Social Psychology of Education (2025) 28:163
https://doi.org/10.1007/s11218-025-10127-4

Students' self-regulation of homework behavior: do autonomy support and effort matter?

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Received: 25 February 2025 / Accepted: 11 August 2025 / Published online: 25 August 2025

Abstract

Drawn from expectancy-value, self-regulated learning, self-determination, and growth mindset theories, our investigation explored multilevel models of homework management among middle school students in Türkiye. At the student level, homework management was positively related to homework interest, homework effort, self-regulatory purpose, parent autonomy support, teacher feedback, homework expectancy, and homework time. Furthermore, males were less likely than females to manage homework. At the class level, homework management was linked positively to homework interest but negatively to homework quality. Notably, our investigation expands the existing literature by showing that homework management was positively related to homework effort and parent autonomy support, but not to teacher autonomy support. Implications of these results are considered in relation to future studies and homework practices.

Keywords Autonomy support · Effort · Homework management · Self-regulation · Middle school

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1 Introduction

Homework – tasks given by teachers for completion outside of school hours – is a long-standing educational practice with a global presence and a significant part of students' daily routine (Bas et al., 2017; Cooper, 1989; Fernández-Alonso et al., 2015; Núñez et al., 2015; Tas et al., 2016; Wang et al., 2025; Wu et al., 2024). Because homework often occurs amidst various enticing activities outside of regular school hours in less structured and supervised settings than classroom learning (Wolters, 2011; Xu et al., 2020; Yang et al., 2016), many students face significant challenges in homework management – self-regulatory demands associated with organizing the homework space, managing time, minimizing distractions, sustaining motivation, and regulating emotions (Avcı & Özgenel, 2025; Frăsineanu, 2023; Oubrayrie-Roussel & Safont-Mottay, 2011; Rahman & Khairani, 2025; Yang & Tu, 2020).

Grounded in self-regulated learning theory (Boekaerts & Corno, 2005; Zimmerman, 2005) and expectancy-value theory (Eccles & Wigfield, 2020; Wigfield et al., 2004), prior studies have associated homework management with various variables, such as background factors (e.g., parent education and gender), homework expectancy, value, and interest, and teacher and parental involvement (Avcı & Özgenel, 2025; Deslandes et al., 2008; Xu et al., 2017a; Xu & Wu, 2013; Yang & Tu, 2020). Yet, this line of research has neglected other theoretically relevant constructs, including autonomy support and effort, as framed by self-determination theory (Ryan & Deci, 2020) and growth mindset theory (Dweck & Yeager, 2019). Given the growing recognition of these constructs' relevance to self-regulation and homework management (Dumont et al., 2014; Feng et al., 2019; Katz et al., 2011; Xu, 2025a; Zhao et al., 2022), incorporating them is imperative.

Our study aims to bridge this gap by investigating the relations between homework management and these variables, while taking into account other theoretically important variables identified in previous studies. This investigation is particularly pertinent to middle-school mathematics homework, a core academic domain with consistently high homework demands that students frequently find especially difficult and time-intensive (Asri et al., 2017; Gao et al., 2025; Kitsantas et al., 2011; Xu, 2015). At this stage, students face growing challenges as the curriculum becomes more abstract (Dettmers et al., 2011), whereas both autonomy support and self-regulation tend to decline – despite students' growing expectations for greater autonomy support rather than less (Eccles, 1993; Gillet et al., 2012; Katz et al., 2009; Martinek et al., 2016).

1.1 Theoretical frameworks

A central framework that directly inform our current investigation is self-regulated learning, which Zimmerman (2005, p. 140) described as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals". This process involves the proactive setting of goals, application of targeted strategies, ongoing progress tracking, and evaluating outcomes (Zimmerman & Moylan, 2009).

Often embedded in the framework of self-regulation – specifically during task performance – volitional control denotes the level to which individuals willfully pursue and implement a goal despite encountering various obstacles (Boekaerts & Corno, 2005; Corno, 2004). It focuses on the challenges of implementation that emerge once a specific goal is set, protecting the intention to achieve it from temptations, setbacks, distractions, and competing demands. Conceptualized as deliberate goal striving, it serves as a safeguard, helping individuals stay on track, and maintain focus for successful completion, by managing time, restructuring workspace, resisting distractions, regulating emotions, and sustaining motivation (Corno, 2011).

Homework has traditionally been regarded as "a classic form of self-regulated learning" (Cadime et al., 2017; Ramdass & Zimmerman, 2011; Trautwein & Köller, 2003; Williams & Williams, 2021). Volitional control is crucial in the self-regulation of homework behavior – specifically, homework management – since homework goals are typically teacher-assigned (Corno, 2011). Compared to classwork, managing homework poses unique self-regulatory challenges, including the allure of more tempting activities, reduced structure, and less adult supervision during afterschool hours (Corno, 2011; Xu et al., 2020; Yang & Tu, 2020). Successfully managing homework requires students to navigate these obstacles by organizing their study spaces, managing their time, overcoming distractions, enhancing or sustaining motivation, and monitoring emotional responses to homework (Corno, 2004; Ramdass & Zimmerman, 2011; Xu & Corno, 2003; Yang & Tu, 2020).

From the viewpoint of expectancy-value theory (Eccles & Wigfield, 2020; Wigfield et al., 2004), individuals are more inclined to employ self-regulatory strategies when they believe they can achieve success and perceive the activity to be valuable and interesting (Pintrich & Zusho, 2002; Schunk, 2005). Thus, homework management could be shaped by students' homework expectancy, value, and interest (Xu et al., 2017a; Xu & Wu, 2013).

Self-regulation posits that individuals' self-regulatory behavior could be shaped by individual characteristics, developmental stages, and sociocultural contexts (Pintrich, 2004; Wolters, 2011). Hence, homework management could be affected by personal factors (e.g., gender) and support, guidance or oversight from important others, such as teachers and parents (Deslandes et al., 2008; Xu, 2025b; Xu et al., 2017a).

1.2 Previous studies pertaining to homework management

Previous research has connected homework management to homework completionn (Xu, 2011; Xu et al., 2017a) and academic achievement (Xu & Corno, 2022a; Yang & Tu, 2020). Involving 1,895 US students in Grades 8 and 11, Xu (2011) found that homework management was positively linked to homework completion. Similarly, involving 305 Chinese students in Grades 7–9, Yang and Tu (2020) reported that, compared to low-achieving students, high-achieving students were more inclined to manage homework – arranging the workspace, managing time, handling distraction, monitoring motivation, and controlling negative emotion.

Other studies suggest that a number of variables may affect homework management, such as background characteristics (parent education, gender, and prior achievement; Xu, 2006, 2007; Xu et al., 2017a; Yang & Tu, 2020), homework char-

acteristics (homework time and frequency; Avcı & Akıncı, 2025; Avcı & Özgenel, 2024a; Xu, 2024a), teacher and parental involvement (feedback and assistance; Deslandes et al., 2008; Xu, 2007; Xu & Corno, 2003; Xu et al., 2017a; Xu & Wu, 2013), homework motivation (expectancy, value, and interest; Xu, 2007; Xu & Wu, 2013; Xu et al., 2017a), and homework purpose (Xu, 2007; Xu et al., 2017a; Xu & Wu, 2013). Involving 194 US students in Grades 5–6, Xu (2007) found that females and students receiving family assistance were more inclined to manage homework. Additionally, homework management positively correlated with homework interest and homework purpose (for reinforcing academic learning and developing self-regulatory habits). Based on the data from 1611 US students in Grades 8 and 11, Xu and Wu (2013) reported that homework management was positively associated with prior knowledge, teacher feedback, family assistance, and homework interest and purpose.

Whereas the above studies took a domain-general approach to homework management (i.e., across different subjects), a subsequent study by Xu et al. (2017a) took a domain-specific approach to homework management, focusing on mathematics homework management. Involving 796 Chinese students in Grade 8, Xu et al. reported that students' management of mathematics homework was positively associated with parent education, teacher feedback, homework expectancy, value, interest, and purpose.

1.3 Autonomy support and effort

Self-determination theory postulates that three fundamental psychological needs – autonomy, competence, and relatedness – are crucial for fostering individuals' motivation and well-being (Deci & Ryan, 2008; Ryan & Deci, 2020). Competence involves the need to feel effective and capable in one's actions, whereas relatedness refers to the desire to feel connected and valued by important others. Both needs play important roles in influencing individuals' overall academic engagement and emotional well-being. Nonetheless, the present study centered specifically on autonomy, as it serves a primary driver in fostering individuals' innate propensities for personal growth, self-development, and well-being. Autonomy is characterized by a sense of ownership, willingness, and psychological freedom that resonates with individuals' goals, values, and interests. Its development is inherently social, influenced by environmental influences, particularly by socializing agents like teachers and parents. Autonomy support, as applied in educational context, reflects the degree to which teachers and parents acknowledge, understand, and respond to students' viewpoints, provide opportunities for ownership and self-initiative in academic tasks, and encourage self-directed learning and active engagement (Deci & Ryan, 2008; Feng et al., 2019; Ryan et al., 2016). We centered on autonomy support in the current investigation not only due to its theoretical importance but also because of its practical relevance in homework settings, where students frequently face external imposed tasks. In such contexts, students' capacity to manage homework is closely linked to their sense of perceived autonomy (Feng et al., 2019; Fernández-Alonso et al., 2022; Patall et al., 2008).

Autonomy support is essential, as it plays a key role in promoting students' intrinsic motivation, self-efficacy, engagement, effort, self-regulation, persistence, and

academic performance (Bureau et al., 2022; Núñez & León, 2019; Ryan & Deci, 2020; Yang et al., 2025). This is further substantiated by prior homework studies, which reported a positive zero-order relationship between homework management and teacher autonomy support (Xu, 2016), as well as between homework management and parent autonomy support (Xu et al., 2017b).

Self-determination theory further posits when students view their effort as self-determined, it enhances autonomous motivation, which fosters a stronger sense of ownership and greater use of self-regulatory strategies (Jeno & Diseth, 2014; Ryan & Deci, 2020; Vansteenkiste et al., 2012). When students invest effort in tasks that align with their values and interests, they are more likely to engage self-regulation. Similarly, growth mindset theory postulates that students tend to persevere through challenges, obstacles, and setbacks when they believe their ability could be developed or improved through effort (Dweck, 2006; Dweck & Yeager, 2019). This approach to effort serves to mobilize and fuel students' self-regulatory behavior by instilling a sense of agency in their learning and encouraging them to embrace challenges as opportunities for improvement and growth (Blackwell et al., 2007; Dweck & Yeager, 2019; Yeager et al., 2019). Consequently, students are more inclined to set goals, monitor their progress, sustain motivation, and regulate their emotional responses when encountered with obstacles and setbacks.

Taken together, self-determination and growth mindset theories point to the crucial role of autonomy support and homework effort in fostering homework management. In addition, effort invested in homework has been positively associated with students' homework expectancy, interest, and student performance (Xu, 2018; Xu & Corno, 2022b). As students gain confidence and develop greater interest in their homework, they are more likely to take initiative in managing it.

1.4 The current study

Guided by self-regulated learning and expectancy-value theories (Boekaerts & Corno, 2005; Eccles & Wigfield, 2002,2020; Ramdass & Zimmerman, 2011), previous studies have linked homework management to various variables (e.g., Avcı & Özgenel, 2025; Deslandes et al., 2008; Xu et al., 2017a; Xu & Wu, 2013; Yang & Tu, 2020). They include background characteristics, teacher and parental involvement, homework expectancy, value, interest, and purpose. Yet, these studies have not examined the predictive effects of teacher autonomy support, parent autonomy support, and homework effort on homework management. Thus, it is important to fill this gap in our current study.

Our central research question explores the extent to which homework management is associated with teacher autonomy support, parent autonomy support, and homework effort, after accounting for a range of variables identified in prior studies (Fig. 1). Grounded in self-determination theory (Deci & Ryan, 2008; Ryan & Deci, 2020) and previous studies (Xu, 2016; Xu et al., 2017b), we expected homework management to be positively related to teacher and parent autonomy support. Drawn from growth mindset theory (Dweck, 2006; Dweck & Yeager, 2019) and related homework studies (Xu, 2018, 2024c), we further expected a positive relation between students' homework effort and homework management.

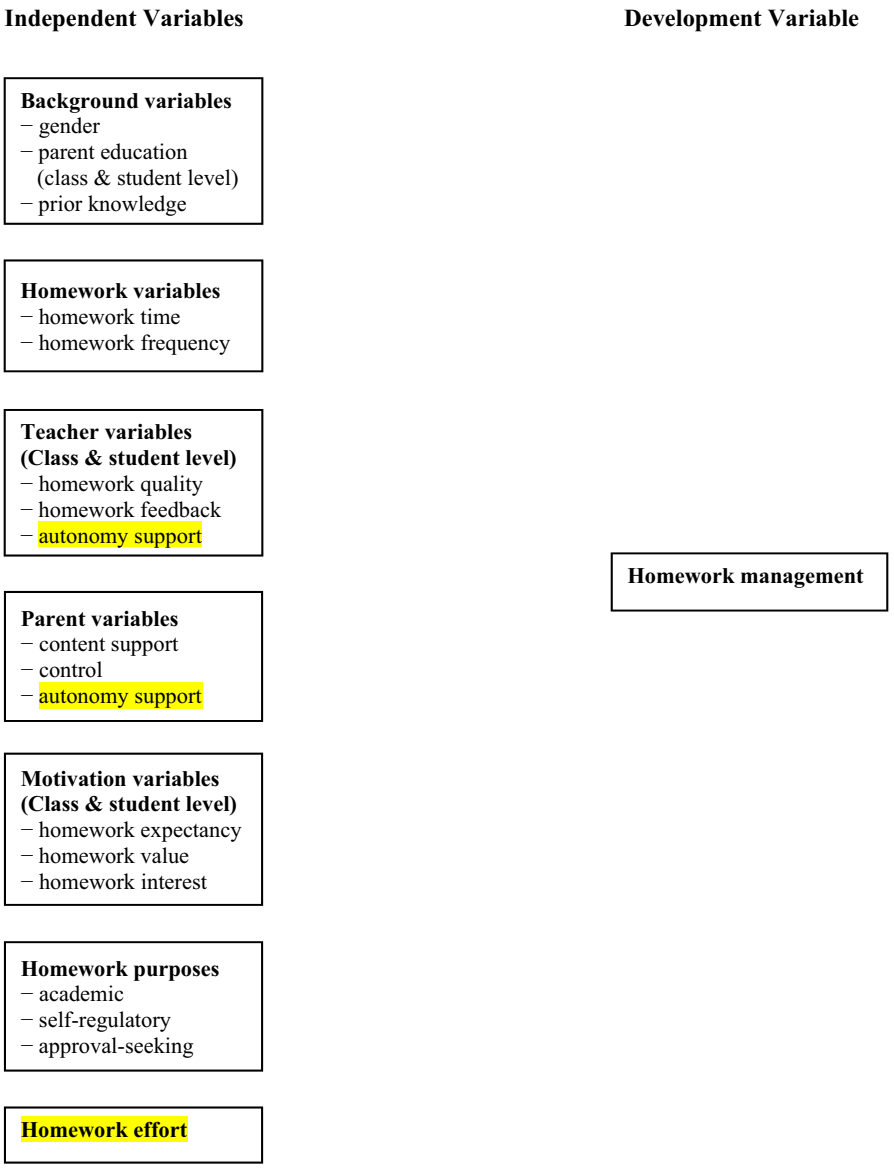

Fig. 1 Conceptual framework. Highlighted elements represent newly added variables; grade level is also modeled at the class level

2 Materials and methods

2.1 Participants and procedure

The present study included 1,426 students from Grades 5 to 8 in Türkiye, with 53.1% of the participants being female, drawn from 74 classes in the southwest region of

the country. To reflect a diverse socioeconomic representation, participants were drawn from ten regular public schools that approved participation in the study. The sample size was guided by guidelines recommending a minimum of 50 groups, each comprising approximately 20 individuals (Maas & Hox, 2005; Raudenbush & Bryk, 2002). Grades 5 through 8 were chosen to capture the full range of middle school levels in Türkiye, reflecting its typical four-year duration.

The participants had on a mean age of 12.0 years (±1.1). Fathers had an average of 9.4 years (±4.1) of education, whereas mothers averaged 8.4 years (±4.2). This is similar to the national average educational attainment of 9.3 years of schooling reported for Turkish working-age adults (Türkiye İstatistik Kurumu, 2024).

In line with standard educational practices in Türkiye, participants attended 6 h of mathematics classes per week in Grades 5 and 6, and 5 h per week in Grades 7 and 8, with each session being 40 min long. Although parental support is expected, the choice to assist with homework or provide an appropriate environment is entirely at the parents' discretion. On average, participants spent 84 min (±58) on mathematics homework each week, which was in line with previous research on homework practices in Türkiye (Avcı & Özgenel, 2025).

With institutional review board approval (No: 2024/4), parental consent and student assent were obtained. To reduce potential response bias, students completed the measures during regular school sessions after teachers had left the classrooms. The response rate was 99.4%.

2.2 Instrumentation

2.2.1 Independent variables

Students reported the highest level of education attained by their parents, varying from "no schooling" to "doctoral degree." Because of the strong association between paternal and maternal education levels ($r = .88$, $p < .001$), a composite variable labeled "parent education" was created by averaging the years of education of both parents. To account for students' prior knowledge, we used their standardized mathematics test scores obtained five months earlier.

To measure frequency of homework assigned, students were asked, "How often does your mathematics teacher assign homework?" Response options ranged from "does not give homework" (1) to "more than 2 per week" (6). To assess weekly time spent on mathematics homework, students answered two questions: one on the time spent on mathematics homework from Monday to Friday and another on weekends. Responses included: "0–15 minutes" (1), "15–30 minutes" (2), "30–60 minutes" (3), "60–90 minutes" (4), "90–120 minutes" (5), and "more than two hours" (6). One composited variable, "homework time," was developed by converting responses to their midpoints (e.g., 1 = 7.5; Xu et al., 2014) and summing the values from both items.

We used multiple scales, detailed with sample items and reliability estimates in Table 1, the majority of which have been previously validated in studies conducted in China and Türkiye (Avcı & Özgenel, 2024a, 2024b; Sun et al., 2020a, 2020b; Xu,

Table 1 Items and reliability coefficients

Scales	Sample Items	α	ω
Homework quality[a]	"Our mathematics teacher knows what homework to give us so that we understand the material covered in the lesson" "Our math homework assignments really help us to understand our math lessons."	0.84	0.84
Teacher feedback[a]	"The feedback I receive from my math teacher helps me do my work." "My mathematics teacher consistently provides me useful information about my homework performance."	0.84	0.84
Teacher autonomy support[a]	"My mathematics teacher encourages me to ask questions about homework assignments." "My mathematics teacher listens to my ideas about homework assignments."	0.87	0.87
Parent content support[b]	"My parents often ask how they can help me with my mathematics homework." "My parents always help me if I get stuck with my mathematics homework."	0.88	0.88
Parent autonomy support[b]	"My parents listen to how I would like to do mathematics homework assignments." "My parents convey confidence in my ability to do with mathematics homework assignments."	0.84	0.84
Parent control[b]	"My parents keep track of whether I complete my mathematics homework." "My parents check that I have done my mathematics homework before I participate in outdoor activities (e.g. soccer, volleyball, swimming, sightseeing)."	0.72	0.73
Homework expectancy[b]	"If I don't understand something in mathematics, I often think I'll never understand it."[c] "Whether or not I do my mathematics homework, I don't understand a thing in the lesson anyway."[c]	0.79	0.79
Homework value[b]	"I don't learn much from our mathematics homework."[c] "It makes barely any difference to me whether I do my mathematics homework or not."[c]	0.82	0.82
Homework interest[d]	"I look forward to mathematics homework." "I enjoy mathematics homework."	0.92	0.92
Academic purpose[b]	"Doing mathematics homework helps me understand what is going on in class." "Doing mathematics homework helps me prepare for the next class."	0.85	0.85
Self-regulatory purpose[b]	"Doing mathematics homework helps me learn to work independently." "Doing mathematics homework helps develop good discipline."	0.80	0.80
Approval-seeking purpose[b]	"Doing mathematics homework brings me teacher approval." "Doing mathematics homework brings me family approval."	0.69	0.69
Homework effort[b]	"I do my best in mathematics homework." "Lately I work on my mathematics homework as good as I can."	0.84	0.84
Homework management[a]	"Find a quiet area." "Keep track of what remains to be done." "Reassure myself that I am able to do mathematics homework when it is hard." "Tell myself not to be bothered with previous mistakes."	0.87	0.87

[a]Never (1), Rarely (2), Sometimes (3), Most of the time (4), Always (5)

[b]Strongly disagree (1), Disagree (2), Agree (3), Strongly agree (4)

[c]Reverse-scored

[d]Strongly disagree (1), Disagree (2), Neither disagree nor agree (3), Agree (4), Strongly agree (5)

2016; Xu et al., 2017b; Yang & Xu, 2018). A summary of their psychometric properties is included below for readers' convenience.

2.2.1.1 Homework quality Four items measured students' perceptions of how well mathematics assignments are prepared, designed, and integrated into classroom instruction ($\alpha = 0.84$; $\omega = 0.84$; Xu, 2016). The reliability coefficients were comparable with those reported in previous research among middle school students in China and Türkiye (Avcı & Özgenel, 2024a; Xu, 2016; Xu et al., 2021; $0.83 \leq \alpha \leq 0.88$).

2.2.1.2 Teacher feedback Four items assessed students' perceptions on the quality of teacher feedback on mathematics homework, particularly evaluating the helpfulness of teachers' feedback on mathematics assignments (Xu, 2016; $\alpha = 0.84$; $\omega = 0.84$). The reliability coefficients mirrored prior validation studies among Chinese and Turkish middle school students (Avcı & Özgenel, 2024a; Xu, 2016; $0.85 \leq \alpha \leq 0.89$).

2.2.1.3 Teacher autonomy support Comprising four items (Xu, 2016), the measure the extent to which teachers recognized students' ideas on tackling mathematics assignments and promoted their independent engagement ($\alpha = 0.87$; $\omega = 0.87$). The reliability coefficients mirrored previous validation research conducted with Chinese and Turkish middle school students (Avcı & Özgenel, 2024a; Xu, 2016; $0.85 \leq \alpha \leq 0.86$).

2.2.1.4 Parent content support Four items evaluated the degree to which parents offered direct assistance with mathematics assignments when the child encountered difficulties completing them (Xu et al., 2017b; $\alpha = 0.88$; $\omega = 0.88$). The reliability coefficients mirrored prior validation research involving Chinese and Turkish middle school students (Avcı & Özgenel, 2024a; Xu et al., 2017b; $0.86 \leq \alpha \leq 0.88$).

2.2.1.5 Parent autonomy support It included four items (Xu et al., 2017b) that measured students' perceptions of parental effort to facilitate independent completion of mathematics assignments such as considering their views and encouraging their initiative ($\alpha = 0.84$; $\omega = 0.84$). The reliability estimates mirrored prior validation research involving Chinese and Turkish middle school students (Avcı & Özgenel, 2024a; Xu et al., 2017b; $0.81 \leq \alpha \leq 0.91$).

2.2.1.6 Parent control It comprised four items (Avcı & Özgenel, 2024a) that assessed students' perceptions of parental involvement in homework, focusing on aspects such as pressure, monitoring, intrusiveness, and dominance ($\alpha = 0.72$; $\omega = 0.73$; Dumont et

al., 2014; Silinskas & Kikas, 2019). The reliability estimates mirrored a prior validation study among Turkish middle school students (Avcı & Özgenel, 2024a; $\alpha = 0.75$).

2.2.1.7 Homework expectancy It consisted of four items (Avcı & Özgenel, 2024b; Xu, 2017; Yang & Xu, 2018) measuring students' expectancy beliefs regarding mathematics homework (e.g., confidence in completing homework successfully; $\alpha = 0.79$; $\omega = 0.79$). The reliability estimates mirrored prior validation studies with Chinese and Turkish secondary school students (Avcı & Özgenel, 2024b; Xu, 2017; Yang & Xu, 2018; $0.79 \leq \alpha \leq 0.84$).

2.2.1.8 Homework value It consisted of four items (Avcı & Özgenel, 2024b; Xu, 2017; Yang & Xu, 2018) assessing students' value beliefs about mathematics homework (e.g., perceived usefulness in completing mathematics assignments; $\alpha = 0.82$; $\omega = 0.82$). The reliability estimates mirrored previous validation studies with secondary school students in China and Türkiye (Avcı & Özgenel, 2024b; Xu, 2017; Yang & Xu, 2018; $0.82 \leq \alpha \leq 0.86$).

2.2.1.9 Homework interest It included five items (Avcı & Özgenel, 2024b; Xu et al., 2016) measuring the degree to which students enjoyed and looked forward to mathematics homework ($\alpha = 0.94$; $\omega = 0.94$). The reliability coefficients were consistent with findings from prior validation studies conducted with Chinese and Turkish secondary school students (Avcı & Özgenel, 2024b; Xu et al., 2016; $0.92 \leq \alpha \leq 0.94$).

2.2.1.10 Academic purpose It contained four items (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b) assessing students' perceptions of homework as a means to reinforce mathematics learning (e.g., to better comprehend the content of mathematics classes; $\alpha = 0.85$; $\omega = 0.85$). The reliability values were slightly higher than prior validation research involving Chinese and Turkish secondary school students (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b; $0.71 \leq \alpha \leq 0.78$).

2.2.1.11 Self-regulatory purpose It included three items (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b) measuring students' perceptions of homework as a tool for cultivating desirable study habits (e.g., to learn to work independently; $\alpha = 0.80$; $\omega = 0.80$). The reliability values mirrored prior validation research with Chinese and Turkish secondary school students (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b; $0.76 \leq \alpha \leq 0.87$).

2.2.1.12 Approval-seeking purpose It contained three items (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b) assessing students' perceptions of homework as a way to gain approval from family, teachers, and peers ($\alpha = 0.69$; $\omega = 0.69$). The reli-

ability values, while somewhat lower than previous studies with Chinese and Turkish secondary school students (Avcı & Özgenel, 2024b; Sun et al., 2020a, 2020b; $0.78 \leq \alpha \leq 0.90$), were deemed acceptable for research purpose.

2.2.1.13 Homework effort It comprised four items (Avcı & Özgenel, 2024a; Xu, 2023, 2024a) aimed at measuring the degree of students' diligently engagement with mathematics assignments ($\alpha = 0.84$; $\omega = 0.84$). The reliability estimates mirrored previous research with Chinese and Turkish middle school students (Avcı & Özgenel, 2024a; Xu, 2023, 2024a; $0.77 \leq \alpha \leq 0.85$).

2.2.2 Dependent variable

2.2.2.1 Homework management This scale comprised 22 items ($\alpha = 0.87$; $\omega = 0.87$) as included a pervious study with Chinese middle school students (Xu et al., 2017a). It tapped into arranging the environment, managing time, monitoring motivation, coping with emotions, and handling distractions. These items were initially developed based on qualitative approach involving elementary and middle school students in the US (e.g., open-ended interviews and videotaped observations; Xu & Corno, 1998; Xu & Yuan, 2003). The reliability coefficients were congruent with the results from prior studies involving both US and Chinese students (Xu et al., 2017a; Xu & Wu, 2013; $0.84 \leq \alpha \leq 0.88$). Aligned with validity evidence from previous research (Xu, 2011; Xu & Corno, 2022a; Xu et al., 2017a; Yang & Tu, 2020), our study found that homework management was positively related to homework completion ($r = .48$, $p < .001$) and mathematics achievement ($r = .38$, $p < .001$).

2.3 Data analysis

To address the hierarchical nature of the data, we employed multilevel modeling as proposed by Raudenbush and Bryk (2002). Continuous variables were standardized, making regression weights comparable to standardized coefficients from traditional multiple regression (Trautwein et al., 2006). All analyses were performed in HLM 8.2 applying full maximum likelihood estimation.

As displayed in Table 3, Model 1 included fifteen individual-level variables and seven class-level variables. In particular, individual-level variables were gender, parent education, prior knowledge, homework frequency, time, quality, teacher feedback, parent content support, parent control, homework expectancy, value, interest, academic, self-regulatory, and approval-seeking purpose. Class-level variables were grade level, parent education, homework quality, teacher feedback, homework expectancy, homework value, and homework interest. The rationale for incorporating these variables at the class level is that students' use of self-regulatory strategies in homework is likely to be shaped by socioeconomic, academic, motivational, and social contexts – such as shared norms, expectations, and classroom homework practices (Corno & Mandinach, 2004; Xu et al., 2017a; Xu & Wu, 2013).

Table 3 Multilevel results for homework management

Model predictor	Null model		Model 1		Model 2	
	b	SE	b	SE	b	SE
Student level						
Gender (female = 0; male = 1)			− 0.22***	0.04	− 0.17***	0.04
Parent education			0.02	0.02	0.01	0.02
Prior mathematics knowledge			0.06*	0.03	0.03	0.03
Homework frequency			− 0.01	0.02	− 0.01	0.02
Homework time			0.06**	0.02	0.05*	0.02
Homework quality			0.06	0.03	0.05	0.03
Teacher feedback			0.11**	0.03	0.10**	0.04
Parent content support			0.12***	0.02	0.05	0.03
Parent control			0.08**	0.02	0.05	0.03
Homework expectancy			0.07*	0.03	0.07**	0.03
Homework value			0.06	0.03	0.05	0.03
Homework interest			0.26***	0.03	0.23***	0.03
Academic purpose			0.05	0.03	0.02	0.03
Self-regulatory purpose			0.15***	0.03	0.14***	0.03
Approval-seeking purpose			0.04	0.03	0.03	0.04
Teacher autonomy support					− 0.04	0.03
Parent autonomy support					0.11***	0.03
Homework effort					0.17***	0.03
Class level						
Grade (5–6 = 0; 7–8 = 1)			0.07	0.06	0.08	0.06
Parent education			0.01	0.06	0.00	0.06
Homework quality			− 0.25*	0.10	− 0.23*	0.10
Teacher feedback			0.21*	0.10	0.17	0.15
Homework expectancy			0.22	0.15	0.24	0.14
Homework value			0.05	0.13	0.03	0.13
Homework interest			0.34***	0.07	0.31***	0.07
Teacher autonomy support					0.02	0.12
Residual (σ^2)	0.891 (0.034)		0.466 (0.018)		0.442 (0.017)	
Intercept (τ_{00})	0.117 (0.028)		0.016 (0.007)		0.012 (0.006)	
Explained variance						
Within classes			47.7%		50.3%	
Between classes			86.2%		90.0%	
Total			52.2%		54.9%	
Deviance statistics (parameters)	3970.960 (3)		2993.125 (25)		2913.741 (29)	

*$p < .05$. **$p < .01$. ***$p < .001$

To test the predictive influences of autonomy support and homework effort, Model 2 further incorporate three variables at the student level (teacher autonomy support, parent autonomy support, and homework effort) and one variable at the class level (teacher autonomy support). Model 1 and Model 2 were random-intercept models (Raudenbush & Bryk, 2002), as no priori hypotheses were made concerning the variability in the predictive power of individual-level predictors across classes.

Following the approach outlined by Graupensperger et al. (2019) to disentangle individual and compositional effects, we group-mean centered parent education,

homework quality, teacher feedback, teacher autonomy support, homework expectancy, value, and interest at the student level, while grand-mean centering these variables at the class level. Missing values (1.8%) were imputed applying the expectation-maximization algorithm in SPSS 29, prior to analysis in HLM 8.2.

3 Results

3.1 Preliminary analyses

Whereas individual Likert items are ordinal in nature, combining several items through summing or averaging can allow for treatment as interval-level data (Carifio & Perla, 2008). Parametric statistical techniques remain robust to moderate departure from normality (Norman, 2010). In multilevel analyzes, results are expected to remain stable provided that distributions are approximately normal (Raudenbush & Bryk, 2002). In our investigation, skewness and kurtosis values for the Likert-type scales fell between −1 and +1, with three minor exceptions: the skewness value for homework quality was −1.02, and kurtosis values for teacher autonomy support and homework interest were −1.08 and −1.12, respectively.

Table 2 includes descriptive statistics for all variables. Homework management was significantly related to all predictors.

We examined multicollinearity using the Variance Inflation Factor (VIF). All VIF values were under 5, with the highest being 3.37, indicating no substantial multicollinearity concerns (Shrestha, 2020).

3.2 Multilevel analyses

The full unconditional model revealed that 11.7% of the variance in homework management was related to the class level, while 88.3% was related to the individual level. Tests for homogeneity of Level 1 variance showed that the fully unconditional model ($\chi^2 = 91.813$, $df = 73$, $p = .067$), Model 1 ($\chi^2 = 90.552$, $df = 73$, $p = .080$), and Model 2 ($\chi^2 = 80.728$, $df = 73$, $p = .250$) were not significant. In addition, histograms and Q-Q plot revealed that the Level 1 residuals followed a normal distribution.

As displayed in Table 3, Model 1 included 15 variables at the individual level and seven variables at the class level. We conducted a likelihood ratio test to compare Model 1 with the fully conditional model, revealing that Model 1 was significantly superior to the fully conditional model [$\chi^2(22) = 977.835$, $p < .001$]. Model 1 accounted for 47.7% of the individual-level variance in homework management, 86.2% of the class-level variance, and 52.2% of the total variance.

To test the predictive influences of autonomy support and homework effort, Model 2 introduced three variables at the student level (teacher autonomy support, parent autonomy support, and homework effort) and one variable at the class level (teacher autonomy support). The likelihood ratio test indicated that Model 2 was significantly better than Model 1 [$\chi^2(4) = 79.384$, $p < .001$], explaining an extra 2.5% of the total variance.

Model 2 accounted for 50.3% of the variance at the student level, 90.0% at the class level, and 54.9% of the total variance in students' management of homework. At the student level, homework management was positively related to homework interest ($b=0.23$, $p<.001$), homework effort ($b=0.17$, $p<.001$), self-regulatory purpose ($b=0.14$, $p<.001$), parent autonomy support ($b=0.11$, $p<.001$), teacher feedback ($b=0.10$, $p=.004$), homework expectancy ($b=0.07$, $p=.009$), and homework time ($b=0.05$, $p=.012$). In addition, males were less likely than females to manage homework ($b=-0.17$, $p<.001$). At the class level, homework management was related positively to homework interest ($b=0.31$, $p<.001$) and negatively to homework quality ($b=-0.23$, $p=.024$).

4 Discussion

Grounded in multiple theories and prior homework studies, the current investigation explored multilevel models of homework management. A key contribution lies in its explicit focus on autonomy support and homework effort – factors that have largely been neglected in recent studies. In the following section, we first examined predictor variables identified in previous research, followed by a discussion of our results regarding autonomy support and homework effort.

4.1 Predictor variables in previous studies

Our findings that homework management was positively related to homework interest, homework expectancy, and teacher feedback align with self-regulation and expectancy-value theories (e.g., interest and confidence leading students to apply adaptive self-regulatory strategies; Eccles & Wigfield, 2020; Schunk, 2005; Zimmerman, 2005). These findings also align with previous findings on middle and high school students in the U.S. (Xu, 2007; Xu & Wu, 2013) and middle school students in China (Xu et al., 2017a). Notably, whereas the U.S. studies took a domain-general approach to homework management, examining homework management across subjects, both our study on Turkish middle school students and the Chinese study (Xu et al., 2017a) focused specifically on mathematics homework management. This consistency suggests that the findings may applicable across school levels (middle vs. high school), countries (Türkiye, U.S., and China), and homework domains (mathematics-specific vs. cross-subject homework management).

How do we interpret our result that homework management was not related to homework value, while a prior study on Chinese middle school students (Xu et al., 2017a) indicated that homework management was positively associated with homework value? One possible explanation is that the predictive influence of homework value on homework management might be mediated by self-regulatory purpose and homework effort. When students perceive homework as important, useful, or relevant to their learning, they are more likely to view it as a means to foster discipline and independent work habits (Hong et al., 2009; Xu, 2013), which may subsequently enhance their homework management. Perceiving homework as valuable may also encourage students to put forth greater effort (Hong et al., 2009; Trautwein et al.,

Table 2 Descriptive statistics and correlations

Variables	M	SD	S	K	1	2	3	4	5	6	7	8	9	10	11	12
1 Gender (female = 0)	0.47	0.50	0.05	− 1.99	–											
2 Parent education	8.88	3.68	0.52	−0.29	0.03	–										
3 Prior mathematics knowledge	64.89	21.74	−0.36	−0.56	−0.08†	0.26†	–									
4 Homework frequency	4.17	1.52	−0.52	−0.74	0.03	0.06*	0.09†	–								
5 Homework time	84.13	58.13	1.10	0.90	−0.01	0.11†	0.15†	0.09†	–							
6 Homework quality	3.96	1.02	− 1.02	0.26	−0.12†	0.06*	0.37†	0.13†	0.06*	–						
7 Teacher feedback	3.63	1.09	−0.62	−0.45	−0.07†	0.06*	0.37†	0.12†	0.09†	0.74†	–					
8 Teacher autonomy support	3.35	1.28	−0.34	− 1.08	−0.03	0.07†	0.32†	0.14†	0.09†	0.59†	0.73†	–				
9 Parent content support	2.91	0.92	−0.60	−0.62	−0.07*	0.23†	0.21†	0.13†	0.08†	0.33†	0.29†	0.26†	–			
10 Parent autonomy support	2.93	0.87	−0.63	−0.48	−0.04	0.18†	0.23†	0.12†	0.09†	0.32†	0.33†	0.32†	0.72†	–		
11 Parent control	2.63	0.82	−0.24	−0.65	0.08†	0.12†	0.15†	0.12†	0.14†	0.21†	0.27†	0.28†	0.43†	0.49†	–	
12 Homework expectancy	2.75	0.88	−0.23	−0.93	0.06*	0.07*	0.32†	0.08†	0.02	0.22†	0.24†	0.20†	0.12†	0.16†	0.02	–
13 Homework value	2.95	0.85	−0.57	−0.53	−0.04	0.04	0.23†	0.10†	0.06*	0.31†	0.32†	0.25†	0.12†	0.16†	0.05	0.62†
14 Homework interest	2.94	1.21	−0.01	− 1.12	−0.04	0.04	0.32†	0.15†	0.15†	0.48†	0.52†	0.49†	0.31†	0.39†	0.32†	0.31†
15 Academic purpose	2.82	0.88	−0.45	−0.63	−0.04	0.07†	0.37†	0.17†	0.10†	0.54†	0.59†	0.51†	0.39†	0.46†	0.38†	0.28†
16 Self-regulatory purpose	2.89	0.89	−0.53	−0.58	−0.08†	0.04	0.33†	0.11†	0.10†	0.46†	0.50†	0.43†	0.30†	0.38†	0.34†	0.26†
17 Approval-seeking purpose	2.88	0.83	−0.50	−0.42	−0.03	0.06*	0.29†	0.14†	0.10†	0.45†	0.51†	0.46†	0.35†	0.42†	0.38†	0.21†
18 Homework effort	2.95	0.75	−0.73	0.07	−0.21†	0.15†	0.39†	0.08†	0.17†	0.42†	0.44†	0.33†	0.31†	0.36†	0.28†	0.16†
19 Grade (5–6 = 0; 7–8 = 1)	0.35	0.48	0.64	− 1.64	0.05	−0.15†	−0.15†	−0.14†	−0.04	−0.10†	−0.11†	−0.09†	−0.21†	−0.22†	−0.18†	−0.13†
20 Parent education-C	8.69	1.65	0.64	0.44	−0.04	0.47†	0.35†	0.09†	0.12†	0.15†	0.12†	0.12†	0.22†	0.19†	0.12†	0.14†
21 Homework quality-C	3.99	0.49	−0.63	0.22	−0.06*	0.15†	0.34†	0.31†	0.07*	0.46†	0.40†	0.36†	0.24†	0.23†	0.15†	0.17†
22 Teacher feedback-C	3.68	0.51	−0.10	−0.15	−0.05	0.13†	0.32†	0.19†	0.04	0.41†	0.45†	0.41†	0.22†	0.24†	0.18†	0.17†
23 Teacher autonomy support-C	3.41	0.60	0.01	−0.71	−0.03	0.12†	0.29†	0.27†	0.05*	0.36†	0.41†	0.46†	0.19†	0.22†	0.18†	0.16†
24 Homework expectancy-C	2.75	0.29	0.42	−0.43	−0.06*	0.21†	0.32†	0.22†	0.05	0.25†	0.26†	0.24†	0.22†	0.22†	0.14†	0.30†
25 Homework value-C	2.95	0.32	0.02	−0.02	−0.10†	0.17†	0.25†	0.32†	0.08†	0.29†	0.26†	0.22†	0.23†	0.22†	0.12†	0.23†
26 Homework interest-C	2.99	0.59	0.18	−0.45	−0.04	0.08†	0.22†	0.36†	0.08†	0.32†	0.34†	0.32†	0.23†	0.25†	0.20†	0.18†
27 Homework management	3.49	0.72	−0.30	−0.10	−0.15†	0.10†	0.36†	0.10†	0.17†	0.47†	0.51†	0.41†	0.38†	0.46†	0.34†	0.31†

Table 3 (continued)

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1 Gender (female = 0)														
2 Parent education														
3 Prior mathematics knowledge														
4 Homework frequency														
5 Homework time														
6 Homework quality														
7 Teacher feedback														
8 Teacher autonomy support														
9 Parent content support														
10 Parent autonomy support														
11 Parent control														
12 Homework expectancy														
13 Homework value	–													
14 Homework interest	0.34†	–												
15 Academic purpose	0.32†	0.66†	–											
16 Self-regulatory purpose	0.32†	0.59†	0.72†	–										
17 Approval-seeking purpose	0.24†	0.54†	0.71†	0.66†	–									
18 Homework effort	0.24†	0.44†	0.47†	0.42†	0.40†	–								
19 Grade (5–6 = 0; 7–8 = 1)	−0.14†	−0.20†	−0.14†	−0.14†	−0.13†	−0.16†	–							
20 Parent education-C	0.12†	0.07†	0.11†	0.11†	0.09†	0.18†	−0.33†	–						
21 Homework quality-C	0.21†	0.31†	0.33†	0.28†	0.31†	0.25†	−0.22†	0.32†	–					
22 Teacher feedback-C	0.19†	0.33†	0.33†	0.29†	0.32†	0.24†	−0.24†	0.27†	0.89†	–				
23 Teacher autonomy support-C	0.16†	0.31†	0.32†	0.26†	0.31†	0.20†	−0.19†	0.25†	0.79†	0.90†	–			
24 Homework expectancy-C	0.26†	0.26†	0.22†	0.21†	0.21†	0.21†	−0.44†	0.44†	0.54†	0.57†	0.53†	–		
25 Homework value-C	0.33†	0.27†	0.25†	0.24†	0.22†	0.22†	−0.41†	0.37†	0.64†	0.59†	0.47†	0.77†	–	

Table 3 (continued)

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25	26
26 Homework interest-C	0.20†	0.44†	0.34†	0.28†	0.31†	0.22†	−0.44†	0.17†	0.71†	0.75†	0.71†	0.58†	0.60†	–
27 Homework management	0.34†	0.60†	0.57†	0.56†	0.50†	0.53†	−0.15†	0.14†	0.25†	0.28†	0.26†	0.26†	0.25†	0.30†

C = Class. S = Skewness. K = Kurtosis

*$p < .05$. †$p < .01$

2006; Xu, 2017), thereby further strengthening their ability to regulate and manage their homework – a topic explored in more details in the following section. This explanation is further corroborated by our supplementary analysis, showing that homework management was positively related to homework value ($b = 0.07$, $p = .03$) after removing self-regulatory purpose and homework effort from Model 2.

Our finding, derived from Turkish students in Grades 5–8, that males were less inclined than females to manage their homework aligns with Xu's (2007) study on U.S. students in Grades 5–6. However, it diverges from the findings of Xu and Wu's (2013) study on U.S. students in Grades 8 and 11 as well as Xu et al. (2017a) study on Chinese students in Grade 8, both of which reported no significant gender differences in homework management. One plausible explanation is that females develop self-regulation and executive functioning skills earlier than males (i.e., before reaching puberty; Hosseini-Kamkar & Morton, 2014; Weis et al., 2013), which may in turn influence homework management. Another related explanation is that gender differences in homework management may manifest at different developmental stages across countries because of contextual variations in schooling practices and societal norms. In the Turkish context, such differences may emerge earlier (e.g., grades 5–8), likely due to stronger gendered messaging that encourage girls to be more diligent, studious, and disciplined in their studies (Karademir & Deveci, 2019; Yurt, 2022). This interpretation is substantiated by a meta-analysis on academic motivation in Türkiye, which found that middle school girls displayed significantly higher academic motivation than boys (Turhan, 2020).

In addition, our result that homework management was positively linked to class-level homework interest suggests that homework interest positively predicts homework management beyond its influence at the student level. In classes with higher interest, students may experience fewer negative emotions (e.g., avoidance, boredom, and stress) and be more inclined to engage discussions about assignments, share strategies, and seek peer support (Pekrun et al., 2002; Volet et al., 2009), thereby enhancing their homework management. Meanwhile, how do we explain that homework management was negatively related to homework quality at the class level?

One possible explanation involves the confluence of influences within classes with higher homework quality. While embodying high academic expectations, these classes may also unintentionally contribute to a climate of elevated academic pressure and stress (Xu, 2024b), which can undermine students' homework management. This explanation is consistent with existing literature that associates high academic expectations with increased academic press and stress (Haspolat & Yalçın, 2023; Putwain, 2007; Sun et al., 2012). These class environments may also foster social comparison (Haspolat & Yalçın, 2023), which could hinder students' homework management by heightening anxiety, making them feel less competent or uncertain about their abilities, and prioritizing external validation (e.g., striving to conform to others' expectations).

4.2 Autonomy support and homework effort

At the core of the present investigation lies in the predictive influences of autonomy support and homework effort on homework management. Our results on auton-

omy support indicated that homework management was positively linked to parent autonomy support but showed no association with teacher autonomy support. These results provide partially support for our hypothesis, suggesting a positive predictive influence of autonomy support on homework management. When students are given greater freedom and autonomy in planning, organizing assignments, and managing their time, they become more invested in their homework, increasing their chances of managing it for successful completion.

On the flip side, how do we reconcile the positive link between homework management and parent autonomy support, but the lack of such a link with teacher autonomy support? When parents offer autonomy support for homework at home, they help their children take responsibility for their work, make independent decisions about their homework routines (e.g., set up a study space), devise strategies to minimize distractions in their surroundings, stay motivated, and encourage them to articulate their emotions about their tasks at hand (Cunha et al., 2015; Pomerantz et al., 2007). This, in turn, helps children more directly arrange a more personalized study environment, manage time, cope with distractions, sustain motivation, and navigate their emotions while completing homework (Xu & Corno, 1998).

Unlike parents, teachers offer autonomy support for homework within the school setting, which is more distanced from the home context where homework usually takes place (Feiss et al., 2025). Additionally, teachers' primary focus, particularly at the middle and high school level, is on academic achievement, learning objectives, and the development of cognitive and academic skills related to homework assignments – such as goal setting, promoting independent thinking, and encouraging problem-solving strategies (Xu, 2024b). As a result, the predictive influence of teacher autonomy support on homework management may be less apparent.

Our findings provide new insights into the differential predictive roles of parent and teacher autonomy support in homework management. Whereas previous research acknowledges parent autonomy support as an important factor in students' well-being and academic outcomes, including intrinsic motivation and engagement, it has been generally regarded as less influential than teacher autonomy support (Feng et al., 2019; Guay et al., 2013). This is largely attributed to the extended time student spend in school, where they are immersed in structured learning experiences, compared to at home (Mammadov & Schroeder, 2023). However, considering the substantial time students allocate to managing homework at home, our findings lend empirical support to Mammadov and Schroeder' (2023) observation that "parent autonomy support does not directly induce students' learning behaviors in school environments, rather it helps in their ability to approach and manage the learning process" (p. 16).

As a pivotal construct in homework models (Trautwein et al., 2006; Xu & Corno, 2022b), homework effort has been associated with critical factors including homework expectancy, completion, and student performance over the past two decades (Dettmers et al., 2010; Rosário et al., 2018; Trautwein et al., 2006; Xu & Corno, 2022b). While theoretical frameworks, including self-determination theory (Ryan & Deci, 2020) and growth mindset theory (Dweck & Yeager, 2019), alongside recent homework research (e.g., Xu, 2024c), suggest that homework effort may contribute to students' homework management, no empirical research to date has investigated its predictive role in this context.

Our research represents a significant advance, by directly linking homework effort to homework management. Our result provides empirical support for the hypothesis that homework effort can enhance homework management. This suggests that by putting forth greater effort, students may cultivate desirable study habits (e.g., setting up a conductive study space and managing time), strengthen resilience and perseverance to challenges, obstacles, and setbacks (e.g., coping with distractions and regulating unpleasant emotions), and enhance confidence, competence, and a sense of accomplishment (e.g., staying motivated). Hence, the present investigation extends beyond extant literature on whether homework effort links to homework motivation, completion, and academic performance (Avcı & Özgenel, 2025; Trautwein et al., 2006; Xu & Corno, 2022b). Theoretically, it provides new insights by combining multiple theories – self-regulation, expectancy-value, self-determination, and growth mindset – within the context of homework, revealing the positive influence of homework effort on homework management persists ever after accounting for important constructs from these theories. Additionally, as discussed earlier, our investigation indicated that the predictive influence of homework value on homework management may be mediated by homework effort and self-regulatory purpose, implying that these factors are more powerful or proximal predictors than homework value.

Compared to Model 1, which excluded autonomy support and homework effort, Model 2 explained an additionally 2.7% of the total variance in students' management of homework. Although this effect size may seem small at first, its practical significance should be considered in relation to multiple contextual factors. First, homework management is shaped by a diverse set of factors grounded in multiple theories (growth mindset, self-determination, expectancy-value, and self-regulation), with autonomy support and homework effort being among them. In addition, the inclusion of strong predictors like homework interest in our models likely limited the variance uniquely explained by autonomy support and homework effort. Furthermore, small effect sizes may lead to important implications in many contexts (Trautwein et al., 2012). In our investigation, the influences of parent autonomy support and homework effort may accumulate over time, exerting a more pronounced influence on students' homework management, particularly as both autonomy support and self-regulation tend to decline during secondary school (Eccles, 1993; Gillet et al., 2012; Martinek et al., 2016). However, traditional instructional practices, especially in middle school, often fail short in meeting students' increasing need for personal agency, self-direction, and autonomy support (Butler & Le, 2018; Katz et al., 2009).

4.3 Strengths, limitations, and implications for future research

Drawing upon multiple frameworks – self-regulated theory (Boekaerts & Corno, 2005), expectancy-value theory (Eccles & Wigfield, 2020), self-determination theory (Ryan & Deci, 2020), and growth mindset (Dweck & Yeager, 2019) – as well as prior research (Avcı & Özgenel, 2025; Deslandes et al., 2008; Xu et al., 2017a; Xu & Wu, 2013; Yang & Tu, 2020), our study applied multiple models to examine the association between homework management and theoretically relevant variables. Notably, it advanced existing research by indicating that homework management remained positively related to parent autonomy support and homework effort, controlling for other

key theoretical variables. In addition, our findings underscore the benefit of combining multiple frameworks in understanding the self-regulation of homework behavior.

Despite the strength of the present study in uncovering the multifaceted influences of homework management, our study has several limitations. Aside from using mathematics achievement as evidence of homework management's predictive evidence, our results were derived from cross-sectional data. As Trautwein and Lüdtke (2009) note, the term "effect" here denotes a "predictive effect." Consequently, echoing Fong et al.'s (2024) recommendations, future investigations could overcome this limitation by employing cross-lagged panel analyses, trace methods, observations, and experiments.

In addition, although our study is grounded in multiple theoretical frameworks, the third-variable problem remains; other unobserved predictors such as structure, competence, relatedness, or peer influence might also affect students' homework management. For instance, grounded in self-determination theory (Deci & Ryan, 2000, 2008; Ryan & Deci, 2020) and its relevance to homework contexts (Feng et al., 2019; Fernández-Alonso et al., 2022), this investigation emphasized autonomy support. However, research has shown that structure –characterized by clear expectations, supportive guidance, and consistent feedback – is also positively associated with student engagement and performance (Grolnick & Pomerantz, 2009; Grolnick et al., 2015; Jang et al., 2010). Future investigation could benefit from considering these additional variables (e.g., the role of structure provided by parents and teachers) shaping homework management.

Furthermore, the current investigation concentrated on mathematics homework for Turkish middle school students. However, homework management may be shaped by grade level and cultural context (e.g., valuing of autonomy and effort; Ryan & Deci, 2020; Xu, 2018; Yang & Tu, 2020). As our earlier discussion suggests that gender differences in homework management could be moderated by grade level, further investigation across elementary and high school settings in different cultural contexts is warranted. Finally, given that our results highlight the importance of parent autonomy support and homework effort – but not teacher autonomy support – exploring these issues through qualitative research could reveal fresh and deeper insights into the implicit theories students hold about the key elements needed to enhance their homework management.

4.4 Implications for practice

Given that our study is the first to explicitly associate homework management with autonomy support and effort, practical implications ought to be handled with care. Even so, the results may provide valuable guidance for improving homework management.

The observed positive link between homework management and homework effort highlights the importance of actively promoting effort throughout the homework process. Cultivating a growth mindset is vital; this involves fostering positive perceptions of effort (Murphy & Dweck, 2010). For example, encouraging students to always strive for their best – even when errors or mistakes occur – help reinforce and internalize the idea that sustained effort leads to progress, improvement, and

academic success. Equally important is teaching them to reframe challenges and setbacks as growth opportunities rather than as barriers. Furthermore, it is crucial to recognize and celebrate not only their accomplishment but also the sustained effort and development exhibited by students.

Furthermore, tailoring homework to align with students' interests and real-world experiences appears to promote homework management. This is especially important considering the bidirectional or reciprocal relationship between homework interest and effort (Xu, 2018). Our study further revealed that increased homework interest – both individually and at class level – is linked with greater homework management. To foster homework interest, teachers might consider integrating real-world tasks, such as virtual modeling and career-oriented projects, or incorporating interactive elements like social media metrics and gamified activities.

The observed positive association between parent autonomy support and homework management underscores the critical role of nurturing such support. It would be beneficial for parents to attend students' preferences and needs in managing their homework, aiming to gain deeper insights into homework issues and concerns from their perspectives. This is especially noteworthy since our investigation further revealed that homework management had no association with parent content support and parent control. Moreover, it would be highly beneficial to create ongoing opportunities for students to express their perspectives on parent autonomy support and how parental involvement can be optimized for homework management. By considering students' evolving insights, parents can better tailor their support.

Meanwhile, aligning with calls for greater parent autonomy support in homework (Feng et al., 2019; Fernández-Alonso et al., 2022; Xu et al., 2024), it would be beneficial for parents to gradually step back from direct assistance, intervention, control as their child develops confidence, competence, and independence, thereby further enhancing self-directed homework management. Finally, consistent with prior research on the quality of parent homework involvement (Dumont et al., 2014), our study revealed that homework management was not related to parent education. This suggests that the recommendations outlined above are likely applicable to students across socioeconomic backgrounds.

Declarations

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

Ethical approval The study (involving human participants; informed consent) was approved the Institutional Review Board, Marmara University (No: 2024/4).

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