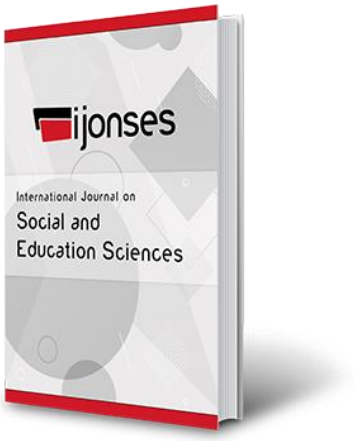

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To cite this article:

Alkhateeb, H. (2025). Motivation and learning strategies of university students in a self-paced developmental course. *International Journal on Social and Education Sciences (IJonSES), 7*(2), 205-221. https://doi.org/10.46328/ijonses.750

International Journal on Social and Education Sciences
2025, Vol. 7, No. 2, 205-221 https://doi.org/10.46328/ijonses.750

Motivation and Learning Strategies of University Students in a Self-Paced Developmental Course

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Article Info

Article History

Received:
30 January 2025
Accepted:
20 April 2025

Keywords

MSLQ
Motivation
Developmental mathematics
Learning strategies

Abstract

This study used the Motivated Strategies for Learning Questionnaire (MSLQ) to assess the motivation and learning strategies of students in a self-paced developmental mathematics class. A total of 194 undergraduate students participated in this study. Descriptive statistics, correlation coefficients, and regression analysis were conducted to assess students' motivation and their use of various learning strategies. The correlation analysis revealed that most MSLQ scale scores were significantly correlated with one another and with the overall MSLQ. Specifically, motivation—particularly task value and test anxiety—was a significant predictor of learning strategies. The mean scores for the MSLQ scales ranged from moderate to high.

Introduction

Research studies have explored the factors that influence students' success, with several studies focusing on students' motivation and the use of learning strategies (Aguila-Gomez, 2016; Chen, 2002; Fang, 2014; Khampirat, 2021; Pintrich & De Groot, 1990; Pintrich et al., 1991, 1993; Walker et al., 2024). These studies have identified motivation and learning strategies as key predictors of academic success. Specifically, students who exhibit high motivation and effectively utilize learning strategies are more likely to achieve better academic performance and overall success. In the works of Pintrich et al. (1993) and Seli (2024), motivation is emphasized as a crucial factor in student learning and achievement. It is described as the process that initiates, directs, and sustains goal-oriented behavior. Both authors focus on the role of motivation in self-regulated learning, highlighting that motivation impacts the decisions students make, the effort they invest, and their persistence when facing challenges. Self-regulated learning is a key concept in education, encompassing cognitive, metacognitive, emotional, behavioral, and motivational dimensions (Morais, Santos, & Mouraz, 2025). Pintrich et al. (1993) and Seli (2024) also underscore the relationship between motivation and cognitive factors, such as learning strategies, proposing that motivated students are more likely to use effective learning strategies to achieve their academic goals. Researchers have defined learning strategies in various ways, Mayer (2007) explained that learning strategies refer to the cognitive processes students develop during learning to enhance the quality of their learning and help them achieve their goals. Zimmerman (2000) proposed that learning strategies should be incorporated into the framework of self-regulated learning, which involves self-generated thoughts, feelings, and actions that are planned and cyclically adjusted to attain personal goals. Therefore, the use of learning strategies can be seen as a sub-construct

of self-regulated learning.

As stated in the study by Adnan, Nordin, and Ibrahim (2013), learning strategies alone are not sufficient to improve student achievement. Students must be motivated to use these strategies, as motivation is the driving force that compels individuals to act to fulfill their desires. The concept of self-regulation refers to a metacognitive process in which students reflect on their own thinking to assess the outcomes of their actions and plan alternative strategies for success. Students who effectively self-regulate organize their tasks, set both short-term and long-term goals, seek help when needed, and manage their time efficiently (Alt, 2015; Pintrich, 2000; Usher & Pajares, 2009; Wolters, Pintrich, & Karabenick, 2005). Research indicated that self-regulated and highly motivated learners tend to experience greater success in college (Araka et al., 2020; Garcia-Ros et al., 2018; Hariri et al., 2021; Khampirat, 2021; Martin & Sorhaindo, 2019). Furthermore, students with high levels of motivation tend to employ both cognitive and metacognitive strategies during the learning process (Eccles, 1983; Pintrich & De Groot, 1990).

Research suggests that student success in mathematics is influenced by a range of factors, such as ability, attitude, perception, socioeconomic status, parental and peer support, school-related factors, and motivation (Singh, Granville, & Dika, 2002). Relevant literature has shown that students' motivation for learning is statistically significant in their correlation with academic achievement across various STEM (science, technology, engineering, and mathematics) disciplines (Bandura, 1982; Lynch, 2010). For instance, in a study of a college physics course, Lynch found that students' semester grades were positively correlated with their self-efficacy, both intrinsic and extrinsic motivation, and task value (Lynch, 2010). Research evidence has shown that students' academic achievement is influenced not only by cognitive factors (Mayer, 1998), such as cognitive abilities, but also by affective factors, including motivation, interest, and learning strategies (Marra et al., 2012; Pintrich & De Groot, 1990). For example, when a student is deeply interested in a particular topic and highly motivated, they are more likely to invest significant time and effort into learning.

To identify the variables that influence academic achievement among university students, the Motivated Strategies for Learning Questionnaire (MSLQ) was developed (Pintrich et al., 1993). MLSQ is among the most widely used questionnaires for assessing students' motivation and learning (Duncan & McKeachie, 2005; Pintrich et al., 1993). It has been widely used to predict academic performance (Burlison, Murphy, & Dwyer, 2009; Kizilcec, Perez-Sanagustin, & Maldonado, 2017; Lynch, 2010) and to identify students at risk (Crede & Phillips, 2011). The MSLQ consists of two main sections: motivation and learning strategies. In the MSLQ, the motivation section measures students' goals, value beliefs about courses, perceived ability to succeed, and test-related anxiety. Learning strategies assess students' use of different cognitive, metacognitive, and resource management strategies (Duncan & McKeachie, 2005; Pintrich et al., 1993). The MSLQ is widely used in studies on motivation and learning strategies across various educational contexts, including research on high school and university students, as well as adult learners. It has been applied in diverse disciplines such as educational psychology, social sciences, accounting, nutrition, and teacher training (Chen, 2002; Duncan & McKeachie, 2005). Research suggests that one approach to understanding motivation is to differentiate between intrinsic and extrinsic motivation (Ryan & Deci, 2000). Intrinsic motivation stems from the sense of accomplishment derived from succeeding in a task after one

or more attempts. This type of motivation is often linked to feelings of pride, self-worth, or satisfaction. In contrast, extrinsic motivation involves external rewards gained through success, which are typically more tangible. These rewards could include a high grade on a test or bonus points, among other forms of recognition (Ryan & Deci, 2000). Ironsmith et al. (2003) conducted a study comparing the motivation and performance of college students in a self-paced learning environment versus traditional learning in a developmental mathematics course. The results revealed no significant difference in final exam scores between the self-paced and traditional lecture formats for most students. However, a key difference was observed among students with a high learning goal orientation, who were particularly motivated by the intrinsic satisfaction of learning and performed better in the self-paced course.

Horn and Asmussen (2014) highlighted that a significant challenge in higher education is narrowing the educational attainment gap between academically prepared and unprepared students. To address this issue, developmental or remedial education aims to enhance the academic skills and knowledge of students who are unprepared for undergraduate coursework, particularly in mathematics, reading, and writing. According to Logue, Watanabe-Rose, and Douglas (2016), approximately 60% of new freshmen in U.S. colleges are assessed as unprepared for college-level work, particularly in mathematics. College policies typically require these students to complete remedial courses before enrolling in college-level courses in the same subjects, based on the assumption that passing remedial courses is necessary for success in college-level courses. Research has examined ways to support the success of developmental mathematics students in college, but further investigation into motivation and learning strategies within developmental mathematics classrooms is needed to improve instructional practices. However, tools to assess motivation and learning strategies are less well-known at the college level, highlighting the need for such measures to better support developmental students' success in mathematics. Using informal observations or survey tools, such as the Motivated Strategies for Learning Questionnaire (MSLQ), can help identify students' levels of motivation and their use of learning strategies. Building on these perspectives, this study focused on assessing motivation and learning strategies as key factors in promoting success.

For decades, developmental mathematics educators have worked to improve the mathematical skills of underprepared students. As administrators push for higher college degree completion rates, there is growing pressure to innovate instructional approaches in developmental mathematics courses to improve student outcomes. Faculty members are beginning to recognize the need for a paradigm shift from traditional methods to more modern, technology-driven approaches (such as self-paced, flipped, and online learning). With the shift in classroom structure, motivation and learning strategies have become critical factors in discussions about supporting the success of developmental mathematics students. Most existing research focused on general motivation for success, such as overall college completion. However, there is a noticeable gap in literature regarding student motivation and learning strategies in mathematics within college classroom settings. The specific purpose of this quantitative study is to assess university students' motivation and learning strategies in a self-paced developmental mathematics course using the Motivated Strategies for Learning Questionnaire (MSLQ). The study aims to examine the relationships among various motivation scales and among different learning strategy scales, as well as to explore whether motivation predicts students' use of learning strategies. For

faculty teaching such courses or for students enrolled in self-paced learning environments, MSLQ scores may help identify those facing challenges and shed light on the motivational factors and learning strategies affecting their success or difficulties.

Method

Participants

A total of 194 students enrolled in the developmental mathematics course "Foundational Mathematics – Algebra" in a state university on the East Coast of the United States participated in this study. This is the university's only developmental mathematics course, offered in multiple sections. Their ages ranged from 18 to 51, with a mean age of 24.4 (SD = 7.4). These students attended a public university offering undergraduate, graduate, and professional programs across four colleges: business, law, public affairs, and applied arts and sciences. Among the participants, 128 (66.0%) identified as female, 60 (30.9%) identified as male, and 6 (3.1%) did not disclose their gender. For class level, 64 students (33%) identified as freshmen, 37 (19.1%) as sophomores, 45 (23.2%) as juniors, and 48 (24.7%) as seniors. Given that the university is a small institution, data were collected over a three-year period to ensure a sufficiently large sample size. All students enrolled in the developmental mathematics classes offered were included as participants in the study. Racially, many respondents were African American/Black, with 141 (72.7%) identifying as such. In 2023, with a total enrollment of 3,710 students, African American students represented nearly half (49.4%) of the undergraduate student body, while female students made up 62%. The rationale for selecting developmental mathematics students is that those placed at this level often demonstrate low motivation and use fewer effective learning strategies. Additionally, a college student sample is more appropriate for this study, as students at this level of education typically have greater control over their learning process. Convenience sampling was employed for this selection.

Foundational Mathematics – Algebra

The developmental mathematics-based algebra course (intermediate algebra) was aligned with the college algebra curriculum and was the lowest-level course offered. It served as a prerequisite course designed to prepare students for college-level mathematics courses, such as college algebra, mathematics for liberal arts, or introductory statistics—all of which are credit-bearing courses. A significant portion of students enrolled in these mathematics courses are transfer students, primarily from community colleges. A developmental mathematics student is one who demonstrates moderate skill deficiencies in mathematics and requires both cognitive and affective development before progressing to credit-bearing courses (Baxter, Bates, & Al-Bataineh, 2017). Placement into developmental mathematics was determined by the results of the ACCUPLACER mathematics placement exam.

This course was one semester in length and was taught in an instructor-led lecture format, with students attending three hours per week. The course emphasized active learning, which encouraged students to engage directly with the material. Students completed paper-and-pencil exercises, and MyMathLab—a Pearson Education online platform—was used for homework assignments and exams, providing interactive support to help students meet course outcomes. To support student success, the Mathematics Learning Center offered free tutoring services and

access to thirty computers for additional practice. It was open 25–38 hours per week, and tutors were also available through the university's Achievement and Learning Center. Faculty members actively monitored student progress, offering early intervention and counseling to those struggling with the material.

The course was structured around eight modules, each requiring a minimum grade of 73% (a "C" or higher) for mastery. The modules covered the following topics: operations with real numbers; fractions and decimals; proportions, ratios, rates, percents; expressions, linear equations, linear inequalities; graphs and equations of lines; polynomials and quadratic applications; rational expressions and equations; and radical expressions and equations. The grading structure for each module included homework 20%, attendance 20%, and module exam 60%. It is important to note that students must pass all eight modules in the developmental mathematics course to successfully complete it. If a student does not pass a module, they may retake the exam at the Mathematics Learning Center, with tutoring required after any unsuccessful attempt. The course was designed to be self-paced, allowing students to progress independently. Self-paced mathematics courses are a specialized format that, while not new to higher education (Ironsmith et al., 2003), allow students to progress independently, without the constraints of a faculty-driven timeline. Students may work on module homework and exams at their own pace, as long as they achieve at least 80% on the module homework before attempting the exam. While students are allowed multiple attempts at the exam, they must seek tutoring after any failed attempt. The course was module-based, with no midterm or final comprehensive exams.

At the end of the semester, students who pass all eight modules with a score of 73% or higher received a grade of "S" for Satisfactory (passing), which is not factored into the GPA. If a student does not complete all eight modules, they will receive a grade of "CS" for Continuing Studies and may re-register for the course in a subsequent semester. The course operated as a variable credit course. Depending on how many modules a student has completed in a prior attempt, they may enroll for one, two, or three credits in subsequent semesters. However, they will not be required to repeat any modules they have already passed. Students who do not complete all modules by the third attempt (over the course of three semesters) will receive a grade of "NS" for Unsatisfactory. Note that developmental mathematics credits do not count toward the 120 credits required for graduation, although they do contribute to full-time enrollment status (12 or more credits per semester).

The mathematics program offering developmental mathematics also includes general education courses (such as college algebra, introductory statistics, and mathematics for liberal arts) and advanced mathematics courses (including calculus, discrete mathematics, and applied probability and statistics), primarily serving students in the applied information technology program. This non-degree mathematics program employed adjunct (part-time) faculty who were responsible for teaching both developmental and certain general education mathematics courses. Graduate courses and teaching assistants are not part of this program.

Measure

The Motivated Strategies for Learning Questionnaire (MSLQ) was developed to assess college students' motivational orientations and their use of various learning strategies in relation to the specific course they are

studying (Pintrich et al., 1991). This instrument is a widely used tool for evaluating college students' self-regulated learning (Chen, 2002; Morais, Santos, & Mouraz, 2025) and is one of the most frequently utilized (Mills & Gay, 2018). The MSLQ is based on a general cognitive view of motivation and learning strategies and it consists of two main sections: the motivation section, which includes six scales, and the learning strategies section, which contains nine scales. These sections are modular, allowing researchers to use the scales individually or in combination, depending on their specific objectives.

The motivation section is based on a general social-cognitive model of motivation, which includes three key motivational constructs: value, expectancy, and affect. The value component focuses on students' beliefs about why they engage in academic tasks. Three scales assess these value beliefs: intrinsic goal orientation (emphasizing learning and mastery), extrinsic goal orientation (focusing on grades and approval from others), and task value (evaluations of how interesting, useful, and important the course content is). The expectancy component relates to students' beliefs in their ability to accomplish tasks, measured through two scales: control beliefs about learning (the belief that outcomes depend on one's own effort) and perceptions of self-efficacy for learning and performance (self-assessment of one's ability to master a task). The third motivational construct, affect, is measured by the test anxiety scale, which gauges students' worry and concern about taking exams (Pintrich et al., 1993).

The learning strategies section of the questionnaire is based on a general cognitive model of learning and information processing, emphasizing students' use of a range of strategies. It includes three categories of strategies: cognitive, metacognitive, and resource management. Cognitive and metacognitive strategies involve both basic and complex approaches students use to process information from texts and lectures. The most basic cognitive strategy scale measures the use of rehearsal (e.g., repeating words to aid memory). More complex strategies are assessed through two scales that measure the use of elaboration (e.g., paraphrasing, summarizing) and organization (e.g., outlining). A critical thinking scale is also included, which evaluates students' ability to apply prior knowledge to new situations or critically evaluate ideas. Metacognition refers to the awareness, knowledge, and regulation of one's own cognition. Metacognitive self-regulation strategies, the second general category, are assessed using a scale that evaluates strategies helping students regulate their own cognition. It contains three essential skills, namely planning (goal setting), monitoring (tracking comprehension), and regulating (adjusting reading speed based on task demands). The third category, resource management, includes four scales that focus on students' strategies for managing resources beyond cognition. These include time and study environment management (e.g., effective time use and finding appropriate study spaces) and effort regulation (e.g., persevering through difficult or tedious tasks). Finally, two additional scales—peer learning (e.g., using study groups or friends to assist in learning) and help-seeking (e.g., seeking help from peers or instructors when needed)—address the use of others in the learning process (Pintrich et al., 1993).

The MSLQ consists of 81 items divided into 15 self-report scales, with each item scored on a 7-point Likert scale ranging from 1 (not at all true of me) to 7 (very true of me). Students used this scale to rate themselves on each item. The motivation section includes 31 items that assess students' goals and value beliefs regarding a course, their beliefs in their ability to succeed, and their anxiety about tests in the course. The motivation section includes

the following scales: intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety. The learning strategy section includes 50 items that evaluate students' use of various cognitive and metacognitive strategies, as well as their management of different resources. The learning strategies section includes the following scales: rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking. Scores for the individual scales created by calculating the average of the items that comprise the scale. For instance, the intrinsic goal orientation scale consists of four items. An individual's score for intrinsic goal orientation is determined by summing the scores for these four items and then taking the average. Some items are phrased negatively, so for these, the ratings are reversed to ensure that higher scores (e.g., 4, 5, 6, or 7) generally reflect more favorable responses, while lower scores (e.g., 1, 2, or 3) indicate less favorable responses. Negative items are reversed before computing individual scores (Pintrich et al., 1991). The items on the test anxiety scale were also scored in reverse. This adjustment ensures that the reported statistics reflect the positively worded items, with a higher score indicating greater levels of the construct of interest. The only exception to this is the test anxiety scale, where a higher score indicates more anxiety or worry. Pintrich et al. (1993) confirmed that the scale reliabilities of the MSLQ were robust and that the instrument demonstrated reasonable predictive validity. The validity and reliability of the MSLQ were also noted in the studies by de Araujo, Gomes, and Jelihovschi (2023) and Pintrich et al. (1991).

Over a period of three years, student participants completed the Motivated Strategies for Learning Questionnaire (MSLQ), along with questions about their general background characteristics. At the end of the semester, students completed the MSLQ survey, which was administered during their regular class sessions. The survey was designed for in-class administration and typically takes about 20 minutes to complete. Given the self-paced nature of the developmental mathematics course in this study, the MSLQ was chosen as the most appropriate instrument, as motivation is closely tied to the ability to self-regulate learning activities. The collected data were then entered into SPSS for statistical analysis. Descriptive analysis was conducted using frequency and mean values, along with ANOVA F-tests, Pearson's Product Moment Correlation (Pearson's r), and regression analysis. Student information remained confidential, and participation was voluntary.

The primary aim of this observational study was to provide empirical data on the motivation and learning strategies of a sample of undergraduate students in developmental mathematics through descriptive analysis. Correlation coefficients were calculated to examine the relationships between students' scores on the motivation scales, the learning strategy scales, and the overall MSLQ score. Multiple regression analysis was conducted to assess whether motivation significantly predicts students' learning strategies.

Results

The internal consistency of the MSLQ was assessed using Cronbach's alpha reliability index (Cronbach, 1951). Descriptive statistics were also calculated for the MSLQ scales. The Pearson correlation coefficient (r) was used to assess the relationship between pairs of scales, as well as between the scales and the total scores for motivation and learning strategies. Since the MSLQ combines two different sections—the Motivation and the Learning

Strategies sections—the findings are presented under separate subheadings for each section.

Table 1 presents the Cronbach's alpha reliability indices for the 15 scales of the MSLQ. The internal consistency coefficients for the Motivation scales ranged from 0.67 for the Control of Learning Beliefs scale to 0.92 for the Self-Efficacy for Learning scale. For the Learning Strategies scales, the consistency indices ranged from 0.40 for the Help Seeking scale to 0.79 for the Elaboration scale. These values are considered acceptable, with reported acceptable values ranging from 0.52 to 0.93 (Pintrich et al., 1991; Pintrich et al., 1993). However, the reliabilities of some scales were low, which may be due to Cronbach's alpha being highly sensitive to the number of items (Pelham, 2013). Overall, Cronbach's alpha was ≥ 0.70 for most scales, which is consistent with the findings of Cook and Skrupky (2024), Holland et al. (2018), and Khampirat (2021).

Table 1. Cronbach's Alpha Reliability Indices for The MSLQ and Its Scales

Scales	# of Items	Cronbach Alpha
Motivation	31	0.91
Intrinsic Goal Orientation	4	0.75
Extrinsic Goal Orientation	4	0.70
Task Value	6	0.84
Control of Learning Beliefs	4	0.67
Self-Efficacy for Learning	8	0.92
Test Anxiety	5	0.76
Learning Strategies Scales	50	0.92
Rehearsal	4	0.65
Elaboration	6	0.79
Organization	4	0.70
Critical Thinking	5	0.77
Metacognitive Self-Regulation	12	0.72
Time and Study Environment	8	0.69
Effort Regulation	4	0.48
Peer Learning	3	0.76
Help Seeking	4	0.40

MSLQ Motivation

In Table 2, the mean scores for the six motivation scales ranged from 3.56 for test anxiety to 5.29 for extrinsic goal orientation, reflecting moderate to high levels of motivation. These results indicate an overall positive response to the scales, with values exceeding the neutral benchmark of 4.0. The exception is test anxiety, where a higher score reflects greater anxiety or worry. A test anxiety score of 3.56 suggests a moderate level of anxiety. The results show no significant difference in motivation between males and females, $F(1, 187) = 0.308$, $p = 0.580$. Similarly, no significant difference in motivation was found across class levels (freshmen, sophomores, juniors, and seniors), $F(3, 193) = 2.578$, $p = 0.055$. Correlations showed a significant relationship between scales ($p <$

.01), except for test anxiety. As shown in Table 3, the correlations between the total score and the individual scale scores range from 0.32 to 0.88. Among the scale scores themselves, the correlations vary from -0.31 to 0.72. Intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning all showed significant positive correlations with one another, with values ranging from 0.22 to 0.72. These positive correlations indicate that students' scores on these scales tend to change in the same direction. For example, if a student has a high score in intrinsic goal orientation, they are likely to have similarly high scores in extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning. Additionally, there is a significant negative correlation between extrinsic goal orientation and test anxiety (r = -0.31), as well as a significant positive correlation between self-efficacy for learning and test anxiety (r = 0.32).

Table 2. Descriptive Statistics for MSLQ Motivation Scores

Scales	Mean	SD
Intrinsic Goal Orientation	4.50	1.40
Extrinsic Goal Orientation	5.29	1.36
Task Value	4.49	1.45
Control of Learning Beliefs	5.10	1.23
Self-Efficacy for Learning	4.95	1.43
Test Anxiety (reversed)	3.56	1.48
Motivation	4.65	0.94

Table 3. Pearson Correlation Coefficients of the Motivation Scales

Scales	Pearson Coefficients					
	1	2	3	4	5	6
1. Intrinsic Goal Orientation	-	0.47**	0.72**	0.39**	0.65**	0.01
2. Extrinsic Goal Orientation		-	0.55**	0.22**	0.39**	-0.31**
3. Task Value			-	0.44**	0.63**	0.08
4. Control of Learning Beliefs				-	0.59**	0.13
5. Self-Efficacy for Learning					-	0.32**
6. Test Anxiety						-
Total	0.80**	0.56**	0.84**	0.67**	0.88**	0.32**

**Correlation is significant at the 0.01 level (2-tailed).

MSLQ Learning Strategies

In Table 4, the mean scores for the nine learning strategy scales ranged from 3.05 for peer learning to 4.80 for effort regulation, reflecting a moderate range. These results suggest an overall positive response to the scales. The results show no significant difference in learning strategies between males and females, $F(1, 187) = 0.796$, $p = 0.373$. Similarly, no significant difference in learning strategies was found across class levels (freshmen, sophomores, juniors, and seniors), $F(3, 193) = 1.439$, $p = 0.233$. The correlations among the learning strategy scales are presented in Table 5, almost all the correlations demonstrated a significant relationship between the

scales ($p < .01$). The correlations between the total score and the individual scale scores range from 0.28 to 0.88. Among the individual scale scores, correlations vary from -0.25 to 0.79. As shown in the table, apart from the relatively low correlations between effort regulation and some other strategies; cognitive and metacognitive, and resource management strategies are generally positively correlated with each other. Notably, effort regulation shows a negative correlation with peer learning ($r = -0.25$, $p < .01$). These findings suggest that students who use one of these strategies tend to use the others in a similar way. For example, the organization strategies were positively correlated with both the metacognitive self-regulation and the peer learning strategies ($r = 0.70$, $p < 0.01$ and $r = 0.47$, $p < 0.01$, respectively). Students who use organization strategies are also likely to employ metacognitive self-regulation and peer learning strategies. Additionally, the peer learning strategy was significantly correlated with the metacognitive self-regulation strategy ($r = 0.32$, $p < 0.01$), indicating that students who use more strategies in peer learning are also more likely to use strategies in metacognitive self-regulation.

Table 4. Descriptive Statistics for MSLQ Learning Strategies Scores

Scales	Mean	SD
Rehearsal	4.61	1.37
Elaboration	4.21	1.36
Organization	4.46	1.45
Critical Thinking	3.98	1.42
Metacognitive Self-Regulation	4.47	0.91
Time and Study Environment	4.64	1.02
Effort Regulation	4.80	1.16
Peer Learning	3.05	1.68
Help Seeking	3.58	1.18
Learning Strategies	4.30	0.85

Table 5. Pearson Correlation Coefficients of the Learning Strategies Scales

Scales	Pearson Coefficients								
	1	2	3	4	5	6	7	8	9
1. Rehearsal	-	0.61**	0.73**	0.59**	0.69**	0.46**	0.14*	0.35**	0.36**
2. Elaboration		-	0.68**	0.79**	0.64**	0.28**	0.01	0.48**	0.50**
3. Organization			-	0.60**	0.70**	0.48**	0.10	0.47**	0.44**
4. Critical Thinking				-	0.58**	0.15*	-0.11	0.59**	0.46**
5. Metacognitive Self-Regulation					-	0.58**	0.32**	0.32**	0.35**
6. Time and Study Environment						-	0.57**	-0.02	0.14
7. Effort Regulation							-	-0.25**	-0.11
8. Peer Learning								-	0.64**
9. Help Seeking									-

Total	0.80**	0.82**	0.84**	0.76**	0.88**	0.62**	0.28**	0.54**	0.57**

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Using Motivation to Predict Learning Strategies

A multiple linear regression analysis was conducted to examine whether motivation significantly predicts learning strategies. The independent (predictor) variables included intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety. Learning strategies served as the dependent variable. The analysis revealed significant predictors of learning strategies ($\alpha = 0.05$). Specifically, task value and test anxiety were identified as significant predictors, accounting for 32% of the variance in learning strategies (adjusted $R^2 = 0.316$). The regression analysis showed a β-value of 0.323 for task value, followed by a β-value of -0.167 for test anxiety. The β-values represent standardized coefficients, which indicate the strength of the relationship between variables. A negative β-value, such as that for test anxiety, suggests an inverse relationship—meaning that as test anxiety increases, learning strategies tend to decrease. This model achieved statistical significance with $p < 0.001$. The adjusted R^2 value was 0.316, which is very close to the R^2 value of 0.337, showing only a slight decrease of 2.1%. Therefore, this model can be considered a reliable predictor of student learning strategies (Field, 2005).

Discussion and Conclusion

Students' academic achievement is influenced not only by cognitive factors, such as abilities, but also by affective factors, including motivation and learning strategies. In this study, the Motivated Strategies for Learning Questionnaire (MSLQ), one of the most widely used self-report tools in educational settings, was employed to assess university students' motivation and learning strategies in a self-paced developmental mathematics course. Students were motivated and typically employed learning strategies. The internal consistency scores obtained for the MSLQ scales were acceptable and comparable to those reported in previous studies, with some scales showing even higher values (Cook and Skrupky, 2024; Duncan & McKeachie, 2005; Morais, Santos, & Mouraz, 2025; Ramirez-Dorantes et al., 2013). The reliability of the help seeking scale was low, consistent with previous findings by Khampirat (2021) and the meta-analysis by Holland et al. (2018). This scale specifically measures the tendency to seek help from peers or instructors.

The correlation findings suggest that self-efficacy is more strongly correlated with overall motivation than with other scales. This result aligns with Bandura's (1977) social cognitive theory, which highlights self-efficacy as a core component. When students have high self-efficacy, they are more likely to exhibit greater motivation, with both variables changing in the same direction. Additionally, students with high self-efficacy believe they can perform well and maintain high academic achievement (Alhadabi & Karpinski, 2020; Miller, 2021). Furthermore, enhancing self-efficacy beliefs in developmental mathematics students may lead to more effective use of cognitive strategies (Adesola & Li, 2018; Jungert & Rosander, 2010). On the other hand, test anxiety showed low correlations with other scales and total motivation, as well as a negative correlation with the extrinsic goal orientation scale, indicating an inverse relationship. High anxiety, as a negative mood (Olafson & Ferraro, 2001),

leads to debilitating feelings (Zeidner & Matthews, 2005), which can diminish student motivation for learning (Hilpert et al., 2013; Oflaz, 2019). However, anxiety may also increase motivation to avoid negative outcomes by prompting greater effort. Therefore, test anxiety was included in the MSLQ construct to reinforce motivation, and it is considered more of an emotional construct rather than a motivational variable (Pekrun et al., 2002). Regarding learning strategies, correlation findings indicate a strong relationship between the nine scales—rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking—and overall learning strategies. These scales also exhibit a strong correlation with one another, consistent with the findings of Hariri et al. (2021). Overall, both motivation and learning strategies are crucial components of the MSLQ, as effectively applying the right motivation and learning strategies can improve academic achievement (Miller, 2021; Seli, 2024; Zimmerman, 2008). Regarding motivation as a predictor of learning strategies, the findings suggest that motivation—specifically task value and test anxiety—can significantly predict students' learning strategies. This highlights the important role of motivation in shaping students' learning strategies, ultimately contributing to their development as self-regulated learners. These results suggest that when teachers implement learning strategies, they should consider variables such as task value and test anxiety.

The present study found that motivation scale scores were generally moderate to high, with values exceeding the neutral benchmark. Among these, extrinsic motivation and control of learning beliefs scored the highest. Extrinsic motivation refers to the degree to which students are driven by external factors such as grades, rewards, performance evaluations, social comparison, and competition. In this case, students view grades and the desire to perform well as central to their success in the course. On the other hand, control of learning beliefs pertains to students' perceptions that their own efforts directly influence their learning outcomes. It reflects the belief that academic success is primarily determined by personal effort, rather than external factors like the instructor's teaching. When students feel that their own actions matter—such as the time and effort they dedicate to studying—they are more likely to engage in strategic and effective learning behaviors. In essence, students who believe they can control their academic performance are more motivated to invest the necessary effort to achieve their goals. Self-efficacy was also high, reflecting a positive self-appraisal of one's ability to master a task. It encompasses both judgments about the ability to accomplish a task and confidence in the skills required to perform it. Test anxiety was moderate; unlike the other scales, a higher score here indicates greater anxiety in testing situations. Test anxiety is believed to consist of two components, a cognitive component, characterized by worry, and an emotionality component. The worry component involves negative thoughts that disrupt performance, while the emotionality component refers to the affective and physiological arousal associated with anxiety (Pintrich et al., 1991). The task value was moderate, referring to a student's assessment of how interesting, important, and useful they perceive the task to be. Goal orientation (intrinsic and extrinsic orientations), on the other hand, relates to the reasons behind a student's participation in the task. When task value is high, students are more likely to become engaged and invest more effort in their learning. In a developmental mathematics course, faculty can enhance task value by clearly demonstrating the relevance and importance of the material, helping students recognize the practical applications and significance of what they are learning. When students see the value of the course content, they are more likely to feel motivated to succeed (Ginsberg & Wlodkowski, 2019). Overall, students are more likely to be motivated and achieve success in a self-paced developmental mathematics course when these

motivational factors are effectively addressed.

For the learning strategies scales, it is observed that the effort regulation scale produced the highest mean score, while the peer learning scale yielded the lowest mean score. The results further indicate that students rely on effort regulation to support the achievement of their learning objectives. Effort regulation, which involves self-management, reflects a commitment to completing study goals despite difficulties or distractions. This strategy is crucial for academic success, as it not only demonstrates goal commitment but also helps sustain the use of effective learning strategies. The peer learning scale, with the lowest mean score, suggests that it is the least utilized learning method by students. Similarly, the help-seeking scale was also low, implying that students may be reluctant to seek support from teachers or peers when facing challenges in their learning tasks. In contrast, the Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive Self-Regulation, and Time and Study Environment scales all recorded moderate mean scores (above the neutral score). These moderate scores suggest that students frequently engage in strategies such as reciting or naming concepts to memorize them, summarizing or paraphrasing textbook material, organizing their notes, reflecting on their thinking processes, applying knowledge to new situations, managing study time, and organizing their study environment. According to Pintrich et al. (1991), high scores on these scales indicate that students use these strategies often.

To foster student motivation and enhance learning strategies, faculty should emphasize the importance of the coursework and highlight the long-term benefits of success, including the potential consequences of repeated enrollment in developmental courses. By demonstrating how their efforts can shape academic outcomes, instructors can encourage students to adopt a more proactive, strategic approach to their studies. The results of this study also have practical implications for developmental mathematics learning strategies. Teachers can use the questionnaire, at either the item or scale level, to identify specific weaknesses in their students' learning approaches.

The findings of this study contribute to the existing body of knowledge and enhance our understanding of self-regulated learning, particularly in relation to motivation and learning strategies within the context of developmental mathematics. A limitation of this study is that the data set was confined to university developmental mathematics students from a single institution, which may limit the ability to generalize the findings to other populations. This study did not examine whether a correlation exists between students' motivated strategies for learning and their academic achievement. Therefore, it is recommended that future research explore this correlation in the context of developmental mathematics. Additionally, future studies could explore the causal relationships between motivation, learning strategies, and achievement. Future research should aim to replicate this study to further validate and strengthen its conclusions.

Acknowledgements

This research was partially supported by an Elkins Fellowship for the Scholarship of Teaching and Learning from the Kirwan Center for Academic Innovation, University System of Maryland. The views expressed in this article are those of the author and do not necessarily reflect the views of the Kirwan Center for Academic Innovation.

The author would like to thank the anonymous reviewers for their valuable feedback on this article.

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