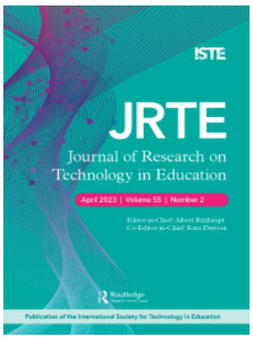

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Examining the relationships among self-regulated learning, homework timeliness, and course achievement: a context of female students learning quantitative topics

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ABSTRACT

Homework completion is associated with learning achievement, but students' challenges revolve around meeting deadlines and preventing procrastination. Promoting students' self-regulated learning (SRL) can overcome these challenges. We explored the role of SRL (forethought and learning strategies) on the timeliness of homework submissions performed by undergraduate female students in quantitative courses. Data were collected from a survey and Learning Management System log. A structural equation modeling analysis indicated that the forethought components had a direct effect on the learning strategies. The use of learning strategies significantly influenced homework timeliness, which then significantly affected course achievement. Discussion regarding mixed results and strategies for scaffolding SRL through homework assignments are included. A suggestion on guiding students to execute suitable learning strategies for mastering quantitative topics is presented.

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Homework timeliness; learning strategies; learning achievement; self-regulated learning; structural equation modeling

Introduction

Homework completion and the timeliness of the submission are associated with academic achievement (Bempechat, 2004; Calderwood et al., 2014; Cooper, 1989; Planchard et al., 2015; Rawson et al., 2017). Although providing students with practice opportunities through homework can promote learning achievement, simply assigning homework does not lead to successful homework completion (Planchard et al., 2015). Some students may not have sufficient motivation, interests, and sustained efforts to work on homework (Patall et al., 2010). Others procrastinate by working on it at the last minute, engendering a low quality of work (Rawson et al., 2017). Additionally, the challenges of completing homework timely rest on meeting deadlines and preventing procrastination (Corno, 1996; Xu, 2010, 2013). Overcoming such challenges is deemed imperative so that students can benefit from the practice opportunities through homework to enhance learning.

Existing literature addresses the aforementioned challenges by recommending the promotion of self-regulated learning (SRL) (Bembenutty, 2011; Ramdass & Zimmerman, 2011; Xu, 2013). Therefore, teachers in the K-12 setting have been making efforts to promote students' self-regulation (Putri et al., 2020; Ramdass & Zimmerman, 2011; Rutherford et al., 2018; Sleeman et al., 2021). When students progress to post-secondary education, more challenges arise as the demand for them to take responsibility and self-regulate their learning increases immensely (Zimmerman, 1998, 2002). This calls for further investigation regarding the association between SRL and homework timeliness among college and university students, particularly to expand the literature intersecting these topics

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(Keith et al., 2004; Stoeger & Ziegler, 2011). This study aimed to explore the relationship between SRL, homework submission timeliness and learning achievement in a higher-education context.

Literature review

Homework timeliness, learning achievement, and self-regulated learning

Students who complete their homework tend to achieve better than their peers who do not (Cooper, 2009; Cooper & Valentine, 2001; Bang et al., 2011; Fan et al., 2017; Núñez et al., 2015). Completing homework can promote both students' understanding of the course topics, as well as learning retention. For example, regularly assigned mathematics (math) homework assists students in gaining a better understanding of math concepts (Kitsantas et al., 2011; Trautwein et al., 2002) and may promote math achievement (Fan et al., 2017; Sun et al., 2020). A potential explanation is that assigning homework provides an opportunity to promote students' strategic study skills (Cooper & Valentine, 2001; Medwell & Wray, 2019). For example, when working on a math homework assignment, students can practice the problem-solving steps about the topic, learned or discussed earlier in the class, to reinforce their problem-solving skills on a math-related problem (Bedford, 2014).

However, simply assigning homework does not naturally engender a better learning achievement due to a lack of interest or motivation (Amzalag, 2021; Patall et al., 2010; Planchard et al., 2015). Some students do not start their homework until there are less than 24 hours before it is due, potentially jeopardizing the quality of homework and final grade (Rawson et al., 2017). Additionally, students may not carry out effective strategies to help them persist and combat the challenges in completing homework. Homework is "any academic, course-related task assigned by the instructor intended for students to carry out during non-class hours" (Planchard et al., 2015, p. 11). Therefore, homework activity is not within the instructor's supervision during class time. Homework completion and timeliness are associated with students' desire and motivation to learn and their appropriate strategies. Put simply, students need to possess self-regulatory skills and carry out self-regulatory strategies to complete homework on time (Bembenutty, 2011; Cadime et al., 2017; Kitsantas & Zimmerman, 2009; Planchard et al., 2015), which may influence students' course grades (Bembenutty, 2010).

The aforementioned relationship indicates that homework timeliness can be a byproduct of SRL and a mediator for learning achievement. Although there appears to be a positive homework-achievement association in quantitative-related courses, the investigation focusing on the gender differences, especially separating male and female students, is still a rarity (Fan et al., 2017). Questions remain regarding female students' homework behaviors, SRL, and the association with math-related learning achievement.

Applying SRL entails mental activities and knowledge, requiring students to have motivation, purpose, goal-directed strategies, strategy monitoring, and continuous adjustment of those actions to ensure improvement (Bembenutty, 2011). Using Zimmerman's SRL model, three phases of SRL can be applied when completing homework: (1) forethought phase is when students determine the sources of motivation, such as self-efficacy, and plan for suitable learning strategies useful to assist them in completing homework; (2) performance phase is when students focus on executing the learning strategies and monitoring the learning efforts; and (3) self-reflection phase is when students evaluate their efforts and outcome and may plan for further goals and better strategies to improve the next cycle of three phases (as cited in Bembenutty, 2011). Students must establish their motivation to initiate a learning process and perform actions by implementing metacognitive, cognitive, and resource management strategies throughout the learning process (Rawson et al., 2017; Schunk & Zimmerman, 2012; Zimmerman, 2008). In other words, the forethought components of SRL serve as a foundation (Lin et al., 2017; Ryan & Deci, 2000); students with well-planned forethought tend to regulate their learning by performing appropriate learning strategies (Pintrich & De Groot, 1990; Rawson et al., 2017).

Assigning homework is also considered an opportunity for students to practice SRL skills (Cadime et al., 2017; Özcan, 2016; Trautwein & Köller, 2003; Zimmerman & Kitsantas, 2005). Completing homework occurs outside the class time and instructor's monitoring, displaying a transition from instructor-led to student-led learning. Working on a homework assignment allows students to think about the steps entailed and how long it may take to complete it (Bembenutty, 2009; Özcan, 2016), wherein the aforementioned SRL phases can be performed. As expected, students performing self-regulatory behaviors during homework activities tend to complete it successfully on time. However, this relationship between SRL behaviors during homework completion and quantitative problem solving deserves further exploration as such an investigation is still a scarcity (Özcan, 2016).

From forethought components to homework timeliness

Self-efficacy, an SRL component in the forethought phase, is associated with homework completion (Bembenutty & White, 2013; Calderwood et al., 2014; Katz et al., 2014; Kitsantas & Zimmerman, 2009; Ramdass & Zimmerman, 2011). Self-efficacy, defined as "individual judgments of his or her capabilities to perform given actions" (Schunk, 1991, p. 207), is positively correlated with homework timeliness (Katz et al., 2014). High self-efficacious students use positive self-talk to promote their self-efficacy, overcome frustration with homework (Xu, 2013), and avoid procrastination (Katz et al., 2014) by concentrating on homework activities and minimizing distractions (Calderwood et al., 2014). They also believe that they can plan and adopt the appropriate learning strategies to complete their homework successfully (Bembenutty, 2005, 2011; Kitsantas et al., 2011; Pintrich & De Groot, 1990). This notion displays that self-efficacy can influence the implementation of learning strategies, which may lead to the timeliness of homework completion (Ginns et al., 2014).

Intrinsic interest and motivation are other SRL forethought components associated with homework behaviors. Intrinsic interest is the intent and willingness to engage in "a task for the sake of the task itself" (Bembenutty, 2009, p. 140). Students with an intrinsic interest in the course topics and homework are likely to carry out a proactive approach (Piñeiro et al., 2019), such as self-control and delayed gratification, that helps them complete homework on time (Bembenutty, 2009, 2011; Bempechat, 2004; Katz et al., 2014). Similarly, intrinsic motivation is students' "engagement and enjoyment in a task for the sake of learning" (Bembenutty & White, 2013, p. 83) and assists students in actively searching and using learning strategies such as metacognitive, cognitive, resource management strategies (Bembenutty & Karabenick, 2004) , and time management strategies (Xu et al., 2014). This notion displays that intrinsic interest and motivation can also influence the execution of learning strategies, which can assist students in completing homework promptly.

Task value, another SRL forethought component, additionally influences homework completion (Ramdass & Zimmerman, 2011; Trautwein & Köller, 2003; Xu & Wu, 2013). Task value is "students' evaluation [or perception] of how interesting, how important, and how useful the task is" (Pintrich et al., 1991, p. 12). When students perceive value in homework, they view it as interesting, important, and useful (Warton, 2001; Xu, 2015). Their willingness to complete homework due to such value affects their self-control during homework activity (Xu, 2015). They are more likely to carry out appropriate actions in order to minimize homework distractions, such as by managing their time and study environment (Xu, 2010, 2013, 2015). This notion indicates that task value can also influence the students' strategies, which can help them complete homework on time.

Performing learning strategies during homework activity

Students' strategies implemented as an application of SRL influence homework behaviors (Özcan, 2016; Ramdass & Zimmerman, 2011; Trautwein & Köller, 2003). The literature review above has shown that intrinsically motivated students actively search and use learning strategies such as cognitive and resource management strategies (Bembenutty & Karabenick, 2004), including time management, while working on homework (Xu et al., 2014).

Elaboration is a cognitive strategy that assists students in transferring information into long-term memory by connecting the new information and prior knowledge (Pintrich et al., 1991). This strategy entails study techniques such as "paraphrasing, summarizing, creating analogies, and generative note-taking" (Pintrich et al., 1991, p. 19). Wolters (1999) postulates that homework activities driven by motivation are associated with elaboration strategy. However, another study does not find elaboration to be influenced by self-efficacy in order to assist students in completing homework timely (Ginns et al., 2014). These mixed findings call for further exploration regarding SRL components that influence homework timeliness.

Completing homework also requires appropriate resource management strategies (Pintrich et al., 1991), such as time management and study environment management (Bembenutty, 2009; Ramdass & Zimmerman, 2011). Time management refers to students' estimation of time allocation needed for studying (Bembenutty, 2009). The more accurate the students can estimate and optimize the required time to finish homework, the higher likelihood they complete their homework on time (Bembenutty, 2009; Núñez et al., 2015; Piñeiro et al., 2019). The study environment is the setting where students do their homework (Pintrich et al., 1991). Students need to be in a place where it is organized, quiet, and free of distractions to successfully undertake homework activities (Bembenutty, 2009; Pintrich et al., 1991). Xu (2009) has found that high-achieving students tend to set up their homework setting appropriately to minimize distractions. Hence, students should be aware that time management and homework setting strategies can help them complete homework on time (Bembenutty, 2011).

Another learning strategy is effort regulation, which is "students' ability to control their effort and attention in the face of distractions and uninteresting tasks" (Pintrich et al., 1991, p. 27). Students with effort regulation are committed to completing their homework despite having difficulties and distractions (Bembenutty, 2011). Xu (2009, 2015) has confirmed that high-performing students can handle distractions while doing homework. This indicates that self-regulatory students can sustain their effort despite facing distractions during homework activities. As Bembenutty (2011) further states, the capability to sustain efforts may be influenced by forethought components such as self-efficacy.

Using learning management system log

SRL processes are not directly observable by the naked eye and not simple to capture (Järvelä et al., 2015; Nouri et al., 2019). Using Learning Management Systems (LMSs) provides a way to capture learning behaviors through obtaining and analyzing LMS log data, which is known as a learning analytics (LA) approach (You, 2016). LA refers to "the collection, analysis, use, and appropriate dissemination of student-generated, actionable data with the purpose of creating appropriate cognitive, administrative, and effective support for learners" (Slade & Prinsloo, 2013, p. 1512). Utilizing LA can help mirror the learning process, since the data can display how students work within a digital learning environment (Winne & Baker, 2013).

Data from LMS and student information systems can be collected and analyzed in order to find strategies to improve student outcomes (Dietz et al., 2018; Muljana & Placencia, 2018; Muljana et al., 2021; Oblinger, 2012). LMSs provide tools for tracking learning activities and behaviors (Muljana & Placencia, 2018; You, 2016). For example, the LMS data log can be retrieved to display the timestamps of homework and quiz submission (Dietz-Uhler & Hurn, 2013; Dietz et al., 2018). In this study, we took an LA approach by using LMS data to identify last-minute homework submissions and establish a connection with the SRL application.

Rationales and purpose of the study

The forethought SRL components can influence the implementation of learning strategies, potentially leading to the timely completion of homework assignments and learning achievement. For example, Lin et al. (2017) found that motivation significantly affected learning strategies that

helped students achieve learning outcomes in online language courses. Ginns et al. (2014) found that self-efficacy significantly influenced the elaboration strategy, leading to homework completion. However, the investigation of relationships among SRL components, specifically regarding the role of learning strategies and homework behavior is still limited; therefore, this topic deserves further attention (Rawson et al., 2017).

The context of female students learning quantitative subjects was selected for this study. Female students are likely to be outperformed by their male peers in quantitative subjects (Beyer, 2008; Busch, 1995; Goetz et al., 2013; Hanna, 2003; Wladis et al., 2015) and have lower self-efficacy in learning quantitative topics (Goetz et al., 2013; Hackett, 1985; Marra et al., 2009; Stewart et al., 2020; Tellhed et al., 2017). They tend to have a fear of math-related concepts and avoid quantitative-related courses (Devine et al., 2012; Fan et al., 2017; Hackett, 1985; Tarasi et al., 2013; Wilson, 1997; Zettle & Raines, 2000). Although female students are likely to complete more homework, their scores on the national exam are lower than their male peers (Rosário et al., 2018). Additionally, female students experience a gender-biased stereotype that quantitative subjects are more suitable for males (Brotman & Moore, 2008; Casad et al., 2019; Eccles & Wang, 2016; Simon et al., 2015), influencing their persistence in quantitative courses (Casad et al., 2019).

However, female students are likely to be adaptable and willing to adjust their learning strategies (Bidjerano, 2005; Lishinki et al., 2016). Hence, female students demonstrating high self-efficacy can outperform their male classmates and persist in quantitative courses (Institute for Research on Higher Education, 1994; Simon et al., 2015). Self-regulation and learning strategies play a crucial role in helping female students perform better in this regard (Snow & Jackson, 1994; Snow & Swanson, 1992; Rouxel, 2000; Simon et al., 2015). Nevertheless, how female students regulate their learning is still perplexing (Bidjerano, 2005), particularly related to their homework behaviors (Yang & Xu, 2018) and their homework-achievement association in the context of learning quantitative topics (Fan et al., 2017).

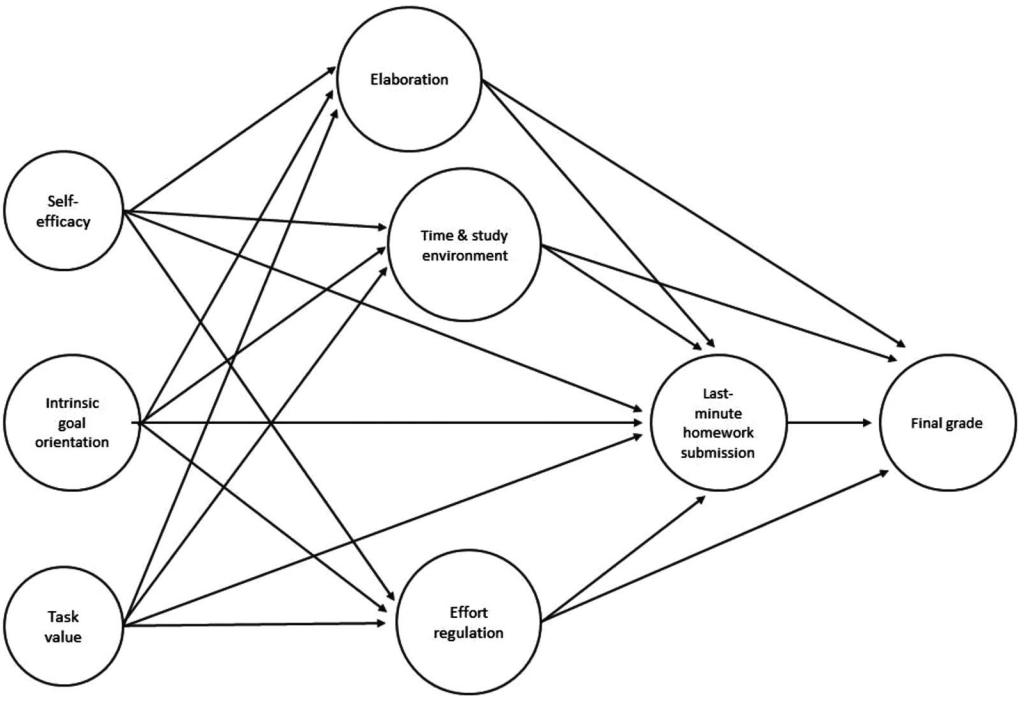

Figure 1. The proposed model, representing the hypotheses.

This study was aimed to explore the relationships among the forethought and learning strategies components of SRL, as well as the timeliness of homework submissions and course achievement of undergraduate female students in quantitative-related courses within a blended learning environment. The following hypotheses guided this study (see Figure 1):

- H1: Last-minute homework submission negatively influences course performance.
- H2: Forethought components (H2a. self-efficacy, H2b. intrinsic orientation, and H2c. task value) positively influence elaboration.
- H3: Forethought components (H3a. self-efficacy, H3b. intrinsic orientation, and H3c. task value) positively influence effort regulation.
- H4: Forethought components (H4a. self-efficacy, H4b. intrinsic orientation, and H4c. task value) positively influence time and study environment management.
- H5: Forethought components (H5a. self-efficacy, H5b. intrinsic orientation, and H5c. task value) negatively influence last-minute homework submissions.
- H6: Better use of learning strategies (H6a. elaboration, H6b. effort regulation, and H6c. time and study environment management) can reduce the number of last-minute homework submissions.
- H7: Last-minute homework submission negatively mediates the relationship between: H7a) elaboration, H7b) time and study environment management, H7c) effort regulation, and d) course performance.
- H8: Last-minute homework submission negatively mediates the relationship between forethought components (H8a. self-efficacy, H8b. intrinsic orientation, and H8c. task value) and course performance.

Methodology

Participants

Participants were recruited from two lower-level quantitative-related courses taught by the same instructor. These courses were offered in multiple sections each term at a large, diverse public university in the western United States. These selected course sections experienced high DFW rates (the number of students who earned grades D, F, and W) in the department with a five-year average of 18%. Students in these courses were non-science students, but the courses discussed quantitative concepts and mathematical formulas applicable in the retail business sector.

Out of the total of 194 students, 161 female students responded to the survey; however, 160 completed responses were deemed usable. We only included the female participants to meet the aim of this study. Table 1 displays the participants' demographic and contextual information.

Variables and measures

Data were collected from an anonymous self-administered online survey and the Learning Management System (LMS) data log. The survey included six demographic-related items and selected items from Pintrich et al. (1991) Motivational Strategies for Learning Questionnaire (MSLQ). All MSLQ variables were measured on a 5-point Likert scale for inquiring students regarding their forethought and learning strategies performance. Items related to the forethought components were self-efficacy, intrinsic goal orientation, and task value. Items related to the learning strategies were elaboration, time and study environment, and effort regulation.

Data for the two variables, last-minute homework submissions and final course scores at the end of the semester (to reflect the course achievement), were collected from the LMS usage data.

Table 1. Participants' demographic and contextual information.

Information	Frequency (*n*)	Percentage (%)
Ethnic background		
African or Black American	13	8.1
Caucasian or European American	32	20
Hispanic or Latino/Latina/Latinx	70	43.7
Don't wish to answer	5	3.1
Asian	30	18.8
Pacific Islander	3	1.9
Other	7	4.4
Total	160	100
Class level		
Sophomore	23	14.4
Junior	77	48.1
Senior	60	37.5
Total	160	100
Enrollment status		
Part-time student (enrolled in less than 12 units per quarter)	3	1.9
Full-time student (enrolled in 12 units or more)	157	98.1
Total	160	100
The number of hours students work for pay		
Less than 10 hours	61	38.1
More than 10 but less than 20 hours	42	26.3
More than 20 but less than 30 hours	40	25.0
More than 30 but less than 40 hours	13	8.1
More than 40	4	2.5
Total	160	100

Note. $N = 160$.

Table 2. Descriptive statistics for last-minute homework submission and total final score in percentage.

Variables	*M*	*SD*	Minimum	Maximum	Median
Last-minute homework submission (in percentage)	62.46%	33.96%	0%	100%	71.43%
Total final score (in percentage)	78.76%	10.64%	40%	97.68%	79.59%

The timestamps for homework submission were retrieved from the LMS. The submissions were categorized as last minute if they were conducted within 12 hours of the due time. The final course score was the percentage of the score achieved in the course as compared to the maximum score.

Procedures

After receiving approval from the Institutional Review Board, the instructor described the purpose of the study to students. Students who agreed to participate were asked to provide a signed consent. Students completed the survey in the middle of the term after they had established learning patterns. The students learned in a blended learning environment, in which the instructor integrated the online activities in the LMS and traditional face-to-face class activities (Alebaikan & Troudi, 2010). Also, the instructor emphasized to students that all learning materials were available in LMS and all assignments must be submitted through LMS only. Most homework assignments were assigned weekly and due between 8:00 AM to 10:00 AM, right before the class sessions. The LMS data log was downloaded at the end of term when all due dates for homework submissions were closed.

Data analysis

Data were consolidated in Microsoft Excel and SPSS. The timestamps of homework submission from the LMS data log were inputted and organized in Microsoft Excel. The number of assignments submitted within the last 12 hours of the due time was added together for each student

to represent last-minute submissions. A percentage score was then calculated by comparing the proportion of last-minute submissions to the total number of submissions. Both final course scores and last-minute homework submission were captured as percentage data (see Table 2), whereas MSLQ variables were measured as numerical scale data. LMS data was then merged with survey data for further analysis.

For data analysis, we used partial least square (PLS) based structural equation modeling (SEM) in the SmartPLS 3.0 software due to three reasons. First, PLS-SEM imposes no demand on the sample size, scale type, and variable distribution (Hair et al., 2014; Tapola et al., 2013). The small sample size for the number of relationships tested in our research made PLS a better-suited analysis method. Different scales used in the current models also made PLS-SEM a preferred method for analysis. Second, PLS-SEM is also recommended when the nature of the analysis is rather exploratory (Hair et al., 2011). Third, recent research suggests that a composite-based SEM method such as partial least squares (PLS-SEM) is a superior approach for testing the mediation effect (Sarstedt et al., 2020).

We followed the three-step process suggested by Hair et al. (2014) for the final model analysis. First, the proposed conceptual model was created in SmartPLS 3.0. This consisted of variables measured on a combination of single-item and multi-item scales and connected together by theoretically driven relationships. Next, the outer model was evaluated for a robust factor structure. Cronbach's alpha values for six MSLQ variables were greater than 0.7, and the average variance extracted (AVE) values were greater than 0.543. All factor loadings were greater than 0.7, except one of the items of effort regulation ($\lambda = 0.675$). After an evaluation of the measurement item and overall factor reliability, we chose to keep the item. For discriminant validity, heterotrait-monotrait (HTMT) criteria were evaluated and were found to be lower than the cutoff value of 0.85 (Henseler et al., 2015). Table 3 shows the results of the outer-model analysis. The third step was to analyze the inner model for path coefficients. Bootstrapping with 5000 samples was used to calculate estimates for this step. Direct and indirect relationships, along with significance values, are discussed in the Results section.

Results

The inner-model analysis indicates that last minute homework submission has significant negative effect on course performance ($\beta = -0.484$, $p = 0.000$), supporting the first hypothesis. For H2, intrinsic orientation ($\beta = 0.263$, $p = 0.01$), and task value ($\beta = 0.246$, $p = 0.039$) positively influenced elaboration but self-efficacy did not ($\beta = 0.148$, $p = 0.061$). This supported H2b and H2c, but not H2a. Next, effort regulation was found to be positively affected by self-efficacy ($\beta = 0.257$, $p = 0.001$) and task value ($\beta = 0.232$, $p = 0.025$), supporting H3a and H3c. Relationship between effort regulation and intrinsic orientation ($\beta = 0.175$, $p = 0.055$) was not significant, hence, H3b was not supported. Time and study environment management was positively affected by self-efficacy ($\beta = 0.361$, $p = 0.000$) and intrinsic orientation ($\beta = 0.332$, $p = 0.000$), but not task orientation ($\beta = -0.030$, $p = 0.764$). These results supported H4a and H4b, but not H4c.

We found that two of the three forethought components and two of the three learning strategies were related to last-minute homework submissions; however, their effects were quite different. Specifically, self-efficacy ($\beta = -0.339$, $p = 0.000$) negatively affected last-minute homework submissions, but task value positively ($\beta = 0.355$, $p = 0.000$) affected last-minute homework submissions. Relationship between intrinsic goals and last-minute homework submissions was not significant ($\beta = 0.105$, $p = 0.238$). These results supported H5a, but not H5b and H5c.

For learning strategies, only effort regulation ($\beta = -0.275$, $p = 0.000$) was found to reduce last-minute homework submissions, supporting H6b. Elaboration in fact had a significant positive effect ($\beta = 0.311$, $p = 0.002$) on last-minute homework submissions, and time and study environment management had no effect ($\beta = -0.181$, $p = 0.066$). Both H6a and H6c were not supported.

For mediation effect, SmartPLS provided total indirect effects and specific indirect effects statistics. Specific indirect effects statistics were used to evaluate hypotheses H7 and H8. We

Table 3. Outer-model analysis for the MSLQ items.

MSLQ variable and item number	Statement	Factor loadings	*M*	*SD*	Factor structure evaluation method for each MSLQ variable
Self-efficacy					Cronbach Alpha = 0.925 Composite Reliability = 0.939 AVE = 0.658
1	I believe I will receive an excellent grade in this class.	0.783	3.38	1.00	
2	I'm certain I can understand the most difficult material presented in the readings for this course.	0.785	3.24	0.95	
3	I'm confident I can understand the basic concepts taught in this course.	0.712	4.08	0.84	
4	I'm confident I can understand the most complex material presented by the instructor in this course.	0.804	3.15	1.03	
5	I'm confident I can do an excellent job on the assignments and tests in this course.	0.865	3.41	0.98	
6	I expect to do well in this class.	0.826	3.78	1.00	
7	I'm certain I can master the skills being taught in this class.	0.831	3.50	0.92	
8	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	0.870	3.54	0.89	
Intrinsic goal orientation					Cronbach Alpha = 0.733 Composite Reliability = 0.833 AVE = 0.556
1	In a class like this, I prefer course material that really challenges me so I can learn new things.	0.784	3.30	0.98	
2	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	0.783	3.55	1.02	
3	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	0.706	4.21	0.83	
4	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	0.707	3.15	1.02	
Task value					Cronbach Alpha = 0.897 Composite Reliability = 0.921 AVE = 0.660
1	I think I will be able to use what I learn in this course in other courses.	0.735	4.38	0.76	
2	It is important for me to learn the course material in this class.	0.811	4.50	0.69	
3	I am very interested in the content area of this course.	0.838	3.79	1.11	
4	I think the course material in this class is useful for me to learn.	0.881	4.33	0.82	
5	I like the subject matter of this course.	0.810	3.66	1.11	
6	Understanding the subject matter of this course is very important to me.	0.792	4.27	0.82	

(Continued)

Table 3. (Continued)

Elaboration					Cronbach Alpha = 0.868 Composite Reliability = 0.905 AVE = 0.656
1	When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	0.736	4.07	0.92	
2	I try to relate ideas in this subject to those in other courses whenever possible.	0.819	3.77	0.97	
3	When reading for this class, I try to relate the material to what I already know.	0.815	4.06	0.86	
5	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.	0.833	3.84	0.97	
6	I try to apply ideas from course readings in other class activities such as lecture and discussion.	0.84	3.69	0.99	
Time and study environment					Cronbach Alpha = 0.830 Composite Reliability = 0.888 AVE = 0.666
1	I usually study in a place where I can concentrate on my course work.	0.837	4.3	0.93	
2	I make good use of my study time for this course.	0.887	3.81	0.98	
4	I have a regular place set aside for studying.	0.701	3.77	1.12	
5	I make sure I keep up with the weekly readings and assignments for this course.	0.828	3.88	1.02	
Effort regulation					Cronbach Alpha = 0.719 Composite Reliability = 0.825 AVE = 0.543
1	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do. (REVERSED)	0.719	3.84	1.13	
2	I work hard to do well in this class even if I don't like what we are doing.	0.675	4.1	0.87	
3	When course work is difficult, I give up or only study the easy parts. (REVERSED)	0.737	3.76	1.02	
4	Even when course materials are dull and uninteresting, I manage to keep working until I finish.	0.81	3.99	0.93	

found that last-minute homework submissions positively mediated the relationship between effort regulation and the final score at the end of the semester ($\beta = 0.161$, $p = 0.002$), supporting H7c. This mediation effect was negative for the relationship between elaboration and final score ($\beta = -0.106$, $p = 0.034$). Also, no mediation effect was found for time and study environment management and final score relationship ($\beta = 0.088$, $p = 0.07$). Hypotheses H7a and H7b were not supported.

For forethought components, the mediation effect of last-minute homework submissions was also significant and positive for the relationship between self-efficacy and course performance ($\beta = 0.164$, $p = 0.002$), supporting H8a. This mediation effect was negative for the relationship between task value and course performance ($\beta = -0.172$, $p = 0.000$). Also, no mediation effect was found for time and study environment management and course performance relationship ($\beta = -0.051$, $p = 0.247$). Hypotheses H8b and H8c were not supported. Table 4 and Figure 2 display the overall results.

F-square statistics indicated that only two relationships had medium to large effect sizes: (1) last-minute homework submission and final score ($f^2 = 0.306$, $p = .000$) and (2) self-efficacy and time and study environment management ($f^2 = 0.126$, $p = .033$). The adjusted R-square for each dependent variable was in the range of 23% to 33% (effort regulation: $R^2 = 0.303$, $p = .000$; elaboration: $R^2 = 0.300$, $p = .000$; time and study environment management: $R^2 = 0.331$, $p = .000$; last-minute homework: $R^2 = 0.233$, $p = .000$; final score submission: $R^2 = 0.314$, $p = .000$). Small sample size may have been a reason for small effect sizes in several relationships. Therefore, a combination of regression coefficients, effect size, and explained variance was used to interpret the results.

Discussion

Our findings highlight the crucial role of homework timeliness on learning achievement. In this study, the last-minute homework submission significantly influences the final grade, aligned with existing literature (Bang et al., 2011; Cooper, 2009; Cooper & Valentine, 2001; Fan et al., 2017; Núñez et al., 2015). Also, this study was aimed to explore the role of the forethought and learning strategies components of SRL on the timeliness of homework submissions performed by undergraduate female students in quantitative courses over a semester. Our findings have revealed that SRL plays a vital role in encouraging homework timeliness that can influence female students' learning achievement in quantitative-related courses. The SEM analysis provides insights that forethought components of SRL can serve as a foundation to implement learning strategies; it also displays significant relationships among SRL components, homework submission, and final grade, resonating with previous studies (Bembenutty, 2010, 2011; Cadime et al., 2017; Ginns et al., 2014; Kitsantas & Zimmerman, 2009; Planchard et al., 2015).

The role of forethought components

Whether students submit their homework timely or at the last minute is potentially influenced by their SRL skills. Our findings reveal relationships among the SRL components and homework timeliness. Self-efficacy seems to serve as a vital forethought component and is a precursor of learning achievement in a quantitative course, especially for underrepresented students (Hardin & Longhurst, 2016; Navarro et al., 2014). In our study, it has a significant (indirect) effect on homework submission, confirming previous research (Bembenutty & White, 2013; Calderwood et al., 2014; Ginns et al., 2014; Katz et al., 2014; Kitsantas & Zimmerman, 2009; Ramdass & Zimmerman, 2011). Students with high self-efficacy can persist through the challenges of completing homework because they possibly have positive self-talk that boosts their self-efficacy (Xu, 2013). Self-efficacy also has a significant direct relationship effort regulation strategy, in which this strategy also significantly influences homework submission. This suggests that high self-efficacious students are likely to plan and select appropriate learning strategies, such as effort regulation, for working on

Table 4. Overall results of the PLS-SEM analysis.

Hypothesis	Path	Mediator	Path coefficient (β)	Significance (p)	F-square	Hypothesis support
H1	Last-minute homework submission → final score	–	–0.0484	0.000	0.306	Yes
H2a	Self-efficacy → elaboration	–	0.148	0.061	0.02	No
	Intrinsic goal orientation → elaboration	–	0.263	0.010	0.065	Yes
	Task value → elaboration	–	0.246	0.039	0.05	Yes
H3a	Self-efficacy → effort regulation	–	0.257	0.001	0.061	Yes
H3b	Intrinsic goal orientation → effort regulation	–	0.175	0.055	0.029	No
H3c	Task value → effort regulation	–	0.232	0.025	0.045	Yes
H4a	Self-efficacy → time and study environment	–	0.361	0.000	0.126	Yes
H4b	Intrinsic goal orientation → time and study environment	–	0.332	0.000	0.109	Yes
H4c	Task value → time and study environment	–	–0.030	0.764	.001	No
H5a	Self-efficacy → last-minute homework submission	–	–0.339	0.000	0.086	Yes
H5b	Intrinsic goal orientation → last-minute homework submission	–	0.105	0.238	0.008	No
H5c	Task value → last-minute homework submission	–	0.355	0.000	0.086	Yes
H6a	Elaboration → last-minute homework submission	–	0.311	0.002	0.036	No
H6b	Effort regulation → last-minute homework submission	–	–0.275	0.005	0.073	Yes
H6c	Time and study environment management → last-minute homework submission	–	–0.181	0.066	0.006	No
H7a	Elaboration → final score	Last-minute homework submission	–0.106	0.034	NA	Yes
H7b	Effort regulation → final score	Last minute homework submission	0.088	0.070	NA	No
H7c	Time and student environment management → final score	Last-minute homework submission	0.161	0.002	NA	Yes
H8a	Self-efficacy → final score	Last-minute homework submission	0.164	0.002	NA	Yes
H8b	Intrinsic goal orientation → final score	Last-minute homework submission	–0.051	0.247	NA	No
H8c	Task value → final score	Last-minute homework submission	–0.172	0.000	NA	Yes

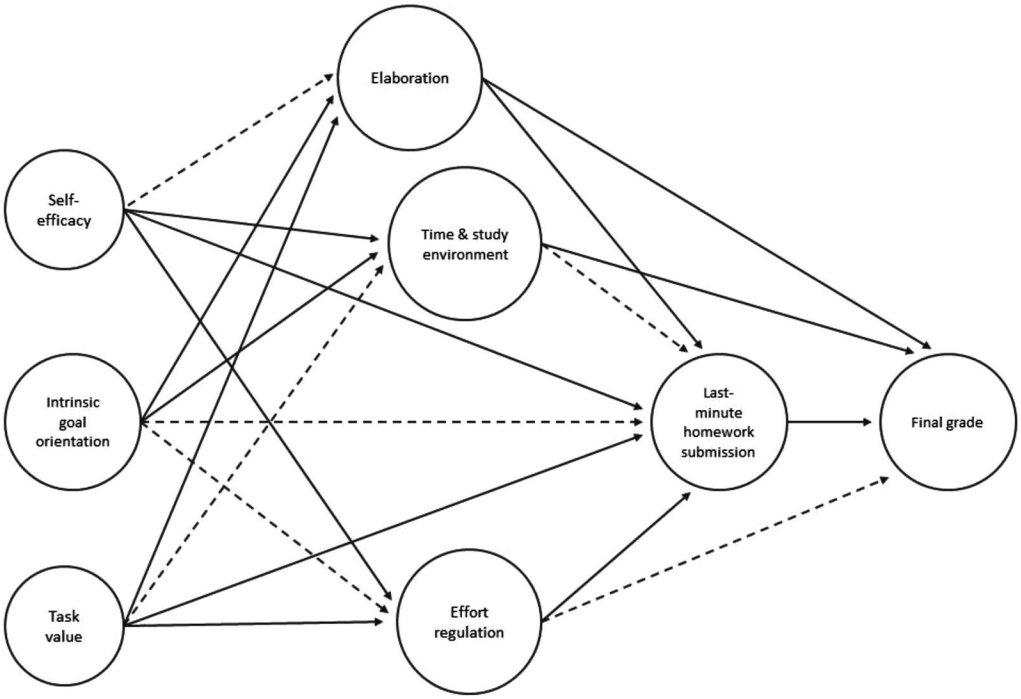

Figure 2. The results of the PLS-SEM analysis. The regular arrow indicates a significant relationship, and the dotted arrow indicates a non-significant relationship.

their homework (Bembenutty, 2005, 2011; Kitsantas et al., 2011; Pintrich & De Groot, 1990). The only learning strategy not significantly influenced by self-efficacy is elaboration, which resonates with Ginns et al. (2014). This non-significant finding may be related to students' limited knowledge or skills about a proper elaboration strategy (Ginns et al., 2014)—further discussion on interpreting the results related to elaboration is provided in a subsequent section.

Female students are likely to be adaptable and willing to correct their learning strategies (Bidjerano, 2005; Lishinki et al., 2016), indicating an opportunity to scaffold their SRL skills through instructional strategies. Educators from higher education may focus on implementing strategies to enhance female students' self-efficacy into homework assignments, especially for supporting the mastery of quantitative topics (Kitsantas et al., 2011), such as by providing clear homework instructions and the purpose of the homework (Cho & Shen, 2013), and assigning homework orderly according to the difficulty level (Bandura, 1997; Cho & Shen, 2013). Another strategy is to add a metacognitive activity in between problems within homework by asking students to self-rate their ability to solve the problem after they read the problem question (Nilson, 2013; Zimmerman et al., 2011). When they think they have solved it or are unsure about the answer, they can reread their self-rating, and reanalyze their answer and any errors. Instructor feedback can be tailored to signify the learning progress and their potential ability for boosting self-efficacy.

We discover mixed findings in the forethought variables (e.g., task value and intrinsic goal orientation). For example, task value does not directly help reduce the last-minute homework submissions in our study, which contradicts previous studies (Warton, 2001; Xu, 2015). Additionally, our findings do not indicate a significant relationship between task value and time and study environment management. Intrinsic goal orientation does not significantly influence effort regulation and last-minute homework submission either. These mixed findings may be associated with the specific context of female students in this study. Existing literature has documented that female students are likely to have math anxiety and a lack of interest in mathematical-related concepts; unsurprisingly, they tend to avoid enrolling in quantitative courses, and it is challenging for them to persist in quantitative courses (Devine et al., 2012; Fan et al., 2017; Recber et al.,

2017; Rundgren et al., 2019; Tarasi et al., 2013). The female students in this study are non-STEM students in a retail management program, but they must enroll in the quantitative courses as a requirement. They appear to understand the value of the required quantitative courses. However, there is a possibility that they may not have sufficient intrinsic interest to help them persist in the quantitative courses (Dasgupta & Stout, 2014; Leaper et al., 2012; Recber et al., 2017), potentially explaining the mixed findings. This is a research area that necessitates further exploration, such as by delving into the relationship between task value components (e.g., utility value and intrinsic value) and homework timeliness.

The role of learning strategies

Two of the three learning strategies significantly influence homework submission (e.g., effort regulation and elaboration). The effort regulation strategy significantly reduces last-minute homework submissions. A possible explanation is that students implementing this strategy can manage their effort and attention during homework activities. In turn, they are not likely bothered by distractions and can complete the homework productively (Xu, 2009). Unsurprisingly, this strategy also helps students achieve better in the course (Xu, 2009). In our study, effort regulation has a significant indirect effect on the final course, and effort regulation and last-minute homework submission significantly affect the final score.

Elaboration displays a significant effect on the last-minute homework submission. However, the relationship is found positive in our study; the more the students apply this strategy, the more frequently the last-minute homework submission occurs. Additionally, elaboration affects the final course score negatively. This contradictory finding may be related to our specific context. The non-science female students in our study might have spent too much time on elaboration, leaving them with less time for homework activity. A previous study has revealed that non-science female students overall outperform their male peers in the elaboration strategy (Bidjerano, 2005). Additionally, female students score higher in the execution of learning strategies (Cadime et al., 2017). However, their male peers are likely to outperform them in quantitative courses (Rosário et al., 2018). The same elaboration strategy may not be suitable for learning quantitative topics. This indicates the essential role of training students in adapting learning strategies for various disciplines (Bembenutty, 2011; Broadbent et al., 2020). The training can be manifested in the homework assignments (Stoeger & Ziegler, 2011), for example, by allowing students to analyze their own homework mistakes in solving quantitative-related problems (Nilson, 2013; Zimmerman et al., 2011). This can also guide them to find a suitable elaboration strategy for mastering quantitative topics.

Previous literature has documented that applying the time and study environment management strategy can increase the likelihood of homework completion (Bembenutty, 2009; Xu, 2009), but our finding indicates an opposite and non-significant relationship. This mixed finding is perplexing and may be due to the unique characteristics of the female group under study. Homework time management is related to the time spent on performing homework activities (Xu et al., 2014) and students' ability to optimize the time spent on homework (Piñeiro et al., 2019). Time spent on homework activities and how students optimize the time to complete homework are not included in our model; these may be amongst those additional factors impacting the relationship between time/study environment management and homework timeliness that are worth exploring in a forthcoming study.

Limitations and research recommendations

There are several limitations in this study. Zimmerman's (2000) SRL model includes the third phase that is excluded in this study. Through the third phase—self-reflection—students evaluate their efforts and outcome. A previous study has highlighted the potential benefits of adding self-reflective activity into math homework (e.g., homework wrappers) (Chew et al., 2016). Future research may include self-reflection intervention to explore how students reflect on current

homework achievement and plan for the follow-up goals and better strategies to improve the subsequent homework completion.

Also, the scope of this study is quite specific; other variables that additionally explain the variance in the outcome variables are excluded from our model. For example, our findings display a contradiction regarding task value and time and study environment management because there may be other possible factors not outlined in our model. Forthcoming research may explore the role of task value components and how the time spent on studying and personal, family, and/or job responsibilities is related to SRL and affects homework timeliness.

Recruiting a larger number of participants can increase the validity and generalization of findings. Additionally, including the male students in the study may reveal how gender may moderate the relationship between homework timeliness and learning achievement. As stated by Fan et al. (2017), only a few studies focus on gender differences while exploring such a relationship. Future studies may also benefit from separating students into different groups (e.g., age, social-economic status, how many semester units enrolled, how many hours spent for paid employment) to discover the differences among groups. Furthermore, the present study relies on quantitative data. Forthcoming studies may include qualitative data to gain in-depth insights regarding additional factors hindering students from completing homework on time.

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Compliance with ethical standards

Research involving human participants: "This research project was reviewed by the Institutional Review Board at the university under study who then granted an approval (IRB Protocol Number: IRB-18-31). The research project was found to be in compliance with applicable federal and state regulations and the university's policies regarding the protection of human subjects used in research."

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Informed consent

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

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