author listed in the manuscript has played a substantial role in writing, conceiving the manuscript, gathering data, conducting statistical analyses, or interpreting the findings. All authors are in agreement with the listed authorship on the manuscript.

Funding Open access funding provided by the Scientific and Technological Research Council of Türkiye (TÜBİTAK).

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, 103(3), 411–423. <https://doi.org/10.1037/0033-2909.103.3.411>
- Azevedo, R., & Hadwin, A. F. (2005). Scaffolding self-regulated learning and metacognition: Implications for the design of computer-based scaffolds. *Instructional Science*, 33, 367–379. <https://doi.org/10.1007/s11251-005-1272-9>
- Babakhani, N. (2014). The relationship between the big-five model of personality, self-regulated learning strategies and academic performance of Islamic Azad University students. *Procedia-Social and Behavioral Sciences*, 116, 3542–3547. <https://doi.org/10.1016/j.sbspro.2014.01.799>
- Bandura, A. (1986). *Social foundations of thought and action*. Prentice-Hall Inc.
- Barak, M., Wattied, A., & Haick, H. (2016). Motivation to learn in massive open online courses: Examining aspects of language and social engagement. *Computers & Education*, 94, 49–60. <https://doi.org/10.1016/j.compedu.2015.11.010>
- Barnard-Brak, L., Paton, V. O., & Lan, W. Y. (2010). Profiles in self-regulated learning in an online learning environment. *International Review of Research in Open and Distance Learning*, 11(1), 61–77.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173–1182.
- Benet-Martínez, V., & John, O. P. (1998). Los Cinco Grandes across cultures and ethnic groups: Multitrait-multimethod analysis of the Big Five in Spanish and English. *Journal of Personality and Social Psychology*, 75(3), 729–750. <https://doi.org/10.1037/0022-3514.75.3.729>
- Bentler, P., & Bonnet, D. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588–606. <https://doi.org/10.1037/0033-2909.88.3.588>
- Bernard, L. C. (2010). Motivation and personality: Relationships between putative motive dimensions and the five factor model of personality. *Psychological Reports*, 106(2), 613–631. <https://doi.org/10.2466/pr0.106.2.613-631>
- Besser, A., Flett, G. L., & Zeigler-Hill, V. (2022). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology*, 8(2), 85.
- Bidjerano, T., & Dai, D. Y. (2007). The relationship between the big-five model of personality and self-regulated learning strategies. *Learning and Individual Differences*, 17(1), 69–81. <https://doi.org/10.1016/j.lindif.2007.02.001>
- Binali, T., Tsai, C. C., & Chang, H. Y. (2021). University students' profiles of online learning and their relation to online metacognitive regulation and internet-specific epistemic justification. *Computers & Education*, 175, 104315. <https://doi.org/10.1016/j.compedu.2021.104315>
- Boekaerts, M. (2016). Engagement as an inherent aspect of the learning process. *Learning and Instruction*, 43, 76–83. <https://doi.org/10.1016/j.learninstruc.2016.02.001>
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, 17(1), 1–30. <https://doi.org/10.1186/s41239-019-0176-8>
- Borup, J., Graham, C. R., West, R. E., Archambault, L., & Spring, K. J. (2020). Academic communities of engagement: An expansive lens for examining support structures in blended and online learning. *Educational Technology Research and Development*, 68(2), 807–832. <https://doi.org/10.1007/s11423-020-09744-x>
- Bruso, J., Stefaniak, J., & Bol, L. (2020). An examination of personality traits as a predictor of the use of self-regulated learning strategies and considerations for online instruction. *Educational Technology Research and Development*, 68, 2659–2683. <https://doi.org/10.1007/s11423-020-09797-y>
- Caprara, G. V., Vecchione, M., Alessandri, G., Gerbino, M., & Barbaranelli, C. (2011). The contribution of personality traits and self-efficacy beliefs to academic achievement: A longitudinal study. *British Journal of Educational Psychology*, 81(1), 78–96. <https://doi.org/10.1348/2044-8279.002004>
- Caraway, K., Tucker, C. M., Reinke, W. M., & Hall, C. (2003). Self-efficacy, goal orientation, and fear of failure as predictors of school engagement in high school students. *Psychology in the Schools*, 40(4), 417–427. <https://doi.org/10.1002/pits.10092>

- Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student engagement and student learning: Testing the linkages. *Research in Higher Education*, 47(1), 1–32. <https://doi.org/10.1007/s11162-005-8150-9>
- Chamorro-Premuzic, T., & Furnham, A. (2003). Personality traits and academic examination performance. *European Journal of Personality*, 17(3), 237–250. <https://doi.org/10.1002/per.473>
- Chamorro-Premuzic, T., & Furnham, A. (2009). Mainly Openness: The relationship between the Big Five personality traits and learning approaches. *Learning and Individual Differences*, 19(4), 524–529. <https://doi.org/10.1016/j.lindif.2009.06.004>
- Chen, C. H., Wu, I. C., & Jen, F. L. (2013). Designing online scaffolds for interactive computer simulation. *Interactive Learning Environments*, 21(3), 229–243. <https://doi.org/10.1080/10494820.2010.549831>
- Cho, M. H., & Jonassen, D. (2009). Development of the human interaction dimension of the self-regulated learning questionnaire in asynchronous online learning environments. *Educational Psychology*, 29(1), 117–138. <https://doi.org/10.1080/01443410802516934>
- Cho, M. H., & Kim, B. J. (2013). Students' self-regulation for interaction with others in online learning environments. *The Internet and Higher Education*, 17, 69–75. <https://doi.org/10.1016/j.iheduc.2012.11.001>
- Cleary, T.J., & Zimmerman, B.J. (2012). A cyclical self-regulatory account of student engagement: Theoretical foundations and applications. In S. Christenson, A. Reschly, C. Wylie (Eds.), *Handbook of Research on Student Engagement*. Springer, Boston, MA. https://doi.org/10.1007/978-1-4614-2018-7_11
- Conrad, R. M., & Donaldson, J. A. (2011). *Engaging the online learner: Activities and resources for creative instruction*. Wiley.
- De la Fuente, J., Paoloni, P., Kauffman, D., Yilmaz Soylu, M., Sander, P., & Zapata, L. (2020). Big five, self-regulation, and coping strategies as predictors of achievement emotions in undergraduate students. *International Journal of Environmental Research and Public Health*, 17(10), 3602. <https://doi.org/10.3390/ijerph17103602>
- Dörrenbächer, L., & Perels, F. (2016). Self-regulated learning profiles in college students: Their relationship to achievement, personality, and the effectiveness of an intervention to foster self-regulated learning. *Learning and Individual Differences*, 51, 229–241. <https://doi.org/10.1016/j.lindif.2016.09.015>
- Draus, P. J., Curran, M. J., & Trempus, M. S. (2014). The influence of instructor-generated video content on student satisfaction with and engagement in asynchronous online classes. *Journal of Online Learning and Teaching*, 10(2), 240–254. https://jolt.merlot.org/vol10no2/draus_0614.pdf
- Eilam, B., Zeidner, M., & Aharon, I. (2009). Student conscientiousness, self-regulated learning, and science achievement: An explorative field study. *Psychology in the Schools*, 46(5), 420–432. <https://doi.org/10.1002/pits.20387>
- Ergulec, F. (2019). Design and facilitation strategies used in asynchronous online discussions. *Malaysian Online Journal of Educational Technology*, 7(2), 20–36. <https://doi.org/10.17220/mojet.2019.02.002>
- Ergulec, F., & Agmaz, R. F. (2023). Self-regulated learning behaviors of pre-school teacher candidates in flipped learning. *Educational Policy Analysis and Strategic Research*, 18(3), 197–222. <https://doi.org/10.29329/epasr.2023.600.10>
- Ergulec, F., Kara, A., & Eren, E. (2022). The impact of flipped learning on the relationship between self-regulated online learning and academic procrastination. *Current Psychology*, 1–15. <https://doi.org/10.1007/s12144-022-03136-5>
- Ergün, E., & Usluel, Y. K. (2015). Çevrimiçi öğrenme ortamlarında öğrenci bağlılık ölçeği'nin türkçe uyarlaması: Geçerlik ve güvenilirlik çalışması. *Eğitim Teknolojisi Kuram Ve Uygulama*, 5(1), 18–33. <https://dergipark.org.tr/en/download/article-file/71843>. Accessed 2 Jun 2023.
- Eysenck, M. W. (1992). *Anxiety: The cognitive perspective*. Lawrence Erlbaum Associates, Inc.
- Fredricks, J. A. (2011). Engagement in school and out-of-school contexts: A multidimensional view of engagement. *Theory into Practice*, 50(4), 327–335. <https://doi.org/10.1080/00405841.2011.607401>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59–109. <https://doi.org/10.3102/00346543074001059>
- Ghazi, S. R., Shahzada, G., & Ullah, S. (2013). Relationship between students' personality traits and their academic achievement in Khyber Pakhtunkhwa. *Pakistan Journal of Educational and Social Research*, 3(2), 437.

- Ghyasi, M., Yazdani, M., & Farsani, M. A. (2013). The relationship between personality types and self-regulated learning strategies of language learners. *International Journal of Applied Linguistics and English Literature*, 2(4), 74–82. <https://doi.org/10.7575/aiac.ijalel.v2n.4p.74>
- Gökler, R., & Taştan, N. (2018). Öğretmenlerin kişilik özellikleri ile okul akademik iyimserliği arasındaki ilişkinin incelenmesi. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 38(1), 333–358. <https://dergipark.org.tr/en/download/article-file/462749>. Accessed 2 Jun 2023.
- Goldberg, L. R. (1990). An alternative description of personality: The big-five factor structure. *Journal of Personality and Social Psychology*, 59, 1216–1229.
- Guo, W., Chen, Y., Lei, J., & Wen, Y. (2014). The effects of facilitating feedback on online learners' cognitive engagement: Evidence from the asynchronous online discussion. *Education Sciences*, 4(2), 193–208. <https://doi.org/10.3390/educsci4020193>
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.
- Hu, L. T., & Bentler, P. M. (1999). Cut off criteria for fit indexes in covariance structural analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55. <https://doi.org/10.1080/10705519909540118>
- Jansen, R. S., Van Leeuwen, A., Janssen, J., Kester, L., & Kalz, M. (2017). Validation of the self-regulated online learning questionnaire. *Journal of Computing in Higher Education*, 29(1), 6–27. <https://doi.org/10.1007/s12528-016-9125-x>
- Järvelä, S., Kirschner, P. A., Panadero, E., Malmberg, J., Phielix, C., Jaspers, J., ... Järvenoja, H. (2015). Enhancing socially shared regulation in collaborative learning groups: Designing for CSCL regulation tools. *Educational Technology Research and Development*, 63(1), 125–142.
- Jensen, M. (2015). Personality traits, learning and academic achievements. *Journal of Education and Learning*, 4(4), 91–118. <https://doi.org/10.5539/jel.v4n4p91>
- Joubert, M., Larsen, A., Magnuson, B., Waldron, D., Sabo, E., & Fletcher, A. (2023). Global challenges: South African and Australian students' experiences of emergency remote teaching. *Journal of University Teaching & Learning Practice*, 20(4). <https://doi.org/10.53761/1.20.4.09>
- Kahn, P. E. (2014). Theorising student engagement in higher education. *British Educational Research Journal*, 40(6), 1005–1018. <https://doi.org/10.1002/berj.3121>
- Kahu, E. R., & Nelson, K. (2018). Student engagement in the educational interface: Understanding the mechanisms of student success. *Higher Education Research & Development*, 37(1), 58–71. <https://doi.org/10.1080/07294360.2017.1344197>
- Kanuka, H. (2005). An exploration into facilitating higher levels of learning in a text-based internet learning environment using diverse instructional strategies. *Journal of Computer-Mediated Communication*, 10(3), JCMC1032. <https://academic.oup.com/jcmc/article/10/3/JCMC1032/4614486>.
- Keller, H., & Karau, S. J. (2013). The importance of personality in students' perceptions of the online learning experience. *Computers in Human Behavior*, 29(6), 2494–2500. <https://doi.org/10.1016/j.chb.2013.06.007>
- Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Publications.
- Koestner, R., Bernieri, F., & Zuckerman, M. (1992). Self-regulation and consistency between attitudes, traits, and behaviors. *Personality and Social Psychology Bulletin*, 18(1), 52–59. <https://doi.org/10.1177/0146167292181008>
- Komaraju, M., & Karau, S. J. (2005). The relationship between the big five personality traits and academic motivation. *Personality and Individual Differences*, 39(3), 557–567. <https://doi.org/10.1016/j.paid.2005.02.013>
- Komaraju, M., Karau, S. J., Schmeck, R. R., & Avdic, A. (2011). The Big Five personality traits, learning styles, and academic achievement. *Personality and individual differences*, 51(4), 472–477. <https://doi.org/10.1016/j.paid.2011.04.019>
- Kuh, G. D. (2003). What we're learning about student engagement from NSSE: Benchmarks for effective educational practices. *Change: The Magazine of Higher Learning*, 35(2), 24–32. <https://doi.org/10.1080/00091380309604090>
- Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education*, 79(5), 540–563. <https://www.jstor.org/stable/25144692>.
- Lehmann, T., Hähnlein, I., & Ifenthaler, D. (2014). Cognitive, metacognitive and motivational perspectives on prefection in self-regulated online learning. *Computers in Human Behavior*, 32, 313–323. <https://doi.org/10.1016/j.chb.2013.07.051>

- Li, S., & Lajoie, S. P. (2022). Cognitive engagement in self-regulated learning: An integrative model. *European Journal of Psychology of Education*, 37(3), 833–852. <https://doi.org/10.1007/s10212-021-00565-x>
- Li, Y., & Lerner, R. M. (2013). Interrelations of behavioral, emotional, and cognitive school engagement in high school students. *Journal of Youth and Adolescence*, 42, 20–32. <https://doi.org/10.1007/s10964-012-9857-5>
- Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: Implications for theory and practice. *Studies in Higher Education*, 27(1), 27–52. <https://doi.org/10.1080/03075070120099359>
- Ma, J., Han, X., Yang, J., & Cheng, J. (2015). Examining the necessary condition for engagement in an online learning environment based on learning analytics approach: The role of the instructor. *The Internet and Higher Education*, 24, 26–34. <https://doi.org/10.1016/j.iheduc.2014.09.005>
- MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, 1(2), 130–149. <https://doi.org/10.1037/1082-989X.1.2.130>
- Mahama, I., Dramanu, B. Y., Eshun, P., Nandzo, A., Baidoo-Anu, D., & Amponsah, M. A. (2022). Personality traits as predictors of self-regulated learning and academic engagement among college students in Ghana: A dimensional multivariate approach. *Education Research International*, 1–12. <https://doi.org/10.1155/2022/2255533>
- Martin, F., & Borup, J. (2022). Online learner engagement: Conceptual definitions, research themes, and supportive practices. *Educational Psychologist*, 57(3), 162–177. <https://doi.org/10.1080/00461520.2022.2089147>
- McCrae, R. R., & Costa, P. T., Jr. (1989). More reasons to adopt the five-factor model. *American Psychologist*, 44(2), 451–452. <https://doi.org/10.1037/0003-066X.44.2.451>
- McCrae, R. R., & Costa, P. T., Jr. (1991). The NEO Personality Inventory: Using the five-factor model in counseling. *Journal of Counseling & Development*, 69(4), 367–372. <https://doi.org/10.1002/j.1556-6676.1991.tb01524.x>
- Morfaki, C., & Skotis, A. (2023). Academic online learning experience during COVID-19-a systematic literature review based on personality traits. *Higher Education Skills and Work-Based Learning*, 13(4), 697–719. <https://doi.org/10.1108/HESWBL-03-2022-0062>
- Nunnally, J. C. (1979). *Psychometric theory*. McGraw-Hill Book Company.
- Ongore, O. (2014). A study of relationship between personality traits and job engagement. *Procedia-Social and Behavioral Sciences*, 141, 1315–1319. <https://doi.org/10.1016/j.sbspro.2014.05.226>
- Ozan, C., Gundogdu, K., Bay, E., & Celkan, H. Y. (2012). A study on the university students' self-regulated learning strategies skills and self-efficacy perceptions in terms of different variables. *Procedia-Social and Behavioral Sciences*, 46, 1806–1811. <https://doi.org/10.1016/j.sbspro.2012.05.383>
- Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, 8, 422. <https://doi.org/10.3389/fpsyg.2017.00422>
- Passer, M. W., & Smith, R. E. (2004). *Psychology: The science of mind and behavior*. McGraw-Hill.
- Paulsen, J., & McCormick, A. C. (2020). Reassessing disparities in online learner student engagement in higher education. *Educational Researcher*, 49(1), 20–29. <https://doi.org/10.3102/0013189X19898690>
- Payne, L. (2019). Student engagement: Three models for its investigation. *Journal of Further and Higher Education*, 43(5), 641–657. <https://doi.org/10.1080/0309877X.2017.1391186>
- Payne, S. C., Youngcourt, S. S., & Beaubien, J. M. (2007). A meta-analytic examination of the goal orientation nomological net. *Journal of Applied Psychology*, 92(1), 128–150. <https://doi.org/10.1037/0021-9010.92.1.128>
- Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16(4), 385–407. <https://doi.org/10.1007/s10648-004-0006-x>
- Quigley, M., Bradley, A., Playfoot, D., & Harrad, R. (2022). Personality traits and stress perception as predictors of students' online engagement during the COVID-19 pandemic. *Personality and Individual Differences*, 194, 111645. <https://doi.org/10.1016/j.paid.2022.111645>
- Qureshi, A., Wall, H., Humphries, J., & Balani, A. B. (2016). Can personality traits modulate student engagement with learning and their attitude to employability? *Learning and Individual Differences*, 51, 349–358. <https://doi.org/10.1016/j.lindif.2016.08.026>
- Robinson, C. C., & Hullinger, H. (2008). New benchmarks in higher education: Student engagement in online learning. *Journal of Education for Business*, 84(2), 101–109. <https://doi.org/10.3200/JOEB.84.2.101-109>

- Salas-Pilco, S. Z., Yang, Y., & Zhang, Z. (2022). Student engagement in online learning in latin American higher education during the COVID-19 pandemic: A systematic review. *British Journal of Educational Technology*, 53(3), 593–619. <https://doi.org/10.1111/bjet.13190>
- Sari, O. P., & Mediatati, N. (2023). Students resilience: The impact of online learning policies during the COVID-19 pandemic on academic stress. *JESS (Journal of Educational Social Studies)*, 12(1), 73–83. <https://doi.org/10.15294/JESS.V12I1.69964>
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of fit measures. *Methods of Psychological Research Online*, 8(2), 23–74. <http://www.mpr-online.de>. Accessed 19 May 2023.
- Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. *International Journal of Educational Technology in Higher Education*, 14(1), 1–28. <https://doi.org/10.1186/s41239-017-0063-0>
- Schwonke, R. (2015). Metacognitive load–Useful, or extraneous concept? Metacognitive and self-regulatory demands in computer-based learning. *Journal of Educational Technology & Society*, 18(4), 172–184.
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, 7(4), 422–445. <https://doi.org/10.1037/1082-989X.7.4.422>
- Smith, B. W., Ford, C. G., Erickson, K., & Guzman, A. (2021). The effects of a character strength focused positive psychology course on undergraduate happiness and well-being. *Journal of Happiness Studies*, 22, 343–362. <https://doi.org/10.1007/s10902-020-00233-9>
- Strauser, D. R., O'Sullivan, D., & Wong, A. W. (2012). Work personality, work engagement, and academic effort in a group of college students. *Journal of Employment Counseling*, 49(2), 50–61. <https://doi.org/10.1002/j.2161-1920.2012.00006.x>
- Sümer, N. (2000). Yapısal eşitlik modelleri: Temel kavramlar ve örnek uygulamaları. *Türk Psikoloji Yazıları*, 3(6), 49–73.
- Sümer, N., Lajunen, T. & Özkan, T. (2005). Big five personality traits as the distal predictors of road accident involvement. In G. Underwood (Ed.), *Traffic and transport psychology*. Elsevier Ltd.
- Sun, J. C. Y., & Rueda, R. (2012). Situational interest, computer self-efficacy and self-regulation: Their impact on student engagement in distance education. *British Journal of Educational Technology*, 43(2), 191–204. <https://doi.org/10.1111/j.1467-8535.2010.01157.x>
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Pearson Education.
- Tao, J., Zheng, C., Lu, Z., Liang, J. C., & Tsai, C. C. (2020). Cluster analysis on Chinese university students' conceptions of English language learning and their online self-regulation. *Australasian Journal of Educational Technology*, 36(2), 105–119. <https://doi.org/10.14742/ajet.4844>
- Vermetten, Y. J., Lodewijks, H. G., & Vermunt, J. D. (2001). The role of personality traits and goal orientations in strategy use. *Contemporary Educational Psychology*, 26(2), 149–170. <https://doi.org/10.1006/ceps.1999.1042>
- Watjatrakul, B. (2016). Online learning adoption: Effects of neuroticism, openness to experience, and perceived values. *Interactive Technology and Smart Education*, 13, 229–243. <https://doi.org/10.1108/ITSE-06-2016-0017>
- Whitehill, J., Serpell, Z., Lin, Y. C., Foster, A., & Movellan, J. R. (2014). The faces of engagement: Automatic recognition of student Engagement from facial expressions. *IEEE Transactions on Affective Computing*, 5(1), 86–98. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6786307>.
- Wilson, K., & Narayan, A. (2016). Relationships among individual task self-efficacy, self-regulated learning strategy use and academic performance in a computer-supported collaborative learning environment. *Educational Psychology*, 36(2), 236–253. <https://doi.org/10.1080/01443410.2014.926312>
- Xu, L., Duan, P., Padua, S. A., & Li, C. (2022). The impact of self-regulated learning strategies on academic performance for online learning during COVID-19. *Frontiers in Psychology*, 13, 1047680. <https://doi.org/10.3389/fpsyg.2022.1047680>
- Yavuzalp, N., & Özdemir, Y. (2020). Adaptation of the self-regulated online learning questionnaire (SOL-Q). *Journal of Higher Education/Yükseköğretim Dergisi*, 10(3), 269–278. <https://doi.org/10.2399/yod.19.512415>
- Yu, Z. (2021). The effects of gender, educational level, and personality on online learning outcomes during the COVID-19 pandemic. *International Journal of Educational Technology in Higher Education*, 18(1), 14. <https://doi.org/10.1186/s41239-021-00252-3>

- Zhang, X., Chen, G., & Xu, B. (2020). The influence of group Big-Five personality composition on student engagement in online discussion. *International Journal of Information and Education Technology*, 10(10), 744–750. <https://doi.org/10.18178/ijiet.2020.10.10.1452>
- Zhu, Y., Zhang, J. H., Au, W., & Yates, G. (2020). University students' online learning attitudes and continuous intention to undertake online courses: A self-regulated learning perspective. *Educational Technology Research and Development*, 68, 1485–1519. <https://doi.org/10.1007/s11423-020-09753-w>
- Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81(3), 329.
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25, 3–17. https://doi.org/10.1207/s15326985ep2501_2
- Zimmerman, B. J. (1998). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist*, 33(2–3), 73–86. https://doi.org/10.1207/s15326985ep3302&3_3
- Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology*, 25(1), 82–91. <https://doi.org/10.1006/ceps.1999.1016>
- Zimmerman, B. J., & Schunk, D. H. (2001). Reflections on theories of self-regulated learning and academic achievement. *Self-regulated Learning and Academic Achievement: Theoretical Perspectives*, 2, 289–307.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Authors and Affiliations

Ahmet Kara¹  · Funda Ergulec²  · Esra Eren² 

✉ Funda Ergulec
fundaergulec@gmail.com

Ahmet Kara
ahmetkara@kastamonu.edu.tr

Esra Eren
esisman@gmail.com

¹ Developmental Psychology, Kastamonu University, Kastamonu, Turkey

² Instructional Technology, Eskisehir Osmangazi University, Eskisehir, Turkey