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Modeling the Relationships Among Cognitive Flexibility, Cognitive Control, and Self-Regulated Learning: The Mediating Role of Cognitive Engagement

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A B S T R A C T

Purpose: The present study aimed to model the relationships of cognitive flexibility and cognitive control with university students' self-regulated learning, with cognitive engagement examined as a mediator.

Methods and Materials: This fundamental, descriptive-correlational study used structural equation modeling. Through convenience sampling, 365 university students in Isfahan were recruited during the 2025–2026 academic year; after excluding six invalid questionnaires, data from 359 participants were analyzed. Data were collected using the Cognitive Flexibility Inventory developed by Dennis and Vander Wal (2010), the Cognitive Control and Flexibility Questionnaire developed by Gabrys et al. (2018), the Self-Regulated Learning Questionnaire developed by Bouffard et al. (1995), and the Cognitive Engagement Subscale developed by Reeve (2013). Pearson correlation coefficients and structural equation modeling with maximum-likelihood estimation were conducted using SPSS version 26 and AMOS version 26. Bootstrap procedures were used to examine the indirect effects.

Findings: The proposed model demonstrated an acceptable fit to the data (RMSEA = .061, CFI = .903, IFI = .915, GFI = .935, χ^2/df = 3.977). Cognitive flexibility had positive and significant direct effects on cognitive engagement, β = .607, $p < .001$, and self-regulated learning, β = .436, $p < .001$. Cognitive control also positively predicted cognitive engagement, β = .256, p = .028, and self-regulated learning, β = .478, p = .005. Cognitive engagement had a positive direct effect on self-regulated learning, β = .267, p = .047. The indirect effect of cognitive control on self-regulated learning through cognitive engagement was significant, β = .069, p = .024. In contrast, the indirect effect of cognitive flexibility on self-regulated learning through cognitive engagement was not significant, β = .162, p = .071.

Conclusion: Cognitive flexibility and cognitive control appear to contribute directly to university students' self-regulated learning. Cognitive engagement also serves as a mechanism through which cognitive control is associated with self-regulated learning; however, its mediating role in the relationship between cognitive flexibility and self-regulated learning was not supported. Educational programs aimed at strengthening attentional control, inhibition of distractions, strategic flexibility, and active cognitive engagement may therefore promote students' self-regulated learning.

Keywords: *cognitive flexibility, cognitive control, cognitive engagement, self-regulated learning, university students, structural equation modeling.*

1. Introduction

Higher education increasingly requires students to assume an active role in planning, monitoring, and evaluating their own learning. Unlike educational settings in which instructional activities are continuously structured and supervised by teachers, university learning typically involves substantial autonomy in managing time, selecting learning strategies, organizing academic resources, sustaining motivation, and responding to complex academic demands. This autonomy has become even more consequential with the expansion of blended, online, technology-supported, and flexible learning environments, where students are expected to make frequent decisions about how, when, and to what extent they engage with learning materials. Accordingly, academic success cannot be adequately explained by intellectual ability or exposure to instruction alone; it also depends on students' capacity to regulate their learning processes purposefully and adaptively. Research with undergraduate students has shown that effective learning involves the active coordination of cognitive, metacognitive, motivational, and behavioral processes rather than the passive reception of instructional information (Chitra et al., 2022; Hey et al., 2024). Moreover, systematic evidence indicates that interventions designed to strengthen self-regulated learning can improve academic performance, motivation, and students' use of effective learning strategies (Theobald, 2021). These findings have made self-regulated learning a central construct for understanding individual differences in university students' learning and academic functioning.

Self-regulated learning refers broadly to the processes through which learners actively direct their thoughts, strategies, behaviors, and available resources toward the achievement of academic goals. It involves establishing goals, selecting and implementing appropriate cognitive strategies, monitoring comprehension and performance, managing time and environmental conditions, and modifying strategies when progress is inadequate. Early research demonstrated that goal orientation is closely connected with students' regulation of learning and subsequent academic performance, emphasizing that effective learners do not simply possess learning strategies but actively deploy them in accordance with their objectives (Bouffard et al., 1995). Within the Iranian educational context, self-regulation has likewise been identified as an important contributor to optimal learning and academic achievement alongside factors such as self-efficacy and intellectual abilities (Kadivar, 2001). Contemporary research further suggests that self-regulated learning is particularly important in educational environments characterized by increased learner autonomy because students must continuously decide whether their current strategies are effective and whether their learning behavior requires adjustment (Luo & Zhou, 2024). Thus, self-regulation can be viewed as a dynamic system through which learners transform academic intentions into organized and goal-directed learning activities.

The effectiveness of this regulatory process, however, depends partly on the cognitive capacities that allow students to adapt to changing demands. One such capacity is cognitive flexibility. Cognitive flexibility generally refers to an individual's ability to consider alternative interpretations or solutions, shift cognitive perspectives, perceive difficult situations as controllable, and modify thoughts or behavioral strategies in response to changing contextual demands. Dennis and Vander Wal conceptualized cognitive flexibility in terms of the capacity to perceive alternatives and experience challenging situations as manageable, providing an influential framework for assessing individual differences in flexible cognition (Dennis & Vander Wal, 2010). The psychometric applicability of this construct has also been supported among Iranian university students, indicating that cognitive flexibility represents a meaningful cognitive characteristic within this population (Shareh et al., 2014). In educational settings, flexibility allows students to abandon ineffective strategies, reorganize information, consider a problem from multiple perspectives, and adopt alternative approaches when academic tasks become difficult or unfamiliar.

Cognitive flexibility may consequently play a fundamental role in self-regulated learning because regulation requires continuous adaptation rather than rigid adherence to predetermined strategies. Students frequently encounter differences in task difficulty, instructional format, assessment expectations, available resources, and feedback. A strategy that facilitates learning in one situation may be ineffective in another. Consequently, adaptive learners need not only a repertoire of strategies but also the capacity to determine when a particular strategy should be modified or replaced. Empirical evidence has demonstrated a positive relationship between cognitive flexibility and self-regulation skills, supporting the proposition that students who can readily alter their perspectives and approaches may be better able to manage their own learning (Tuncer & Tanaş, 2022). Structural modeling research has similarly identified

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meaningful relationships among cognitive flexibility, self-regulation, and resilience among students (Nakhostin-Khayyat et al., 2024). In addition, cognitive flexibility has been associated with metacognitive functioning, academic buoyancy, and the ability to respond adaptively to academic challenges (Borji et al., 2024). These relationships suggest that flexible cognition may support the monitoring and adjustment processes that constitute the core of self-regulated learning.

The educational importance of cognitive flexibility extends beyond self-regulation itself. Flexible students may be more capable of critically evaluating information, generating alternative explanations, and reconsidering initial assumptions. Research among university students has demonstrated a positive association between cognitive flexibility and critical-thinking dispositions (Karakuş, 2024), while other evidence has shown that cognitive flexibility may contribute to academic achievement through psychologically relevant mechanisms such as critical thinking and reduced academic anxiety (Gökçe & Güner, 2024). Recent findings have also positioned cognitive flexibility within broader models of university students' learning engagement, indicating that flexible cognition can function alongside psychological resilience in explaining students' involvement in learning activities (Zhang et al., 2026). Taken together, these findings indicate that cognitive flexibility is not simply an abstract cognitive characteristic; rather, it may determine how effectively students respond to difficulties, persist in complex tasks, modify ineffective strategies, and remain mentally involved in learning.

A second cognitive capacity that may be fundamental to self-regulated learning is cognitive control. Cognitive control encompasses the processes through which individuals maintain goal-relevant information, direct and sustain attention, inhibit inappropriate or distracting responses, monitor ongoing behavior, and coordinate cognitive activity in accordance with current goals. It is closely related to executive-function processes such as working memory, inhibitory control, attentional regulation, and cognitive shifting. Research examining executive functions and learning has indicated that these capacities contribute substantially to individual differences in study success among higher-education students, particularly when considered together with students' self-regulated learning abilities (Manuhuwa et al., 2023). Similarly, associations have been reported between cold executive functions and the management of self-regulated learning among college students, suggesting that effective regulation of learning partly depends on the cognitive resources required to maintain goals and control behavior (Pinochet-Quiroz et al., 2022).

Cognitive control is especially relevant when students must maintain concentration despite competing stimuli, postpone immediately rewarding activities, resist distraction, or persist when a learning task becomes cognitively demanding. Gabrys and colleagues conceptualized cognitive control and flexibility in terms of the ability to regulate intrusive thoughts and emotions and to adapt appraisals and coping responses, illustrating how cognitive control contributes to adaptive functioning under demanding or stressful circumstances (Gabrys et al., 2018). Within academic contexts, these capacities may allow students to maintain learning goals in working memory, inhibit irrelevant responses, detect discrepancies between intended and actual performance, and redirect attention following distraction. Recent evidence among university students has also linked cognitive control and metacognitive awareness with academic achievement, emphasizing the importance of cognitive monitoring and top-down regulation for effective academic functioning (Musullulu et al., 2025). Cognitive control may therefore constitute an executive foundation on which strategic and self-directed learning behavior is built.

Nevertheless, the possession of cognitive flexibility and cognitive control does not necessarily ensure that students will actively invest cognitive resources in academic activities. A student may possess the capacity to inhibit distraction or consider alternative strategies but fail to apply these capacities when engagement with the learning task is weak. This distinction highlights cognitive engagement as a potentially important mechanism linking cognitive capacities with learning regulation. Student engagement is a multidimensional construct that includes behavioral, emotional, cognitive, and agentic components. Within this framework, cognitive engagement refers particularly to students' psychological investment in learning, including the use of sophisticated learning strategies, active processing of information, integration of new material with prior knowledge, and deliberate attempts to understand instructional content at a deeper level (Reeve, 2013). Cognitive engagement therefore reflects not merely whether students participate in an academic activity but how intensively and strategically they process the learning material.

Cognitive engagement has increasingly been recognized as a central component of successful learning in higher

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education. A systematic review of learning analytics research demonstrated the significance of student engagement for understanding learning behavior and educational outcomes, while also showing the conceptual complexity involved in capturing students' active participation across contemporary higher-education environments (Bergdahl et al., 2024). Evidence further indicates that engagement and executive-function skills jointly contribute to academic success during the college years, suggesting that the capacity to control cognition may become educationally meaningful partly through students' actual investment of cognitive effort in learning activities (Budwig et al., 2025). Cognitive engagement includes sustained attention, elaboration, organization, critical processing, monitoring of understanding, and the purposeful allocation of mental effort. Consequently, it provides an important conceptual bridge between underlying cognitive capacities and the strategic behaviors involved in self-regulated learning.

The relationship between cognitive engagement and self-regulated learning is theoretically close because both constructs emphasize active learner participation. However, they are not equivalent. Self-regulated learning concerns the broader management of learning through planning, strategy selection, monitoring, evaluation, and adjustment, whereas cognitive engagement represents the quality and intensity of mental involvement during learning activities. Integrative models have explicitly positioned cognitive engagement within self-regulated learning processes, indicating that learners' active cognitive investment interacts with goal setting, strategy implementation, monitoring, and adaptation (Li & Lajoie, 2022). Empirical studies also support this relationship. In online discussions, self-regulated learning has been shown to contribute to cognitive engagement and learning achievement, demonstrating that active mental involvement and regulatory processes operate in an interconnected manner (Liu et al., 2024). Similarly, embedding self-regulation supports within mobile learning environments has been associated with undergraduate students' cognitive engagement and learning performance (Yang & Song, 2022). These findings indicate that cognitive engagement may be both facilitated by regulatory capacities and important for sustaining effective regulation throughout the learning process.

The interaction between regulation and engagement is also evident in blended learning environments, where students are frequently required to organize learning activities independently while responding to instructional guidance. Research using experience-sampling methods has demonstrated meaningful relationships among regulated learning, teaching presence, and student engagement in blended learning (Liao et al., 2023). Systematic evidence likewise suggests that self-regulated learning strategies are critical to effective participation and achievement in higher-education blended learning contexts (Luo & Zhou, 2024). Furthermore, the growing use of digital and smart learning environments has increased the importance of students' capacity to interpret information, monitor learning processes, and engage strategically with educational technologies. Data literacy, for example, has been identified as an important factor associated with the quality of smart learning among university students (Ahmadi, 2024). Such developments strengthen the need to investigate the cognitive mechanisms through which students sustain engagement and independently regulate learning in increasingly complex educational environments.

Metacognitive processes provide another conceptual connection among cognitive control, cognitive flexibility, engagement, and self-regulated learning. Effective learners need to assess what they know, recognize deficiencies in comprehension, evaluate the effectiveness of a strategy, and determine whether changes are necessary. Research on undergraduate learning has demonstrated that strategy use is embedded within a network of self-regulatory and metacognitive factors rather than operating independently (Hey et al., 2024). Neuroscience-informed approaches to higher education have likewise highlighted the importance of educational conditions that support students' metacognitive strategies (Salehi et al., 2024). From this perspective, cognitive control may enable students to maintain attention and inhibit irrelevant responses, while cognitive flexibility allows them to generate and select alternative approaches once monitoring indicates that a strategy is ineffective. Cognitive engagement, in turn, may provide the active processing and mental investment necessary for students to obtain sufficiently detailed information about their own understanding and performance to make such regulatory decisions.

Despite increasing evidence regarding these constructs, important questions remain concerning how they operate together. Existing studies have established associations between cognitive flexibility and self-regulation (Nakhostin-Khayyat et al., 2024; Tuncer & Tanaş, 2022), executive functions and self-regulated learning (Manuhuwa et al., 2023; Pinochet-Quiroz et al., 2022), engagement and self-regulated learning (Li & Lajoie, 2022; Liu et al., 2024), and

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cognitive capacities and academic outcomes (Gökçe & Güner, 2024; Musullulu et al., 2025). However, examining these relationships separately provides only a partial explanation of how cognitive capacities are translated into the active regulation of academic behavior. Cognitive flexibility may allow a learner to identify alternatives, whereas cognitive control may enable the learner to maintain goal-directed attention; yet the educational consequences of these capacities may depend on whether students actually invest cognitive effort, process material deeply, and monitor their understanding. This possibility gives cognitive engagement particular relevance as an explanatory variable.

Clarifying these pathways is important both theoretically and practically. If cognitive flexibility and cognitive control are directly associated with self-regulated learning, interventions may need to strengthen the cognitive capacities that support strategic adaptation, attentional maintenance, and inhibitory control. If their relationships with self-regulated learning are also transmitted through cognitive engagement, educational interventions may additionally need to create learning conditions that stimulate deep processing, active monitoring, elaboration, and sustained mental effort. Evidence that self-regulated learning training improves academic performance and motivation indicates that regulatory processes are modifiable rather than fixed characteristics (Theobald, 2021), while research on contemporary university learning suggests that engagement, executive functioning, metacognitive strategy use, and adaptive cognition represent interconnected determinants of academic success (Bergdahl et al., 2024; Budwig et al., 2025). An integrated examination of these variables can therefore contribute to a more precise account of why some university students are better able than others to manage their learning effectively.

Accordingly, a model that simultaneously examines cognitive flexibility and cognitive control as cognitive antecedents, cognitive engagement as a potential mediating process, and self-regulated learning as the principal learning outcome may address an important gap in the literature. Such an approach moves beyond isolated bivariate associations and recognizes university learning as a coordinated process in which executive control, adaptive cognition, mental investment, and strategic regulation operate together. It may also be particularly informative in university populations, where academic demands require students to adapt to varying instructional conditions, sustain attention despite numerous competing demands, engage deeply with complex information, and independently modify their strategies in response to feedback and performance. Therefore, the present study aimed to model the relationships of cognitive flexibility and cognitive control with self-regulated learning among university students, with cognitive engagement examined as a mediator.

2. Methods and Materials

2.1. Study Design and Participants

The present study was fundamental in purpose and employed a descriptive-correlational design using structural equation modeling. The statistical population consisted of all students enrolled at universities in Isfahan during the 2025–2026 academic year. Participants were selected through convenience sampling. The sample size was determined based on the number of observed variables, the number of estimable parameters in the model, and sample-size requirements for structural equation modeling. In June 2026, a total of 365 questionnaires were collected. Following an initial screening, six questionnaires were excluded because of incomplete responses or invalid response patterns. Therefore, data from 359 students were included in the final analyses.

The inclusion criteria were being enrolled as a university student at the time of the study, providing informed consent to participate, being able to read and respond to the items, and completing the research questionnaires. Withdrawal from participation, incomplete completion of the instruments, and uniform or otherwise invalid response patterns were considered exclusion criteria.

After obtaining the required permissions and coordinating with the participating universities, data were collected in June 2026. Before the questionnaires were administered, the purpose and procedure of the study were explained to the students. Participants completed the research instruments after providing informed consent.

Participants were assured that their involvement was voluntary, their responses would remain anonymous and confidential, and the collected data would be used solely for the scientific purposes of the study. They were also informed that they could withdraw from the study at any stage without penalty or adverse consequences.

2.2. Data Collection Tools

Cognitive Flexibility Inventory (CFI; Dennis & Vander Wal, 2010): This 20-item self-report instrument assesses an individual’s ability to challenge maladaptive thoughts and

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replace them with more adaptive alternatives. In the version used in the present study, the items are classified into three subscales: perceived controllability, comprising eight items; perceived alternatives, comprising 10 items; and perceived justifications for human behavior, comprising two items. Perceived controllability refers to the tendency to view difficult situations as manageable. Perceived alternatives assesses the ability to generate alternative solutions for difficult situations, whereas perceived justifications for human behavior evaluates the ability to provide different explanations for life events and the behavior of others. Responses are rated on a 7-point Likert scale ranging from 1, "strongly disagree," to 7, "strongly agree," with higher scores indicating greater cognitive flexibility. Dennis and Vander Wal (2010) reported Cronbach's alpha coefficients of .91, .84, and .90 for the total scale, perceived controllability, and perceived alternatives, respectively. In Iran, Shareh (2014) reported a Cronbach's alpha coefficient of .90 for the total scale and coefficients of .87, .89, and .55 for perceived controllability, perceived alternatives, and perceived justifications for human behavior, respectively.

Cognitive Control and Flexibility Questionnaire (CCFQ; Gabrys et al., 2018): This questionnaire was developed to assess individuals' ability to control intrusive thoughts and emotions and to respond flexibly to stressful situations. The instrument consists of 18 items and two subscales: cognitive control over emotion and appraisal and coping flexibility, each measured by nine items. The cognitive control over emotion subscale assesses the ability to direct attention and control unwanted thoughts and emotions. The appraisal and coping flexibility subscale evaluates the ability to examine a situation from different perspectives, revise initial appraisals, and select alternative coping strategies. Responses are rated on a 7-point Likert scale ranging from 1, "strongly disagree," to 7, "strongly agree," with higher scores indicating greater cognitive control and flexibility. Gabrys et al. (2018) reported Cronbach's alpha coefficients of .90 and .93 for the cognitive control over emotion and appraisal and coping flexibility subscales, respectively. In the present study, the item-level mean for cognitive control over emotion was 3.71 (SD = 1.16), whereas the item-level mean for appraisal and coping flexibility was 4.62 (SD = 0.94).

Bouffard Self-Regulated Learning Questionnaire (SRLQ; Bouffard et al., 1995): This 14-item questionnaire assesses self-regulated learning across two subscales: cognitive strategies and metacognitive strategies. Cognitive strategies include activities such as rehearsal, elaboration, organization, and information processing. Metacognitive strategies include processes such as planning, monitoring learning, evaluating performance, and modifying one's approach. Responses are rated on a 5-point Likert scale ranging from 1, "strongly disagree," to 5, "strongly agree." Items 5, 13, and 14 are reverse-scored. Total scores range from 14 to 70, with higher scores indicating greater use of self-regulated learning strategies. The Persian version of the questionnaire was examined and standardized by Kadivar (2001). Cronbach's alpha coefficients of .71, .70, and .68 were reported for the total questionnaire, cognitive strategies, and metacognitive strategies, respectively. Factor-analytic findings also supported the two-factor structure of the instrument and showed that the two factors accounted for 52% of the variance in self-regulated learning.

Reeve Cognitive Engagement Subscale (2013): Cognitive engagement was assessed using the cognitive engagement subscale of Reeve's Student Engagement Questionnaire. The original questionnaire assesses four dimensions of engagement: behavioral, emotional, cognitive, and agentic engagement. The cognitive engagement subscale consists of four items and assesses the use of deep-learning strategies, such as connecting new material with prior knowledge and personal experience, organizing concepts, and generating examples to improve understanding. Responses are rated on a 7-point Likert scale ranging from 1, "strongly disagree," to 7, "strongly agree." Accordingly, scores on this subscale range from 4 to 28, with higher scores indicating greater cognitive engagement. Reeve reported a Cronbach's alpha coefficient of .84 for this subscale. The psychometric properties of the Persian version were also examined by Ramezani and Khamsan (2017), and confirmatory factor analysis supported its four-factor structure.

2.3. Data Analysis

The data were analyzed using SPSS version 26 and AMOS version 26. First, the data were screened for questionnaire completeness and invalid response patterns. Means, standard deviations, frequencies, and percentages were then used to describe the data, and Pearson correlation coefficients were calculated to examine the preliminary relationships among the variables.

The hypothesized model was tested using structural equation modeling with maximum-likelihood estimation. Model fit was evaluated using absolute and comparative fit indices. The indirect effects of cognitive flexibility and

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cognitive control on self-regulated learning through cognitive engagement were examined using a bootstrap procedure with 5,000 resamples and bias-corrected 95% confidence intervals. An indirect effect was considered statistically significant when the corresponding 95% confidence interval did not include zero. The significance level was set at .05.

3. Findings and Results

The initial sample consisted of 365 university students. Following data screening, the main analyses were conducted using data from 359 participants.

The initial study sample consisted of 365 university students aged between 18 and 35 years, with a mean age of 26.68 years (SD = 5.34). Of the initial participants, 191 (52.3%) were men and 174 (47.7%) were women. Following data screening, six participants were excluded because of incomplete responses or invalid response patterns, resulting in a final analytic sample of 359 students.

The means, standard deviations, skewness, and kurtosis values of the study variables are presented in Table 1.

Table 1

Descriptive Statistics of the Study Variables

Variable	N	Mean	Standard Deviation	Skewness	Kurtosis
Cognitive flexibility	359	88.82	12.99	.069	−.791
Cognitive control	359	68.94	6.43	.036	−.798
Self-regulated learning	359	36.74	8.84	.010	−.981
Cognitive engagement	359	16.24	5.52	−.063	−.791

As shown in Table 1, the mean scores for cognitive flexibility, cognitive control, self-regulated learning, and cognitive engagement were 88.82, 68.94, 36.74, and 16.24, respectively. The skewness values ranged from −.063 to .069, while the kurtosis values ranged from −.981 to −.791. Because all skewness and kurtosis values fell within the acceptable range of ±2, the distributions of the study variables were considered approximately normal.

Pearson correlation coefficients were calculated to examine the preliminary relationships among the study variables. The results are presented in Table 2.

Table 2

Correlation Matrix of the Study Variables

Variable	1	2	3	4
1. Cognitive flexibility	1			
2. Cognitive control	.488**	1		
3. Self-regulated learning	.548**	.419**	1	
4. Cognitive engagement	.488**	.334**	.453**	1

The results indicated that all study variables were positively and significantly correlated with one another. The strongest association was observed between cognitive flexibility and self-regulated learning, $r=.548$, $p<.001$. Cognitive engagement was also positively and significantly related to cognitive flexibility, $r=.488$, cognitive control, $r=.334$, and self-regulated learning, $r=.453$, all $p<.001$.

The sample size of 359 participants was considered sufficient for estimating a model with 27 free parameters, resulting in a ratio of more than 13 participants per estimated parameter. Complete data were available for all variables, and the valid sample size was 359.

The skewness and kurtosis values of all variables were within the acceptable range of ±2, supporting the assumption of univariate normality. In addition, the correlations among the study variables ranged from .334 to .548, and no correlation exceeded .85. Therefore, there was no evidence of severe multicollinearity or complete overlap among the variables.

Absolute, incremental, and parsimonious fit indices were examined to evaluate the extent to which the proposed model corresponded to the observed data. The results are presented in Table 3.

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Table 3

Fit Indices of the Structural Equation Model

RMSEA	CFI	IFI	GFI	χ^2/df	Fit Index
.061	.903	.915	.935	3.977	Value

The results of the model fit assessment indicated that the proposed model demonstrated an acceptable fit to the data. The chi-square-to-degrees-of-freedom ratio was 3.977, the Goodness-of-Fit Index was .935, the Incremental Fit Index was .915, and the Comparative Fit Index was .903. In addition, the RMSEA value was .061. Given that the GFI, IFI, and CFI values exceeded .90 and the RMSEA value fell within the acceptable range, it can be concluded that the proposed model showed an adequate fit to the observed data.

The standardized and unstandardized coefficients for the direct structural paths are presented in Table 4.

Table 4

Direct Path Coefficients in the Structural Model

Structural Path	*B*	*β*	C.R.	ML *p*
Cognitive flexibility → Cognitive engagement	.191	.607	5.839	< .001
Cognitive control → Cognitive engagement	.154	.256	2.195	.028
Cognitive flexibility → Self-regulated learning	.370	.436	3.495	< .001
Cognitive control → Self-regulated learning	.777	.478	2.776	.005
Cognitive engagement → Self-regulated learning	.723	.267	1.987	.047

Cognitive flexibility had a positive and significant effect on cognitive engagement, $\beta=.607$, $p<.001$. Cognitive control also positively and significantly predicted cognitive engagement, $\beta=.256$, $p=.028$.

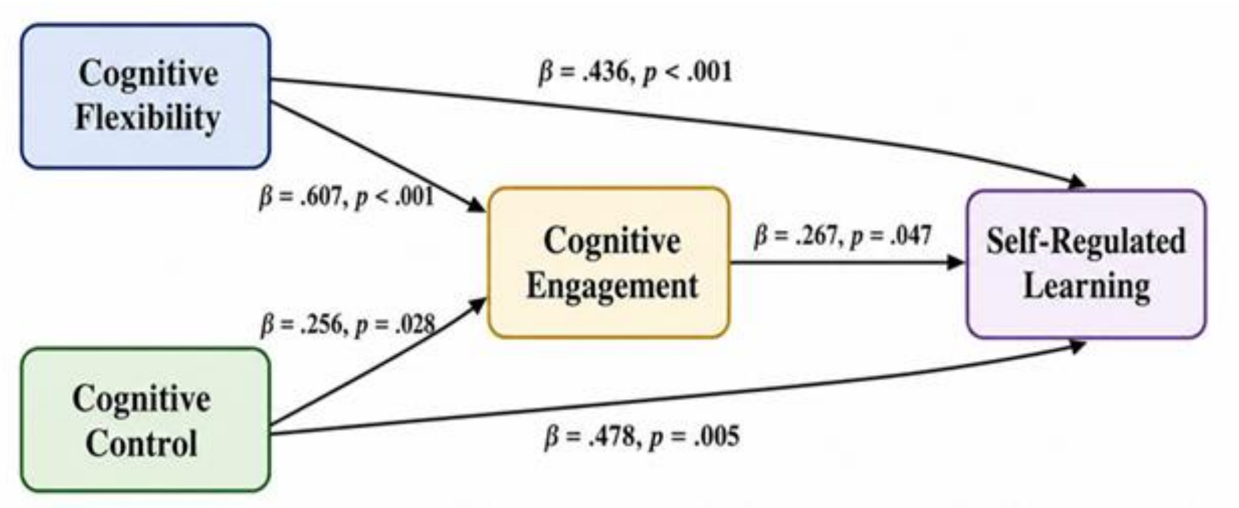
In addition, cognitive flexibility, $\beta=.436$, $p<.001$, and cognitive control, $\beta=.478$, $p=.005$, had positive and significant direct effects on self-regulated learning.

Based on the maximum-likelihood estimate, cognitive engagement also had a positive direct effect on self-regulated learning, $\beta=.267$, $p=.047$.

The standardized structural model and the estimated direct path coefficients are presented in Figure 1.

Figure 1

Structural model of the study



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The indirect effects were tested using the bootstrap procedure to examine the mediating role of cognitive engagement. The results are presented in Table 5.

Table 5

Standardized Indirect Effects Through Cognitive Engagement

Indirect Path	Standardized Effect	95% Bootstrap Confidence Interval	***p***	Result
Cognitive flexibility → Cognitive engagement → Self-regulated learning	.162	[−.025, .328]	.071	Not significant
Cognitive control → Cognitive engagement → Self-regulated learning	.069	[.012, .184]	.024	Significant

The indirect effect of cognitive control on self-regulated learning through cognitive engagement was positive and significant, β=.069, p=.024. Because the direct effect of cognitive control on self-regulated learning also remained significant, cognitive engagement played a partial mediating role in the relationship between cognitive control and self-regulated learning.

In contrast, the indirect effect of cognitive flexibility on self-regulated learning through cognitive engagement was not significant, β=.162, p=.071, because the bootstrap confidence interval included zero. Therefore, the mediating role of cognitive engagement in the relationship between cognitive flexibility and self-regulated learning was not supported.

4. Discussion and Conclusion

The present study aimed to model the relationships of cognitive flexibility and cognitive control with self-regulated learning among university students, with cognitive engagement examined as a mediator. The findings indicated that the proposed structural model demonstrated an acceptable fit to the observed data. Cognitive flexibility had positive and significant direct effects on both cognitive engagement and self-regulated learning, while cognitive control also positively and significantly predicted cognitive engagement and self-regulated learning. In addition, cognitive engagement had a positive and significant direct effect on self-regulated learning. Examination of the indirect pathways revealed that the effect of cognitive control on self-regulated learning through cognitive engagement was positive and significant. In contrast, although cognitive flexibility significantly predicted cognitive engagement and cognitive engagement significantly predicted self-regulated learning, the indirect effect of cognitive flexibility on self-regulated learning through cognitive engagement did not reach statistical significance. These findings collectively suggest that flexible and controlled cognitive functioning are important resources for university students' regulation of learning, although cognitive engagement appears to play a more clearly supported explanatory role in the pathway from cognitive control to self-regulated learning than in the pathway from cognitive flexibility.

The first finding showed that cognitive flexibility had a positive and significant direct effect on self-regulated learning. This finding is consistent with previous evidence indicating a positive relationship between cognitive flexibility and self-regulation skills (Tuncer & Tanaş, 2022). It is also in line with structural modeling findings demonstrating meaningful associations between self-regulation and cognitive flexibility among students (Nakhostin-Khayyat et al., 2024). Furthermore, Borji et al. found that cognitive flexibility was meaningfully involved in the relationship between metacognitive strategies and students' academic adaptation, providing additional support for the educational significance of flexible cognition (Borji et al., 2024). The present result can be explained by considering self-regulated learning as a dynamic process rather than a fixed set of study behaviors. Students must continuously assess whether their current strategies are helping them achieve academic goals and, when necessary, replace ineffective strategies with more suitable alternatives. Cognitive flexibility facilitates precisely this type of adaptive modification. Students with greater flexibility are more capable of approaching a problem from different perspectives, generating alternative solutions, revising initial interpretations, and changing strategies in response to new information or feedback (Dennis & Vander Wal, 2010; Karakuş, 2024). Consequently, they may be better able to regulate their learning when task requirements, academic demands, or instructional conditions change.

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The positive effect of cognitive flexibility on self-regulated learning can also be interpreted from a metacognitive perspective. Effective self-regulation requires more than simply knowing a variety of learning strategies; students must recognize which strategy is appropriate for a particular task, monitor its effectiveness, and discontinue or modify it when it no longer produces the desired outcome. Research on undergraduate learning has emphasized the interdependence of metacognitive processes, strategy use, and self-regulatory functioning (Hey et al., 2024). Similarly, research concerning higher-education metacognitive strategies highlights the importance of cognitive processes that enable students to monitor and reorganize their learning activities (Salehi et al., 2024). Cognitive flexibility therefore appears to provide the adaptive capacity required for translating monitoring information into strategic change. Rather than perseverating on an ineffective approach, cognitively flexible students can reinterpret difficulty as a signal that their strategy needs adjustment. This adaptive capacity is particularly important in contemporary higher education, where blended and technology-supported learning environments require students to independently modify their learning behaviors across varying instructional conditions (Luo & Zhou, 2024).

The second major finding indicated that cognitive flexibility had a positive and significant effect on cognitive engagement. This result is consistent with research showing that cognitive flexibility is related to constructive academic and cognitive outcomes, including critical-thinking dispositions and academic achievement (Gökçe & Güner, 2024; Karakuş, 2024). It is also compatible with recent evidence suggesting that cognitive flexibility contributes to learning engagement among university students (Zhang et al., 2026). Cognitive engagement requires learners to invest sustained mental effort in understanding academic material, connect new information with existing knowledge, consider alternatives, organize information, and persist when learning becomes difficult. Cognitive flexibility may facilitate these processes by preventing students from becoming cognitively fixed on a single interpretation or strategy. When one method fails, flexible learners are more able to consider another method rather than disengaging from the task. This capacity may sustain curiosity, deeper processing, and active problem solving. Cognitive flexibility may therefore contribute to cognitive engagement by increasing students' tolerance of complexity and ambiguity and by maintaining the perception that alternative solutions remain available even when initial attempts are unsuccessful.

This interpretation is also consistent with the broader literature on student engagement in higher education. Cognitive engagement involves active processing and strategic mental participation rather than mere attendance or behavioral compliance (Reeve, 2013). Contemporary research has emphasized that engagement is closely interconnected with students' cognitive abilities, executive functioning, and academic success (Bergdahl et al., 2024; Budwig et al., 2025). A cognitively flexible student may be more likely to reorganize information, compare competing explanations, test alternative solutions, and remain mentally involved when a learning task presents difficulty. Such characteristics are closely aligned with deep cognitive engagement. Furthermore, cognitive flexibility has been associated with resilience and self-regulatory capacities, suggesting that flexible learners may respond more adaptively to academic obstacles rather than withdrawing from learning activities (Nakhostin-Khayyat et al., 2024). Accordingly, the significant direct pathway from cognitive flexibility to cognitive engagement observed in the present study is theoretically plausible and supported by previous evidence.

Despite these significant direct pathways, the indirect effect of cognitive flexibility on self-regulated learning through cognitive engagement was not statistically significant. This finding indicates that cognitive engagement could not be established as the mechanism through which cognitive flexibility was associated with self-regulated learning in the present model. This result should not be interpreted as evidence that cognitive flexibility is unrelated to cognitive engagement or self-regulated learning, because both corresponding direct effects were significant. Rather, it suggests that the combined indirect pathway was not sufficiently strong to establish mediation. One possible explanation is that cognitive flexibility may influence self-regulated learning primarily through more proximal regulatory mechanisms, including metacognitive monitoring, strategy selection, cognitive reappraisal, problem solving, or resilience. Previous research has linked cognitive flexibility directly with self-regulation and resilience (Nakhostin-Khayyat et al., 2024), as well as with metacognitive and adaptive academic processes (Borji et al., 2024). Thus, flexible cognition may enable students to revise plans and change learning strategies directly, without requiring a substantial increase in their level of cognitive engagement as an intermediate mechanism.

Another possible explanation is that cognitive flexibility represents a capacity that does not necessarily translate

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uniformly into active academic engagement. A student may be capable of generating alternative strategies or changing perspectives while not consistently investing high levels of mental effort in a particular learning task. The practical expression of cognitive flexibility may depend on motivational factors, task value, instructional structure, feedback, and opportunities to exercise autonomy. Studies of self-regulated learning have demonstrated that strategy use is shaped by an interconnected set of cognitive, metacognitive, and motivational factors (Hey et al., 2024; Theobald, 2021). Likewise, engagement in blended learning is influenced not only by student characteristics but also by regulated learning and teaching presence (Liao et al., 2023). Therefore, the nonsignificant indirect pathway may reflect the fact that cognitive flexibility contributes to self-regulation through multiple routes, only one of which involves cognitive engagement.

The next finding showed that cognitive control had a positive and significant direct effect on self-regulated learning. This result is consistent with studies demonstrating relationships between executive functions and the management of self-regulated learning among university students (Manuhuwa et al., 2023; Pinochet-Quiroz et al., 2022). It is also supported by recent research linking cognitive control and metacognitive awareness with academic achievement (Musullulu et al., 2025). Self-regulated learning requires students to maintain academic goals over time, resist distractions, organize behavior according to plans, monitor progress, and inhibit responses that interfere with learning. These behaviors depend substantially on cognitive control. Students may establish appropriate academic goals and possess effective learning strategies, but these resources are unlikely to produce consistent self-regulation unless students can maintain attention and suppress competing responses. Cognitive control therefore provides an executive mechanism through which academic intentions can be converted into sustained goal-directed behavior.

This interpretation can also be understood in terms of the executive requirements of university learning. Working memory allows students to maintain task-relevant goals and information, inhibitory control helps them resist irrelevant stimuli and impulsive responses, and attentional control enables the allocation of cognitive resources to the task at hand. Together, these functions make it possible to follow a study plan, persist with difficult material, monitor errors, and return attention to learning after distraction. Research has shown that executive-function abilities and self-regulated learning jointly contribute to explaining differences in academic success (Manuhuwa et al., 2023). Similarly, cognitive control has been conceptualized as the ability to regulate intrusive thoughts, emotions, and appraisals while flexibly adapting to demanding circumstances (Gabrys et al., 2018). In an academic setting, this capacity may reduce off-task behavior and permit students to maintain the sustained, organized effort required for effective self-regulation.

The findings further demonstrated that cognitive control positively and significantly predicted cognitive engagement. This result is compatible with evidence linking student engagement with executive-function skills and academic success (Budwig et al., 2025), as well as studies demonstrating relationships between regulated learning and engagement in contemporary learning environments (Liao et al., 2023; Liu et al., 2024). Deep cognitive engagement requires sustained attention, purposeful allocation of working-memory resources, active elaboration of information, and protection of task-relevant processing from competing stimuli. Cognitive control provides the mechanisms required to sustain these processes. When students can inhibit distractions and redirect attention to learning, they are more capable of analyzing material deeply, organizing information, drawing connections between concepts, and monitoring their understanding. Conversely, poor cognitive control may lead to frequent attentional shifts, superficial processing, and withdrawal from challenging learning activities. Thus, cognitive control can be understood as a cognitive prerequisite for maintaining the mental effort characteristic of cognitive engagement.

Another important finding was that cognitive engagement had a positive and significant direct effect on self-regulated learning. This result is consistent with integrative models that conceptualize cognitive engagement as an important component of self-regulatory learning processes (Li & Lajoie, 2022). It also corresponds with research demonstrating close relationships among cognitive engagement, self-regulated learning, and learning achievement in online educational activities (Liu et al., 2024), as well as evidence from mobile learning environments indicating that self-regulatory supports and cognitive engagement are interconnected (Yang & Song, 2022). Cognitive engagement allows students to interact actively with learning material rather than merely receiving information. Through elaboration, organization, self-questioning, and deep processing, students obtain information about the extent to which they understand the material. This internal feedback is essential for self-

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regulation because learners cannot effectively monitor or modify their learning strategies without actively evaluating their comprehension and performance.

The significance of cognitive engagement may be particularly pronounced in modern higher education, where students increasingly operate in blended, online, and smart learning settings. These environments often provide greater flexibility but simultaneously demand greater learner responsibility. Systematic evidence has demonstrated the importance of self-regulated learning strategies in blended higher education (Luo & Zhou, 2024), while research on smart learning has highlighted the role of competencies such as data literacy in supporting effective university learning (Ahmadi, 2024). In such environments, students need to actively interpret information, monitor progress, and make independent learning decisions. Cognitive engagement may maintain the regulatory cycle by providing continuous information about understanding and performance, which subsequently guides the modification of goals, effort, and strategy selection.

Finally, the indirect effect of cognitive control on self-regulated learning through cognitive engagement was positive and statistically significant. This finding provides support for the proposed explanatory role of cognitive engagement in connecting cognitive control with students' regulation of learning. Cognitive control enables learners to suppress distractions, sustain attention, and keep learning goals active; these capacities create favorable conditions for deeper mental investment in academic tasks. In turn, cognitive engagement facilitates elaboration, active monitoring, and evaluation of understanding, all of which contribute to self-regulated learning. This interpretation is consistent with evidence linking executive functioning with student engagement (Budwig et al., 2025), cognitive control with metacognitive academic functioning (Musullulu et al., 2025), and cognitive engagement with self-regulated learning and achievement (Li & Lajoie, 2022; Liu et al., 2024). Thus, cognitive control appears to contribute to self-regulated learning not only directly but also through the extent to which students are mentally and strategically engaged in their learning activities. Overall, the findings support an integrated perspective in which cognitive capacities and active mental participation operate together to facilitate effective self-regulation among university students.

The present study should be interpreted in light of several limitations. First, the cross-sectional and correlational design does not permit conclusions regarding causal or temporal relationships among cognitive flexibility, cognitive control, cognitive engagement, and self-regulated learning. Second, all principal variables were assessed through self-report questionnaires, making the results potentially vulnerable to common-method variance, social desirability, inaccurate self-perceptions, and response tendencies. Third, participants were recruited through convenience sampling from universities in Isfahan, which may restrict the representativeness of the sample and limit generalization to university students from other geographical regions, educational systems, disciplines, or cultural contexts. In addition, potentially relevant variables such as academic motivation, perceived task value, academic self-efficacy, socioeconomic conditions, field of study, teaching quality, digital-learning experience, and psychological well-being were not included in the model. Finally, cognitive engagement was represented as an overall construct, and the study therefore could not clarify whether specific forms or components of engagement might operate differently in the proposed relationships.

Future studies should examine the proposed relationships using longitudinal, prospective, and experimental designs to determine the temporal ordering and possible causal connections among cognitive capacities, engagement, and self-regulated learning. Researchers could employ multi-method assessment by combining self-report scales with behavioral tasks of executive functioning, learning analytics, observation, academic performance indicators, or real-time measures of engagement. Replication with larger probability-based samples from different universities, academic disciplines, age groups, and cultural contexts would improve generalizability. Future structural models could also investigate additional mediators and moderators, including metacognitive awareness, academic motivation, self-efficacy, resilience, task value, emotion regulation, perceived autonomy, and teaching presence. It would also be useful to examine different dimensions of cognitive engagement separately and compare whether deep strategy use, elaboration, sustained attention, or metacognitive monitoring account for distinct portions of the relationships between cognitive control, cognitive flexibility, and self-regulated learning.

Universities may use these findings to design educational programs that simultaneously strengthen students' executive capacities and their active participation in learning. Workshops and student-support programs can incorporate exercises in attentional control, distraction management, goal maintenance, cognitive shifting, problem solving,

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generation of alternative strategies, planning, time management, and monitoring of academic progress. Instructors can also design learning activities that require students to explain their reasoning, compare alternative solutions, connect new concepts with prior knowledge, reflect on their understanding, and revise strategies after receiving feedback. Learning environments should provide structured opportunities for autonomy while also offering clear goals, timely feedback, and scaffolding that encourages sustained cognitive effort. Academic counseling and learning-support services may additionally identify students who experience difficulties in attentional control or strategic adaptation and provide targeted training aimed at improving both engagement and self-regulatory learning behaviors.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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References

Ahmadi, B. (2024). The Role of Data Literacy in Enhancing the Quality of Smart Learning Among University Students. *Smart Learning and Management Transformation*, *2*(4), 1-12.

Bergdahl, N., Bond, M., Sjöberg, J., Dougherty, M., & Oxley, E. (2024). Unpacking Student Engagement in Higher Education Learning Analytics: A Systematic Review. *International Journal of Educational Technology in Higher Education*, *21*, 63. https://doi.org/10.1186/s41239-024-00493-y

Borji, M., Arabzadeh, M., & Zahed, S. (2024). The Relationship Between Metacognitive Strategies and Academic Buoyancy in Students: The Mediating Role of Cognitive Flexibility. *Rooyesh-e-Ravanshenasi Journal*, *13*(3), 55-64.

Bouffard, T., Boisvert, J., Vezeau, C., & Larouche, C. (1995). The Impact of Goal Orientation on Self-Regulation and Performance Among College Students. *British Journal of Educational Psychology*, *65*(3), 317-329. https://doi.org/10.1111/j.2044-8279.1995.tb01152.x

Budwig, N., Halder, S., Wang, S., & Zhong, J. (2025). Student Engagement, Executive Function Skills, and Academic Success: The Connection During the College Years. *International Journal of Learning, Teaching and Educational Research*, *24*(9), 323-345. https://doi.org/10.26803/ijlter.24.9.16

Chitra, E., Hidayah, N., Chandratilake, M., & Nadarajah, V. D. (2022). Self-Regulated Learning Practice of Undergraduate Students in Health Professions Programs. *Frontiers in Medicine*, *9*, 803069. https://doi.org/10.3389/fmed.2022.803069

Dennis, J. P., & Vander Wal, J. S. (2010). The Cognitive Flexibility Inventory: Instrument Development and Estimates of Reliability and Validity. *Cognitive therapy and research*, *34*(3), 241-253. https://doi.org/10.1007/s10608-009-9276-4

Gabrys, R. L., Tabri, N., Anisman, H., & Matheson, K. (2018). Cognitive Control and Flexibility in the Context of Stress and Depressive Symptoms: The Cognitive Control and Flexibility Questionnaire. *Frontiers in psychology*, *9*, 2219. https://doi.org/10.3389/fpsyg.2018.02219

Gökçe, S., & Güner, P. (2024). Pathways from Cognitive Flexibility to Academic Achievement: Mediating Roles of Critical Thinking Disposition and Mathematics Anxiety. *Current Psychology*, *43*, 18192-18206. https://doi.org/10.1007/s12144-024-05642-0

Hey, R., McDaniel, M., & Hodis, F. A. (2024). How Undergraduate Students Learn: Uncovering Interrelationships Between Factors That Support Self-Regulated Learning and Strategy Use. *Metacognition and Learning*, *19*(3), 743-772. https://doi.org/10.1007/s11409-024-09389-8

Kadivar, P. (2001). *The Role of Self-Efficacy Beliefs, Self-Regulation, and Intelligence in the Academic Achievement of Students to Design a Model for Optimum Learning*.

Karakuş, İ. (2024). University Students' Cognitive Flexibility and Critical Thinking Dispositions. *Frontiers in psychology*, *15*, 1420272. https://doi.org/10.3389/fpsyg.2024.1420272

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

Liao, H., Zhang, Q., Yang, L., & Fei, Y. (2023). Investigating Relationships Among Regulated Learning, Teaching Presence, and Student Engagement in Blended Learning: An Experience Sampling Analysis. *Education and Information Technologies*, *28*, 12997-13025. https://doi.org/10.1007/s10639-023-11717-5

E-ISSN: 3041-8828

Liu, Z., Gao, Y., Zhang, N., Long, T., Liu, S., & Peng, X. (2024). Effects of Self-Regulated Learning on Cognitive Engagement and Learning Achievement in Online Discussions. *Current Psychology*, *43*, 28147-28162. https://doi.org/10.1007/s12144-024-06445-z

Luo, R. Z., & Zhou, Y. L. (2024). The Effectiveness of Self-Regulated Learning Strategies in Higher Education Blended Learning: A Five-Year Systematic Review. *Journal of Computer Assisted Learning*, *40*(6), 3005-3029. https://doi.org/10.1111/jcal.13052

Manuhuwa, D. M., Snel-de Boer, M., Jaarsma, D., Fleer, J., & De Graaf, J. W. (2023). The Combined Value of Executive Functions and Self-Regulated Learning to Predict Differences in Study Success Among Higher Education Students. *Frontiers in psychology*, *14*, 1229518. https://doi.org/10.3389/fpsyg.2023.1229518

Musullulu, H., Garcia-Orza, J., Gómez Vázquez, D., & Garcia-Sanz, S. (2025). Cognitive Control and Metacognitive Awareness: Do They Shape Academic Achievement in University Students? *Frontiers in psychology*, *16*, 1633996. https://doi.org/10.3389/fpsyg.2025.1633996

Nakhostin-Khayyat, M., Borjali, M., Zeinali, M., Fardi, D., & Montazeri, A. (2024). The Relationship Between Self-Regulation, Cognitive Flexibility, and Resilience Among Students: A Structural Equation Modeling. *BMC psychology*, *12*, 337. https://doi.org/10.1186/s40359-024-01843-1

Pinochet-Quiroz, P., Ramos-Galarza, C., Lepe-Martínez, N., Del Valle Tapia, M., Gálvez-Gamboa, F., & Acosta-Rodas, P. (2022). Relationship Between Cold Executive Functions and Self-Regulated Learning Management in College Students. *Estudios Sobre Educación*, *43*, 93-113. https://doi.org/10.15581/004.43.005

Reeve, J. (2013). How Students Create Motivationally Supportive Learning Environments for Themselves: The Concept of Agentic Engagement. *Journal of Educational Psychology*, *105*(3), 579-595. https://doi.org/10.1037/a0032690

Salehi, D., Hosseini-Daronkolaei, S. Z., & Hosseinzadeh, B. (2024). The Effect of Neuroscience-Based Higher Education Dimensions on University Students' Metacognitive Strategies. *Journal of Cognition, Behavior, and Learning*, *1*(1), 1-14. https://doi.org/10.61838/jcbl.1.1.1

Shareh, H., Farmani, A., & Soltani, E. (2014). Investigating the Reliability and Validity of the Cognitive Flexibility Inventory (CFI-I) Among Iranian University Students. *Practice in Clinical Psychology*, *2*(1), 43-50.

Theobald, M. (2021). Self-Regulated Learning Training Programs Enhance University Students' Academic Performance, Self-Regulated Learning Strategies, and Motivation: A Meta-Analysis. *Contemporary Educational Psychology*, *66*, 101976. https://doi.org/10.1016/j.cedpsych.2021.101976

Tuncer, M., & Tanaş, R. (2022). The Relationship Between Cognitive Flexibility and Self-Regulation Skills. *Afyon Kocatepe University Journal of Social Sciences*, *24*(2), 467-479. https://doi.org/10.32709/akusosbil.903722

Yang, Y., & Song, Y. (2022). Effects of a Self-Regulation Scheme Embedded in a Mobile App on Undergraduate Students' English Vocabulary Learning Performance and Cognitive Engagement. In C. P. Lin, Y. H. Wang, B. Jiang, J. L. Shih, S. C. Kong, & X. Gu (Eds.), *Conference Proceedings of the 26th Global Chinese Conference on Computers in Education* (pp. 61-64).

Zhang, Z., Rao, Z., Liu, M., Han, J., & Zheng, L. (2026). The Relationship Between Physical Exercise and Learning Engagement Among Chinese College Students: The Chain Mediating Roles of Cognitive Flexibility and Psychological Resilience. *Frontiers in psychology*, *17*, 1731426. https://doi.org/10.3389/fpsyg.2026.1731426

E-ISSN: 3041-8828