The Relationships Between Adolescents' Academic Self-Regulation, Motivational Strategies, and Academic Achievement in Distance Education Process

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Abstract

Considering the spread of distance education worldwide and the acceleration of this situation by the COVID-19 epidemic, this study aimed to explore the relationships between adolescents' academic self-regulation skills and academic performance, and the mediating role of motivational strategies during distance learning. The sample was composed of a total of 311 adolescents (71% girls; $M_{Age} = 15.70$, $S = 1.05$) attending public high schools from different socioeconomic levels in the central districts of Ankara, Republic of Turkey. The results revealed gender differences in self-regulation and cognitive strategy use, while academic achievement varied by adolescence stage. Maternal education positively correlated with adolescents' achievement. Duration of participation in distance education impacted academic achievement, with longer participation linked to higher scores. Increased use of self-regulation and motivational strategies correlated with higher academic achievement. Path analysis results indicated that the effect of self-regulation on adolescents' academic achievement in distance education was mediated through motivational strategies. These findings underscore the importance of motivational processes in adolescent academic success, shedding light on critical skills for thriving in distance education.

Keywords: Distance education, self-regulation, motivational strategies, academic success, adolescents

Introduction

The pandemic has led to profound educational shifts, impacting education. Distance education has emerged as a crucial method to ensure uninterrupted learning during this period (Moreno & Gortazar, 2021). Children and adolescents are away from their schools, friends, and even family members for indefinite periods (Huremović, 2019). Children face uncertainties and

anxiety, potentially affecting their academic motivation and achievement (Trickey & Black, 2000). To mitigate educational losses, a smooth transition to distance education post-pandemic is crucial, prompting widespread adoption of hybrid education models (Moreno & Gortazar, 2021). For these reasons, investigating the effect of self-regulation skills and motivation on academic performance in distance education is imperative.

Research on middle school, high school, and undergraduate levels suggests that self-regulation and motivation contribute to success in distance education (Cho et al., 2017; Greene & Azevedo, 2009). However, studies on success in distance education (Cho et al., 2021; Wang et al., 2013) were mostly conducted for graduate students. Studies conducted in high school samples are limited. We examined the relationships between self-regulation and motivational strategies and the academic achievement of adolescents in the distance education process together. In addition, the relationship between different types of self-regulation and motivation with academic achievement in distance education was also addressed. In line with the aforementioned information, the constructs addressed within the scope of the study are introduced below and the possible relationships between the variables are explained in the light of the literature.

Literature Review

Distance Education

The coronavirus pandemic has been the main factor in the rapid transition to distance education primarily due to the need for social isolation (Viktoria & Aida, 2020). To ensure uninterrupted learning, distance education has entered our lives as a viable and crucial educational method and thus has greatly affected the field of education (Moreno & Gortazar, 2021; Viktoria & Aida, 2020). Consequently, distance education has started to be used compulsorily and widely during the pandemic. Furthermore, in case of disruption of the traditional education system after the pandemic, a smooth transition to the distance education system has been recommended to prevent interruptions in learning (Moreno & Gortazar, 2021). Distance education is often referred to as the education model of the new generation, particularly for individuals born after 2000 who are considered digital individuals (Öz-Ceviz et al., 2020). This method connects teachers and students through internet technologies, allowing learning to occur without time or space constraints and enabling students to learn at their own pace (Wei & Chou, 2020). As a result, this model places strong emphasis on the value of self-learning skills, underscoring the critical role of self-regulation skills and motivation in facilitating effective learning in a distance education context.

Self-Regulation and Distance Education

Self-regulation skills contribute to academic success in both traditional and distance education settings. Self-regulation involves actions individuals take to adapt towards their goals effectively (Zimmerman, 2000). In an academic context, it refers to students actively evaluating and adjusting their behavior, motivation, and cognitive skills to align with their learning goals, while also considering environmental constraints (Pintrich, 2000). Students lacking adequate academic self-regulation skills often struggle in distance education (Brooks et al., 2001). Studies with high school (Hatami et al., 2018; Sáez-Delgado et al., 2023) and undergraduate/graduate students (Wang et al., 2013; Kashif & Shahid, 2021; Wehrhahn et al., 2024) demonstrate that those employing self-regulation skills in distance learning environments fare better.

Motivational Strategies and Distance Education

Motivational strategies, which define the individual's perception of the tools he/she uses for learning goals and his/her performance, include two basic dimensions: self-regulation strategies and motivational beliefs (Pintrich & De Groot, 1990). *Self-regulation strategies* are the processes students use to access information by their learning goals, including the subdimensions of cognitive strategy use and self-regulation (Zimmerman, 1989; Zimmerman, 1990). Cognitive strategy usage entails methods such as comprehending, rehearsing, and organizing to learn and retain information (Pintrich & De Groot, 1990), while self-regulation involves monitoring and adjusting behaviors, cognitions, and motivations to meet goals amidst environmental influences (Pintrich, 2000). *Motivational beliefs* encompass students' perceptions of their academic responsibilities and cognitive activities, with subdimensions including self-efficacy, intrinsic value, and test anxiety (Pintrich & De Groot, 1990). Self-efficacy involves making and sustaining efforts to succeed, intrinsic value pertains to finding classroom responsibilities engaging and meaningful, and test anxiety encompasses thoughts that may adversely impact academic performance and exams (Pintrich & De Groot, 1990; Schunk & Usher, 2012).

Motivation is pivotal for overcoming challenges and achieving goals in distance education environments (Deimann & Bastiaens, 2010; Yaban & Gaschler, 2024), thereby enhancing academic achievement. Research indicates that employing motivational strategies benefits academic performance in both face-to-face (e.g., Ning & Downing, 2010; Liu et al., 2014; Kryshko et al., 2020) and distance education (e.g., Hodges, 2004).

Self-Determination Theory

This study adopts self-determination theory (SDT) as its theoretical framework because it encompasses self-regulation and motivation, recognized as crucial factors for positive academic outcomes in distance education, providing a comprehensive perspective. SDT proposes a motivational schema based on intrinsic and extrinsic factors that shape an individual's behavior and reveal patterns of motivation and self-regulation (Deci & Ryan, 2000; Ryan & Deci, 2000). Amotivation, extrinsic motivation, and intrinsic motivation refer to states of motivation. Individual's actions move from a state of least autonomy to a state of most autonomy.

Amotivation is a lack of intention, desire, and energy to act (Deci & Ryan, 2008) and related to low academic achievement in adolescents (Taylor et al., 2014). Extrinsic motivation entails engaging in behavior to attain a specific outcome and is categorized into four categories: (1) external regulation (action driven by external factors); (2) introjected regulation (partial internalization of action with internal pressures); (3) identified regulation (valuing and embracing the action); and (4) integrated regulation (actions aligning with individual values and self-congruence) (Deci & Ryan, 2000; Deci & Ryan, 2008). Internalized regulation denotes the most effective internalization (Deci & Ryan, 2000), akin to intrinsic motivation (Deci & Ryan, 2008). However, while integrated regulation aims for outcomes through behavior, intrinsic motivation arises from finding the behavior inherently interesting and enjoyable, reflecting self-determined behavior prototypes (Ryan & Deci, 2000).

In general, motivation is divided into two categories: controlled motivation (introjected and external regulation) and autonomous motivation (integrated, identified, and internal regulation). In controlled motivation, behaviors are generated by external pressure and cannot be

internalized (Deci & Ryan, 2008). Areepattamannil et al. (2011) indicated that when behaviors cannot be internalized, academic performance indicates negative consequences.

Research examining the role of self-regulation and motivation on academic performance in distance education primarily comprises undergraduate and postgraduate students. These studies consistently demonstrate that achievement and motivation are positively related (Goulimaris, 2015; Rêka et al., 2015). Conversely, the current study focuses on adolescents aged 14 to 18, encompassing middle and late adolescence stages.

The Mediating Role of Motivational Strategies

Self-regulation skills can foster high academic achievement by increasing students' motivation, which is one of the basic skills for learning (Kosnin, 2007; Uçar & Zarfsaz, 2023). Motivated students typically display enthusiasm for challenging tasks, invest effort in learning endeavors, and consequently exhibit favorable academic outcomes (Brenner, 2022).

These skills also facilitate the use of motivational strategies (e.g., Daniela, 2015). Virtanen et al. (2015) found a relationship between certain motivational strategies (e.g., self-efficacy, performance anxiety) and self-regulation among undergraduate students. Moreover, reciprocal effects between these constructs were emphasized (Ning & Downing, 2010; Yaban & Gaschler, 2024). In their study focusing on students aged 16 to 19 based on the SDT, Liu and colleagues (2014) found that students exhibiting autonomous self-regulation also used motivational strategies. In a distance education environment, students with high self-regulation and motivation levels are likely to have high performance levels (Semmar, 2006). However, most of the studies focus on undergraduate and graduate students.

The Current Study

It is crucial to identify the factors influencing academic success in the context of widespread distance education that has become widespread with the pandemic. Thus, this study aimed to (1) identify the status of adolescents engaged in distance learning, (2) investigate the relationships between academic self-regulation skills, usage of motivational strategies, and the academic performance of adolescents, and (3) examine whether motivational strategies mediate the association between self-regulation skills and academic achievement. Furthermore, the study assessed the group differences based on developmental stage, gender, and socioeconomic status (SES). Specifically, the following hypotheses were tested:

(1) Adolescent students' self-regulation skills in the academic field are related to their success in distance education environments.
(2) There is a relationship between adolescents' ability to use motivational strategies and their success in distance education environments.
(3) Motivational strategies have a mediating role in the relationship between adolescents' self-regulation skills and their academic achievement.
(4) We expect that academic achievement, self-regulation, and motivational strategies will differ according to adolescents' age, gender, SES (e.g., maternal education level), and adolescents' distance education status. Based on previous research, we expect girls to have higher academic achievement (Carvalho, 2016), self-regulation (Liu et al., 2021), and intrinsic motivation (Oga-Baldwin & Fryer, 2020) than boys. Studies also indicate

that self-regulation (Størksen et al., 2015), motivational strategies (Tan et al., 2023), and academic achievement (Li et al., 2020) vary with socioeconomic status. Academic achievement decreases with age (Hartanto et al., 2018). Finally, participation in distance education affects self-regulation (Landrum, 2020) and motivational strategies (Geng, 2022).

Method

Participants

A total of 315 adolescents attending the first through fourth grades of public high schools in the central districts of Ankara, Turkey province took part in the study. Four participants were excluded from the analysis because they filled out the scales incorrectly. A priori sample size estimation for regression was performed using G*Power with 95% power, $\alpha = .05$ type I error, 0.3 effect size (Faul et al., 2009), and the minimum required sample size was calculated as 232.

Of the participants included in the study, 222 were girls (71%) and 89 were boys (29%). The mean age was 15.70 years ($S = 1.05$). Most of the participants were in the first (36.3%) and second (37.3%) years of high school. The educational level of the participants' parents was assessed on a 6-point scale (0 = illiterate to 5 = master's degree and above). It was observed that 36% of the mothers were high school graduates, 26.7% were university graduates, 18.6% were primary school graduates, 15.4% were secondary school graduates, 2.6% were postgraduate and above, and 0.6% were illiterate. It was observed that 30.2% of the fathers were university graduates, 30.2% were high school graduates, 18.3% were middle school graduates, 16.1% were primary school graduates, and 5.1% had a master's degree or higher. Most of the adolescent participants (79.7%) considered themselves and their families to be in the middle SES.

Measurements

Demographic and Personal Information Form.
Participants were asked to indicate their gender, age, educational level of their parents, and where they considered themselves and their families to be in terms of SES on a six-step ladder visual (bottom two steps: low status, middle two steps: medium status, top two steps: high status).

Frequency of Participation in Distance Education.
Adolescents were asked to rate the frequency of their involvement (attending class online) in distance education on a scale of 0–10.

Measurement of Academic Achievement.
We used the weighted end-of-semester e-school grade point average of the first semester of the 2019–2020 academic year in which participants received face-to-face education and the first semester of the 2020–2021 academic year in which they received distance education.

Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989).
The Turkish version (Kındap, 2011) of the Academic Self-Regulation Questionnaire (SRQ-A) was used. The SRQ-A contains 29 items and four subscales: intrinsic, identified, introjected, and external regulation. Adolescents rated their perceptions of self-regulation for each target situation

and possible responses (e.g., Target situation: "Why do I do my homework? Possible response: "Because I want my teacher to think I am a good student," with eight possible responses for each situation) on a 1 (not at all true) to 6 (very true) point scale. A high score on a sub-dimension indicates high regulation. The four subscales can be combined into two general subscales: controlled motivation (introjected and external regulation) and autonomous motivation (integrated, identified, and internal regulation). The Turkish validity and reliability study of the scale was conducted by Kındap (2011). The Cronbach's alpha internal consistency coefficients of the subdimensions range from .74 to .89.

The Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & De Groot, 1990).

The 44-item Turkish version (İlker et al., 2014) of the MSLQ was used. It includes motivational beliefs (e.g., "I hope that I will be successful in this course compared to other students in the class") and self-regulation strategies (e.g., "When I study for an exam, I try to combine the information in the book with the information I have learned in the course"). We used these two sub-dimensions. Motivational beliefs have three subscales: self-efficacy (9 items), intrinsic value (9 items), and test anxiety (4 items), while self-regulation strategies have two subscales: cognitive strategy use (13 items) and self-regulation (9 items). Participants answered on a Likert scale ranging from 1 (does not fit me at all) to 7 (fits me completely). The Cronbach alpha internal consistency coefficients of the subdimensions of the scale are between .70 and .88.

Procedure

The study had been approved by the ethics committee of the Hacettepe University. The scales were administered to adolescents who had received informed consent from their parents and agreed to participate. The adolescents and their parents were informed about the study, that the study was voluntary, and that their information would remain confidential. Data were collected online via Google Forms (Google Survey) due to the pandemic. The data collection tools took an average of 15 minutes to complete.

Data Analysis

Data were analyzed using SPSS software (IBM SPSS Statistics 26 and AMOS 28). Before analysis, the data were examined to determine univariate and multivariate extreme values, multicollinearity, missing values, and normality. Absolute skewness and kurtosis values were within the limits of 2 (-1.317 – .104) and 7 (-.878 – 2.130); respectively. Considering the z value ±3.29, two participants were excluded. Twenty-six participants identified with multivariate extreme values were also excluded from regression-based analyses. There were no variables with a tolerance score below .1 and a VIF value above 10, except the intrinsic subdimensions of self-regulation and motivational strategies. Thus, in the mediation analysis, we used the sub-dimensions by combining them as mentioned before (e.g., Kındap, 2011; İlker et al., 2014; Guo et al., 2016).

We examined whether self-regulation, motivational strategies, and academic achievement differed by gender and developmental stage by using a 2x2 MANOVA. To determine whether the related variables differed by SES variables and weekly participation rate, one-way ANOVAs were conducted. The relationships were assessed by calculating Pearson correlations. Path analysis was used to test the mediating role of motivational strategies.

Results

The Role of Demographical Characteristics

We categorized adolescents into two developmental stages: middle adolescents (1st and 2nd grades, n = 229) and late adolescents (3rd and 4th grades, n = 82). Bonferroni correction was used to control for type I errors in comparisons (p < .004). The MANOVA results indicated the main effects of gender (Wilk's λ = .891, F (11, 297) = 3.29, p < .001, partial η^2 = .11) and developmental stage (Wilk's λ = .805, F (11, 297) = 6.53, p < .001, partial η^2 = .19) were significant. The interaction was not significant. Follow-up analysis revealed self-regulation and cognitive strategy use differed by gender; girls were higher than boys (self-regulation, M_{Girls} = 4.70, SD = .91; M_{Boys} = 4.29, SD = .81; cognitive strategy use, M_{Girls} = 5.36, SD = 1.06; M_{Boys} = 4.87, SD = 1.02). Middle adolescents' GPAs for the first semester of 2019–2020 (M = 85.02, SD = 11.28) were higher than late adolescents' GPAs for the same semester (M = 78.48, SD = 12.45).

Academic performance differed by maternal education level, F2019-2020 (3, 277) = 10.413, partial η2 = .10, p < .001; F2020-2021 (3, 277) = 7.625, partial η2 = .08, p < .001. The effect of economic status was significant only for self-efficacy scores; F (2, 280) = 5.788, partial η2 = .04, p = .003. For Semester I of 2019-2020, the GPAs of students whose mothers had a college degree or higher (M = 93.38, SD = 7.85) were higher than those whose mothers had a primary, secondary, or high school degree (MPrimary = 80.59, SD = 11.39; MSecondary = 81.01, SD = 12.68; MHigh = 88.94, SD = 9.45). Students whose mothers held a university degree or higher (M = 94.75, SD = 4.59) exhibited higher GPAs compared to adolescents whose mothers had completed middle, elementary, or high school (MMiddle = 83. 21, SD = 12.32; MElementary = 84.47, SD = 10.90; MHigh = 89.61, SD = 9.03). The self-efficacy among students from high (Mn=35 = 5.32, SD = 1.05) and low (Mn=22 = 5.31, SD = 1.25) SES are higher than those of students from middle SES (Mn=226 = 4.71, SD = 1.24).

Approximately one hundred and eighteen adolescents (37.9%) engaged in distance education for 11 to 20 hours per week, 34.1% participated for 21 hours or more, and 28% participated for less than 10 hours. Students must participate in distance education courses; however, the number of hours participated in varied among students due to individual circumstances, including technical difficulties and access to adequate devices (e.g., computers, tablets, phones). Differentiation status of academic self-regulation, motivational strategy uses, and grade point averages in two semesters between the groups is presented in Table 1.

Table 1

The Effect of Frequency of Participation in Distance Education (Weekly Hours)

Dependent Variables	*Sum of Squares*	*SD*	*F*	*p*
Self-Regulation				
External	10.79	2	5.03	.007**
Introjected	12.50	2	6.36	.002**
Identified	13.77	2	5.25	.006**

Internal	3.28	2	1.96	.141
Motivational Strategies				
Self-regulation	6.56	2	4.14	.017*
Cognitive	9.57	2	4.27	.015*
Self-efficacy	15.63	2	4.45	.012*
Intrinsic	10.12	2	2.88	.057
Anxiety	8.33	2	1.54	.215
Academic Achievement (GPA)				
2019–2020 I. Semester	1428.53	2	5.14	.006**
2020–2021 I. Semester	1292.63	2	5.24	.006**

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

The results indicated the SRQ-A external ($F(2,308) = 5.03$, $p = .007$), introjected ($F(2,308) = 6.36$, $p = .002$), and identified ($F(2,308) = 5.25$, $p = .006$) self-regulation and the MSLQ self-regulation ($F(2,308) = 4.14$, $p = .02$), cognitive strategy use ($F(2,308) = 4.27$, $p = .02$), and self-efficacy ($F(2,308) = 4.45$, $p = .01$) and GPAs in two semesters ($F_{2019-2020} (2,308) = 5.14$, $p = .00$; $F_{2020-2021} (2, 308) = 5.24$, $p = .00$) was significantly differentiated between groups (see Table 1).

Academic Self-Regulation.

Post-hoc analyses indicated students who participated in 21 hours or more of distance education ($M = 5.20$, $SD = .99$) had higher external self-regulation scores than those who participated in 10 hours or less ($M = 4.74$, $SD = 1.14$) and 11-20 hours ($M = 4.90$, $SD = .98$). Introjected self-regulation was higher for students who participated in 21 or more hours ($M = 4.89$, $SD = 1.03$) than those who participated in 10 or fewer ($M = 4.37$, $SD = 1.04$). Identified self-regulation scores were higher for students who participated in 21 hours or more ($M = 5.35$, $SD = 1.14$) than those who participated in 10 hours or less ($M = 4.82$, $SD = 1.34$).

Motivational Strategies.

Self-regulation was higher for students who completed 21 hours or more of distance education ($M = 4.75$, $SD = .88$) than those who completed 10 hours or less ($M = 4.38$, $SD = .98$). The cognitive scores of students who participated in 21 or more hours ($M = 5.44$, $SD = 1.05$) were higher than those who participated in 10 or fewer hours ($M = 5.00$, $SD = 1.18$). Self-efficacy scores were higher for students who participated in 21 or more hours ($M = 4.99$, $SD = 1.30$) than those participating in 10 or fewer hours ($M = 4.44$, $SD = 1.49$).

Academic Achievement.

The GPAs for the 2019–2020 I. semester were higher for students who participated in 21 hours or more ($M = 85.16$, $SD = 11.7$) than those who participated in 11–20 hours ($M = 84.09$, $SD = 13.1$) and 10 hours or less ($M = 79.93$, $SD = 9.75$). The GPAs for the 2020–2021 semester were higher for students who attended 21 hours or more ($M = 87.73$, $SD = 10.2$) and 11-20 hours ($M = 86.05$, $SD = 11.6$) than those who attended 10 hours or less ($M = 82.59$, $SD = 11.3$).

Correlations

The correlations between the sub-dimensions of academic self-regulation and motivational strategies and the mother's education status and academic achievement are presented in Table 2.

Table 2

Descriptive Statistics

| Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. Mother Education	-.09	-											
Self-Regulation			-										
3. External Regulation	.04	-.08											
4. Introjected	.06	-.14*	.78**	-									
5. Identified	.10	-.08	.85**	.81**	-								
6. Internal	.05	-.09	.60**	.69**	.61**								
Motivational Strategies						-							
7. Self-regulation	.02	-.10	.77**	.63**	.72**	.42**	-						
8. Cognitive	.01	-.15**	.77**	.75**	.76**	.50**	.74**	-					
9. Self-efficacy	.12*	.00	.81**	.69**	.84**	.52**	.58**	.51**	-				
10. Internal	.11*	-.11*	.81**	.82**	.87**	.66**	.67**	.65**	.75**	-			
11. Anxiety	-.10	-.05	.05	.25**	-.01	.48**	-.08	.11*	-.15**	-.08	-		
Academic Achievement (GPA)													
12. 2019–2020 I. Semester	-.37**	.26**	.02	-.06	.03	-.15**	.04	.04	.06	-.05	-.13*	-	
13. 2020–2021 I. Semester	-.06	.15**	.17**	.07	.21**	-.10	.18**	.15**	.24**	.10	-.18**	.66**	-
M	15.69	2.77	4.96	4.65	5.12	4.47	4.58	5.22	4.70	4.90	4.64	83.29	85.65
SD	1.04	1.13	1.04	1.00	1.16	.91	.89	1.06	1.33	1.33	1.64	11.93	11.25
Range	13-18	0-5	2-7	1.7-7	1.4-7	2-7	1.4-6.4	1.7-7	1.1-7	1-7	1-7	39-100	30-99

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

Positive correlations were observed (see Table 2) between adolescents' external self-regulation and academic achievement scores for 2020–2021 ($r = .17, p = .002$), as well as between identified self-regulation and GPA scores for 2020-2021 ($r = .21, p < .000$). Conversely, internal self-regulation was negatively correlated with academic achievement for 2019–2020 ($r = -.15, p = .006$). GPA scores for 2020–2021 were positively related to self-regulation of motivational strategies ($r = .18, p = .001$), utilization of cognitive strategies ($r = .15, p = .007$), and self-efficacy ($r = .24, p = .000$). Anxiety levels were negatively correlated to academic achievement in both years ($r_{2019-2020} = -.13, p = .015$; $r_{2020-2021} = -.18, p = .001$). Maternal education was positively correlated to academic achievement ($r_{2019-2020} = .26, r_{2020-2021} = .15$).

The Mediating Role of Motivational Strategies

Both self-regulation (controlled motivation – introjected and external regulation – and autonomous motivation – integrated, identified, and internal regulation –) and motivational strategies (motivational autonomy – including cognitive strategy use and self-regulation – and motivational beliefs – including self-efficacy and test anxiety –) were represented by two general sub-dimensions (see İlker et al., 2014; Kındap, 2011). Age and gender (dummy-coded, 0-males, 1-females) were included as control variables. Self-regulation skills ($r = .14, p = .02$) and motivational autonomy strategies ($r = .22, p < .001$) were positively associated with academic performance in the 2020–2021 academic year.

Primary analysis indicated that the relationship between motivational beliefs and 2020–2021 semester I academic achievement was not statistically significant (*Coefficient* = -1.219, $p = .107$). After removing the nonsignificant path, the data had an excellent fit to the mediation model: $\chi^2(3, n = 283) = 2.768$, $\chi^2/df < 2$, $p = .429$, GFI = .997, AGFI = .974, CFI = 1.000, NFI = .997, TLI = 1.000, RMSEA = .000 (see Figure 1). Age negatively correlated with academic achievement for 2019–2020: $\beta = -.36$, $SE = .62$, $t = -6.67$, $p < .001$. The gender correlated with motivational autonomy: $\beta = .15$, $SE = .07$, $t = 4.40$, $p < .001$.

Self-regulation positively predicts both motivational beliefs ($\beta = .75$, $SE = .04$, $t = 19.01$, $p < .001$) and motivational autonomy ($\beta = .80$, $SE = .03$, $t = 23.49$, $p < .001$). Motivational autonomy positively predicted GPA scores for Semester I 2019–2020 ($\beta = .15$, $SE = .81$, $t = 2.46$, $p = .01$) and Semester I 2020–2021 ($\beta = .20$, $SE = .77$, $t = 3.41$, $p < .001$). Motivational beliefs negatively predicted GPA scores for Semester I 2019–2020 ($\beta = -.10$, $SE = .55$, $t = -2.53$, $p = .011$

Figure 1

The Mediating Role of Motivational Strategies
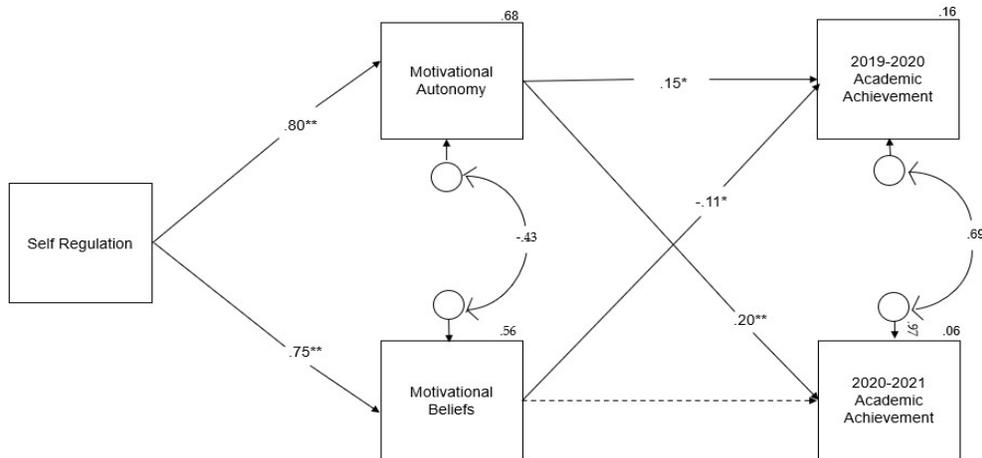
Note. The model controls for possible confounding effects of age and gender.

The effect of self-regulation on adolescents' achievement emerged through motivational strategies (see Table 3). The indirect effect of self-regulation on academic achievement in the 2020–2021 semester was calculated as .16 (*p* = .001, *BC* = .07–.26). The indirect effect of self-regulation on adolescents' academic achievement in the 2019–2020 semester was not significant (*p* = .454).

Table 3

Effect of self-regulation on adolescents' achievement emerged through motivational strategies

	Coefficient	*SE*	*BC*	*p*
Direct Effects				
Self-Regulation→Motivational Strategies	.750	.027	.692–.799	.001**
Self-Regulation→Motivational Autonomy	.798	.024	.748–.839	.001**
Motivational Beliefs→2019-2020 GPA	-.112	.046	-.202–.021	.019*
Motivational Autonomy→2019-2020 GPA	.146	.053	.045–.257	.011*
Motivational Autonomy→2020-2021 GPA	.202	.059	.085–.317	.001**
Indirect Effects				

Self-Regulation→Motivational Autonomy→2019–2020 GPA	.032	.042	-.054 - .112	.268
Self-Regulation→Motivational Autonomy→2020–2021 GPA	.161	.048	.067- .256	.001**

Note. $*p < .05$; $**p \leq .001$. GPA: Grade point average.

Direct and Indirect Effects

Self-regulation was correlated with increased use of motivational autonomy strategies, and increased use of motivational autonomy strategies was associated with increased academic achievement in 2020–2021. Controlling for age and gender, self-regulation, and motivational strategies explain 6% of the variance in academic achievement in 2020–2021 while explaining 16% of the variance in academic achievement in 2019–2020.

Discussion

Distance learning has become widespread today. There is a necessity for supportive frameworks that can mitigate the impact on adolescents' academic performance. The current study addressed the relationships between adolescents' academic self-regulation and academic performance, and the mediating role of motivational strategies during distance learning. We also assessed developmental stage, gender and SES variables, and participation rate effects.

Our results revealed academic achievement scores of middle adolescents in 2019–2020 were higher than those of late adolescents, aligning with prior evidence (e.g., Momanyi et al., 2015). In Turkey, 12th-grade students (i.e., late adolescents) would take the university exam. Thus, they may focus their priorities on matriculation leading to a decrease in their academic performance.

Girls have higher self-regulation and cognitive strategy usage scores than boys, consistent with previous studies (e.g., Liu et al., 2021; Kesici et al., 2009). Haron et al. (2010) reported that girls demonstrate higher levels of emotional self-regulation than boys, making them more proficient in skills such as structuring their environment before lessons, setting and focusing on goals, self-evaluation, motivation, and recognizing their needs. Girls may also surpass boys in structuring the learning environment, including active participation in the learning process within new educational contexts and building relationships with teachers' key skills for transitioning from face-to-face to online learning (Korlat et al., 2021). Supporting these findings, Du (2016) observed that boys were less inclined to structure their work environment compared to girls. Additionally, Liu et al. (2021) found that female students in distance education exhibited higher levels of self-evaluation, another critical component of self-regulation, than their male counterparts. During the COVID-19 lockdown, Korlat et al. (2021) highlighted that female students were more likely to establish strong relationships with teachers and access them more effectively important self-regulatory skills. Similarly, Alghamdi et al. (2020) concluded that female students tend to outperform male students in using cognitive strategies required for completing academic tasks and organizing their actions.

These self-regulatory actions, essential for achieving academic goals, reflect individuals' ability to align their cognitive skills with their learning objectives. In Turkey, societal expectations may contribute to these gender differences, as girls are often encouraged to pursue careers, maintain organization, and engage in self-regulatory routines such as cooking and planning. These daily roles may foster stronger self-regulatory abilities, enabling girls to focus more effectively on learning and adopt an effort-oriented approach. Likewise, Du (2016) suggested that in China, the greater responsibility women bear for housework may enhance their sense of responsibility and commitment, which extends to their engagement with online courses.

It was also found that the academic performance of both boys and girls whose mothers had completed university and above was higher than those whose mothers had completed primary, secondary, and high school. Awada and Shelleby (2021) found a positive relationship between educational level and academic achievement. As education levels increase, mothers are more likely to provide problem-solving, academic support, and guidance. The effect of SES was significant only for self-efficacy; high and low SES students have higher scores than middle SES students. A limited number of studies examining the relationship between SES and self-efficacy indicated a positive relationship between two variables (Tan et al., 2023). Students from high SES have the educational opportunities they may need, as well as quick access to technological materials needed for distance learning, which may have allowed them to see themselves as more self-efficacious. On the other hand, the self-efficacy of low SES students is higher than that of middle SES students. The limited opportunities available to middle SES students may have led them to exert more effort to succeed and increased their belief in their ability to sustain that effort.

Generally, a majority of students actively engage in distance education. Despite challenges within the distance education framework, students exhibit a commitment to their courses (Niemi & Kousa, 2020). Studies identified low participation as a drawback attributed to factors like lack of motivation and challenges in adjusting to abrupt distance learning transitions (Güney & Yalçın, 2023). The COVID-19 era, marked by uncertainty and anxiety, likely contributed to decreased participation (Çetinel & Gürcüoğlu, 2022). During the period of face-to-face education after the pandemic post-pandemic, student motivation improved, although those affected directly by COVID-19 or with afflicted family members displayed higher levels of demotivation (Karabulut, 2023). In two different semesters, the group that participated more in distance learning had higher academic achievement scores. It is important to note that distance learning in this context was a required component of the curriculum. However, the number of hours participated in varied among students due to individual circumstances, including technical difficulties and access to adequate devices (e.g., computers, tablets, phones). As previously mentioned, approximately 37.9% of students participated in distance learning for 11–20 hours per week, 34.1% for 21 hours or more, and 28% for less than 10 hours. These participation hours, though compulsory, were influenced by challenges that may have affected students' ability to consistently engage in the learning process. A study conducted in high school (Niemi & Kousa, 2020) revealed that participation in distance education is high and distance education is implemented very successfully, while a study conducted at a university (Kurnaz & Ergün, 2019) found that increased participation in distance education supports academic success.

Adolescents who participated in distance education (attending class online) for 21 hours or more per week exhibited higher scores in external, introjected, and identified subdimensions of self-regulation skills. While literature underscores the significance of self-regulation skills in distance education (Cho et al., 2021; Goulimaris, 2015; Rêka et al., 2015), research examining subdimensions based on the duration of distance education is lacking. Generally, adolescents with high self-regulation scores tend to participate more in distance education. However, a study highlighted deficiencies in self-regulation among high school students in distance education due to issues such as time management and environment (Arık et al., 2021). Although internal self-regulation scores were similar across groups, since internal self-regulation involves the internalization of knowledge, it may not have come to the forefront due to problems in the distance education system (e.g., technical problems). Salmela-Aro et al. (2022) in their study with university students stated that at the beginning of the pandemic, the role of distance education-related demands (e.g., technical difficulties, planning of daily programs) and resources (e.g., the ability to work in a digital environment and the support of teachers in distance education) was very important in study engagement (e.g., the student finding the study full of meaning and purpose, being willing and interested in learning). Problems such as technical difficulties related to distance education have reduced study participation. As a matter of fact, the researchers emphasized that finding solutions to the problems (e.g., technical problems) in the distance education system can increase engagement, self-regulation and academic performance. In addition, the researchers stated that identifying existing problems (e.g., technical problems) and finding solutions can increase engagement, self-regulation, and academic performance.

Adolescents engaging in 21 hours or more of weekly attendance showed higher scores in self-regulation, cognitive strategy, and self-efficacy sub-dimensions of motivational strategies. Previous emphasis on the role of self-regulation in distance learning is corroborated by increased cognitive engagement when psychological needs are fulfilled (Chiu, 2022). Geng (2022) reported that self-efficacy in distance learning is directly related to students' participation in distance learning. Generally, high participation correlates with increased use of motivational strategies, albeit with no significant difference observed between groups regarding intrinsic and anxiety subdimensions. Our study consistently found a similar outcome in the internal sub-dimension of self-regulation. Another study based on SDT found that students are not intrinsically motivated in distance learning (Hartnett et al., 2011). During the pandemic's rapid shift to distance learning, decisions like reducing students' subject responsibilities didn't impact anxiety levels between groups. However, systemic issues like technical problems were noted to detrimentally affect motivation (Arık et al., 2021). Addressing these issues can enhance both motivation and student participation.

Our study revealed a significant positive correlation between external and identified self-regulation and their academic achievement scores for 2020–2021. Self-regulation stands pivotal for effective distance learning, as weaker self-regulation places students at risk (Boshoff-Knoetze et al., 2023; Xu et al., 2023). This aligns with Goulimaris's (2015) findings that students who participated in distance education had highly identified regulation skills. Dickson (2018) underscored extrinsic motivation significance for academic success, elucidating our study's observed relationship between external regulation and academic achievement.

Conversely, studies emphasize fulfilling basic psychological needs (autonomy, relatedness, competence) for student success in distance education (Chiu, 2022; Salikhova et al., 2020). Intrinsically motivated students outperform their extrinsically motivated counterparts (Goulimaris, 2015; Rêka et al., 2015). However, our study diverged from this trend, indicating a significant positive correlation between adolescents' external and identified self-regulation and academic achievement, while there was a significant negative relationship between their intrinsic self-regulation and their average academic achievement scores for 2019–2020. The educational systems predominantly assess academic performance in specific subjects, rather than on the knowledge they have internalized about the subjects they are interested in. Intrinsic regulation operates in realms of enjoyment and curiosity, potentially diverging from curriculum mandates. Encouraging extrinsic motivation (e.g., rewards), and emphasizing rote learning may yield short-term successes but could falter in fostering sustainable knowledge internalization (Deci et al., 2001).

In a distance learning context, motivational strategies are crucial for fostering both engagement and academic attainment (Shih & Gamon, 2001). Our study identified a significant positive correlation between adolescents' utilization of motivational strategies and their academic achievement scores for 2020–2021. Cho et al. (2017) emphasize the pivotal role of these strategies in distance education. Research also suggests self-efficacy significantly influences active participation (Zapata-Cuervo et al., 2021), while motivation predicts satisfaction (Goulimaris, 2015).

Using motivational strategies and self-regulation skills in distance learning enhances the likelihood of achieving high achievement (Semmar, 2006). AlMahdawi et al. (2021) found a positive correlation between technology-related self-efficacy in distance education and overall achievement. High self-regulation correlates with increased motivation and cognitive performance, fostering course success in distance learning (Cho et al., 2017; Wang et al., 2013). Our findings align with studies indicating a positive relationship between academic success, motivation, and self-regulatory skills in distance education (Jiang et al., 2023; Koca & Dadandı, 2019). Adolescent learners' use of learning strategies and motivation appears pivotal in promoting strong academic performance.

The findings revealed a significant negative correlation between adolescents' test anxiety and their academic achievement scores across both semesters. This pattern may stem from heightened anxiety hindering the effective use of mental skills and study strategies. Irregular study patterns and low motivation contribute to elevated test anxiety, while motivation and positive thinking aid in maintaining lower anxiety for achieving success. Our result indicating adolescents exhibiting low test anxiety and high academic achievement, attributed to self-regulation and motivational strategy use, is consistent with existing literature (Koca & Dadandı, 2019; Steinmayr et al., 2016).

Adolescents' self-regulation skills were found to predict motivational strategies (i.e., motivational autonomy and beliefs) and motivational autonomy strategies positively and significantly predicted academic achievement in both the 2019–2020 and 2020–2021 academic years. The results are consistent with those of studies linking self-regulation to motivational strategies (Daniela, 2015; Virtanen et al., 2015) and cognitive strategy use and self-regulation

(aspects of motivational autonomy) to academic performance in various learning environments (Cho et al., 2015). Enhanced self-regulation fosters positive learning perceptions and motivation, thus promoting academic achievement through goal-directed behavior and reinforced learning with cognitive strategies.

Motivational beliefs (self-efficacy and test anxiety) were noted to negatively forecast academic achievement in face-to-face education, while a non-significant association was found with academic scores in distance education. Increased self-efficacy (Khan, 2023) and decreased test anxiety (Koca & Dadandı, 2019) typically correlate with academic success. However, the sudden shift to distance learning, technical problems, and uncertainties might have obscured the impact of students' motivational beliefs on academic performance. While the transition and exam uncertainties commonly induce anxiety, later decisions to limit exam subjects potentially mitigated anxiety.

A significant positive correlation was found between adolescents' self-regulation skills, motivational autonomy strategies, and academic achievement. Motivational autonomy strategies, encompassing cognitive strategy use and self-regulation skills, are pivotal in distance learning (Boshoff-Knoetze et al., 2023; Xu et al., 2023). Motivation aids in deploying cognitive strategies, thus fostering academic success (Patricia, 2020). Enhanced self-regulation correlates with increased motivation and better use of cognitive strategies, thereby enhancing academic performance (Cho et al., 2017). This finding underscores the mutually reinforcing nature of these skills, culminating in academic success in distance education.

Conversely, the absence of a significant relationship between self-regulation skills, motivational autonomy strategies, and academic achievement in face-to-face education may signify differences in educational paradigms. Traditional practices like homework assignments might have diverted focus from students' intrinsic interests, diminishing motivational resources. These dynamics within the face-to-face education system may have hindered the prominence of motivational autonomy strategies. Giving students a choice can contribute to the internalization process (Patall et al., 2008). Notably, our findings indicated higher academic achievement during the distance education period compared to face-to-face education. The reduced workload and assignment responsibilities in distance education likely bolstered students' academic performance.

Limitations and Future Research

This study focuses on perspectives from students in grades 1–4 of public high schools in Ankara, Turkey, during the first semesters of the 2019–2020 and 2020–2021 academic years. To ensure broader applicability, it is essential to examine whether these findings hold across diverse (cultural) contexts. While our study underscored the significance of researching adolescents' motivation and self-regulation, it primarily explored quantitative aspects and lacked focus on relational dimensions within the context of the basic needs of SDT (i.e., relatedness). Future research can explore environmental influences (e.g., autonomy support) to identify factors in adolescents' academic achievement in distance education.

These findings offer guidance for professionals involved in developing distance education systems, emphasizing the importance of addressing participation issues and seeking student

feedback. Implementing strategies like goal-setting, behavior management, study planning, and self-assessment can enhance student achievement. Additionally, organizing seminars for adolescents on motivation and self-regulation, as well as educating parents on supporting these skills, can further promote academic success.

Declarations

Statement Regarding Informed Consent

Informed consent was obtained from all individual participants and their parents included in the study.

Statement Regarding Ethical Approval

The study data were collected in a manner consistent with ethical standards. We obtained approval from Ethics Commission Board of Hacettepe University (Ethics approval number: E-68552689-300-00001397740) and Ministry of National Education (Ethics approval number: 00001503836). Informed consent forms were also obtained from the parents and the children.

Statement Regarding Research Involving Human Participants and/or Animals

Ethics committee permission was obtained.

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Author's Contribution

Both authors contributed to the concept and design of the study. Dr. Gür conceived of the study, designed and coordinated the study, conducted the literature search, drafted the manuscript, collected the data and wrote the interpretation of the data and discussion. Dr. Yaban helped in drafting the manuscript, critically revised it for important intellectual content, and performed the statistical analysis of the study.

Competing Interests

The authors declare that there is no conflict of interest.

Availability of Data and Materials

Data is not open to sharing for ethical reasons.

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