

Metacognition, Academic Motivation, Depth of Studying and Academic Success

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Abstract

While self-regulated learning (SRL) suggests that students with greater metacognitive control achieve higher academic success, the relationship between grade point average (GPA) and self-regulation may be more complex than previously assumed. This study examined the relationship among motivation (intrinsic and extrinsic), metacognition, study habits, and academic success in 335 undergraduate students enrolled in introductory courses. Results revealed a positive correlation between both intrinsic motivation and internalized forms of extrinsic motivation (identified and introjected), and metacognitive awareness and deep learning strategies. However, GPA demonstrated a different pattern of relationships as it was positively correlated with strategic study skills (organization, time management, understanding expectations) and metacognitive knowledge, but showed no relationship with deep learning strategies (seeking meaning and making connections) or intrinsic motivation. This could suggest that higher grades in introductory courses may reflect strategic academic skills and metacognitive knowledge rather than intrinsic motivation or deep conceptual processing. Further, this might raise the question about whether current grading practices, at least at the freshman level, adequately capture and reward the deeper cognitive engagement central to meaningful learning.

Keywords

Metacognition, Motivation, Intrinsic Motivation, Extrinsic Motivation, Academic Motivation, Study Habits, Learning, Self-Regulated Learning

1. Introduction

Self-regulated learning (SRL) provides a dynamic framework to help understand

academic achievement based off Bandura's social cognitive model (Bandura, 2001; Zimmerman, 2002). Social Cognitive Theory emphasizes the interaction among personal, behavioral, and environmental factors to suggest that strong learners go through three recursive phases within SRL (forethought, performance, and self-reflection) as they evaluate and direct their learning (Zimmerman, 2002). While SRL predicts that students who use self-monitoring and self-regulation should achieve greater academic success, empirical studies show a more complex relationship between self-regulation and GPA (e.g., Pérez-González et al., 2022). This raises the question of how factors like motivation might mediate the metacognitive processes that influence learning and whether traditional measures, like GPA can truly capture this dynamic process.

1.1. Motivation and Self-Regulated Learning

According to Zimmerman's (2002) model, the learner goes through a forethought phase where students set goals and plan out learning strategies. If true, then academic motivation would serve as a primary force to aid students as they move through this initial process. Traditional views posited that intrinsic motivation was the driving force of deep and meaningful learning and extrinsic motivation seemed to be discounted or was considered to have the opposite effect on learning and instead was associated with quantity of performance outcomes (Cerasoli et al., 2014).

Vallerand et al. (1992) grounded their instrument, the Academic Motivation Scale (AMS) in self-determination theory (SDT; Ryan & Deci, 2000), suggesting that both intrinsic and extrinsic motivation play key roles in learning. The AMS follows SDT with treating extrinsic motivation along a continuum from more externalized, controlling motivation (e.g., external and introjected regulation), to more autonomous forms of extrinsic motivation (e.g., identified regulation). When considering why we do something, these researchers divided intrinsic motivation down further into three reasons, including, 1) to know, 2) toward accomplishment, and 3) to experience stimulation (e.g., Carbonneau et al., 2012). Contemporary researchers, like Vallerand, consider the importance of both intrinsic and extrinsic motivation to help facilitate SRL. Intrinsic motivation can help facilitate metaregulation and deeper cognitive engagement including critical thinking (Taylor et al., 2014), while more autonomous extrinsic motivation can help to direct strategic learning (Guay et al., 2010). If true, this may suggest that the quality of motivation may be more instrumental in autonomous engagement with learning than categorizing motivation as either extrinsic or intrinsic. Therefore, students who exhibit both high intrinsic motivation and autonomous forms of extrinsic motivation (e.g., identified regulation) may be best positioned to engage effectively in the metacognitive and strategic processes essential to academic success.

1.2. Metacognition, Motivation, and Depth of Studying

Metacognition is a dynamic learning process that includes both awareness and

regulation (Schraw & Dennison, 1994). Metacognitive knowledge or awareness of our thinking and approaches to learning provides the learner insight into strengths, weaknesses, task demands and strategies available. Metacognitive regulation is a dynamic aspect of learning that allows the student to implement, monitor, and modify these strategies while learning (Flavell, 1979; Schraw, 1998). These two dimensions of metacognition line up with Zimmerman's performance and self-reflection phases, where the learners actively monitor their progress and adjust their strategies as they get feedback (Panadero, 2017; Zimmerman & Moylan, 2009). Past research found metacognition, both knowledge and regulation, was closely tied to undergraduate student study techniques (MacKewn et al., 2022; Schraw & Moshman, 1995).

Students with strong metacognitive skills tend to demonstrate deeper and more strategic study techniques (Dent & Koenka, 2016; Pintrich, 2004). A deep learning technique includes those tied to critical thinking, like seeking meaning and examining evidence, whereas strategic strategies include awareness of the task demands and allocation of study efforts to match the demands (Entwistle, 2009). Both intrinsic and extrinsic motivation help drive students to engage with learning the course material by allocating the necessary cognitive resources (Pintrich, 2000; Ryan & Deci, 2000). Metacognitive knowledge allows students to recognize the appropriate strategies, while metacognitive regulation aids the learner to implement the appropriate strategies and monitor them throughout the learning process (Efklides, 2011; Winne & Hadwin, 1998). Therefore, motivational orientation influences the depth and quality of cognitive processes that can be viewed by measuring depth of studying.

1.3. The Paradox of Self-Regulation and Academic Performance

It seems intuitive to predict that strong metacognitive processes would correlate with deeper studying methods and enhanced critical thinking, thus leading to superior academic outcomes, however, this relationship is tenuous. When reviewing research on the relationships among motivation, learning strategy use, and achievement, there are mixed findings. Some studies demonstrate that intrinsic motivation predicts GPA through its influence on the learning strategies students implement (Credé & Phillips, 2011), while other research suggests that certain forms of extrinsic motivation show weak or inconsistent direct relationships with academic achievement (Taylor et al., 2014).

It has been suggested that GPA represents an outcome that is influenced by factors that go beyond a student's cognitive and metacognitive control including prior knowledge, attendance, and assignment completion (Richardson et al., 2012). GPA could be influenced by the grading rubric or other practices within a specific context or expectation and does not account for the learning experience or the transferable skills developed, or the long-term retention of the information (Brookhart, 2013). Finally, the relationships among various forms of motivation, study approaches, and metacognition may be indirectly related (Efklides, 2011;

Mega et al., 2014).

This study will examine the relationship among intrinsic motivation (to know, accomplishment, stimulation) and extrinsic academic motivation (external, introjected, identified), metacognition (metacognitive knowledge, metacognitive regulation), approaches to studying (deep, strategic, surface), and academic success (cumulative GPA).

2. Method

2.1. Participants

Online surveys were made available to undergraduate students enrolled in large introductory psychology and geoscience classes yielding 370 responses, however 335 responses were used in the final analysis when multiple responses from the same student were deleted. Of the 335 participants, 83 were male, yielding an average age of 23.48 ($SD = 7.71$) with an institutional GPA of 3.15 ($SD = 0.62$; $N = 74$); 249 females yielded an average age of 23.61 ($SD = 8.21$) and a GPA of 3.26 ($SD = 0.55$; $N = 215$). The final number of participants for GPA collection ($N = 289$) was slightly lower compared to the total number of participants ($N = 335$) due to students who did not supply a student number to look up the official GPA. Two students did not report their sex. In the final data set, there were 93 freshmen, 59 sophomore, 68 junior, 100 senior and 15 students did not answer this question.

2.2. Materials

Demographics: Students answered basic demographic questions like their major, a minor, if applicable, current number of hours in which they were enrolled that semester, and a total number of hours completed towards their degree. They were asked to provide a cumulative GPA and a student number so researchers could access their official GPA at the end of the term. Only the official GPA was used in the final analysis.

Metacognitive Awareness Inventory (MAI; Schraw & Dennison, 1994): This 52-item instrument assesses self-regulated learning. The metacognitive knowledge subscale is what students know about their learning and can be further divided into three subcategories of learning (declarative, conditional, procedural). The metacognitive regulation subscale measures how students monitor, evaluate, and control their learning through five specific strategies (planning, information management strategies, comprehension monitoring, debugging, and evaluation).

Academic Motivation Scale (AMS; Vallerand et al., 1992): This 28-item scale has seven subscales measuring three intrinsic reasons (to know, towards accomplishment, to experience stimulation); three extrinsic reasons (identified, introjected, external); amotivation.

Revised Approaches to Studying Inventory (RASI; Duff, 2004): This is an 18-question shortened version instrument that measures approaches and depth of studying using 5-point Likert style questions. Students get a score on three sub-

scales including deep (seeks meaning and connections), strategic (organized, time management, and understands expectations), and surface (motivated by fear of failure, do not understand the purpose of the material, and do not tie ideas together).

2.3. Procedure

A brief description of the study was posted on SONA, a university wide research pool website, with the Qualtrics link to the survey. Participants who consented to the conditions of the study and were at least 18 years of age, completed the demographics then the MAI, followed by the RASI, and then the AMS. Upon completion of the survey, students were redirected to SONA for their research credit and thanked for their participation.

3. Results

3.1. Metacognition and Intrinsic Academic Motivation

To examine the relationship within metacognitive knowledge and metacognitive regulation, Pearson correlations were performed separately for the three subscales of intrinsic motivation (to know, accomplishment, stimulation). Both metacognitive knowledge and metacognitive regulation scores were found to be significant and positively correlated with all three intrinsic motivators (See **Table 1**).

Table 1. Intercorrelations among metacognition (metacognitive knowledge, metacognitive regulation) and subscales of intrinsic motivation (to know, accomplishment, stimulation).

Variable	1	2	3	4	5
Metacognition					
1. Metacognitive Knowledge	(0.70)				
2. Metacognitive Regulation	**0.58	(0.85)			
Intrinsic Motivation					
3. To know	**0.27	**0.35	(0.88)		
4. Accomplishment	**0.33	**0.35	**0.73	(0.87)	
5. Stimulation	**0.31	**0.39	**0.65	**0.60	(0.86)

* $p < 0.05$, ** $p < 0.001$, *Cronbach's alpha reliability estimates are along the diagonal.

3.2. Metacognition and Extrinsic Academic Motivation

Pearson correlations were performed separately for the three subscales for extrinsic motivation (identified, introjection, external) and metacognitive knowledge and metacognitive regulation. Metacognitive knowledge and metacognitive regulation were found to be significantly and positively correlated with identified and introjected, but not with external regulation, although slightly lower than the relationship with intrinsic factors (See **Table 2**).

Table 2. Intercorrelations among metacognition (metacognitive knowledge, metacognitive regulation) and subscales of extrinsic motivation (identified, introjected, external).

Variable	1	2	3	4	5
Metacognition					
1. Metacognitive Knowledge	(0.70)				
2. Metacognitive Regulation	**0.58	(0.85)			
Extrinsic Motivation					
3. Identified	**0.18	**0.16	(0.84)		
4. Introjected	**0.20	**0.25	**0.63	(0.87)	
5. External	0.06	0.07	**0.71	**0.54	(0.81)

* $p < 0.05$, ** $p < 0.001$, ***Cronbach's alpha reliability estimates are along the diagonal.

3.3. Academic Motivation, Depth of Study Approach, Academic Success

When intrinsic and extrinsic motivation were correlated with depth of studying (deep, strategic, surface) and academic success, several significant correlations emerged. All three subscales of intrinsic motivation (to know, accomplishment, stimulation) were positively correlated with the deep and strategic techniques and negatively related with surface depth of study, although the correlation was not significant between stimulation, it was approaching significance (See **Table 3**).

Table 3. Intercorrelations among intrinsic motivation (to know, accomplishment, stimulation), extrinsic motivation (identified, introjected, external), depth of studying (deep, strategic, surface), and academic success (GPA).

Variable	1	2	3	4	5	6	7	8	9	10
Intrinsic Motivation										
1. To know	--									
2. Accomplishment		--								
3. Stimulation			--							
Extrinsic Motivation										
4. Identified				--						
5. Introjected					--					
6. External						--				
Depth of Studying										
7. Deep	**0.39	**0.36	**0.29	**0.26	**0.30	*0.12	(0.67)			
8. Strategic	**0.22	**0.38	**0.21	**0.22	**0.29	**0.13	**0.38	(0.80)		
9. Surface	**−0.16	**−0.14	−0.08	−0.05	−0.001	0.05	0.06	**−0.26	(0.74)	
Academic Success										
10. GPA	0.09	**0.15	−0.005	**0.21	0.09	**0.12	−0.05	**0.20	**−0.26	--

* $p < 0.05$, ** $p < 0.001$, ***Cronbach's alpha reliability estimates are along the diagonal.

GPA was positively correlated with the strategic study score and negatively correlated with surface techniques but not related with the deep strategy score. GPA was also positively correlated with the intrinsic subscale of accomplishment. The three subscales of extrinsic motivation (identified, introjected, external) were positively correlated with both deep and strategic techniques, but no relationship was found with surface depth. GPA was positively correlated with identified and regulation motivation, but the relationship with introjected motivation was not significant, but was approaching significance.

3.4. Metacognition, Depth of Study Approach, Academic Success

Pearson correlations were performed among the metacognitive knowledge and metacognitive regulation scores with the three study techniques (deep, strategic, surface) also indicated significant positive correlations with deep and strategic study techniques and a significant negative correlation with surface methods. GPA was positively correlated with metacognitive knowledge but the relationship with metacognitive regulation was slightly negative and not significant (See **Table 4**).

Table 4. Intercorrelations among metacognition (metacognitive knowledge, metacognitive regulation), depth of study (deep, strategic, surface), academic success (GPA).

Variable	1	2	3	4	5	6
Metacognition						
1. Metacognitive Knowledge	(0.70)					
2. Metacognitive Regulation	**0.58	(0.85)				
Depth of Study						
3. Deep	**0.21	**0.44	(0.67)			
4. Strategic	**0.46	**0.37	**0.38	(0.80)		
5. Surface	**−0.38	**−0.16	0.06	**−0.26	(0.74)	
Academic Success						
6. GPA	*0.11	−0.03	−0.05	**0.20	**−0.24	--

* $p < 0.05$, ** $p < 0.001$, ***Cronbach's alpha reliability estimates are along the diagonal.

3.5. Academic Motivation, Metacognition, Depth of Study Approach, and Academic Success

A hierarchical multiple regression was conducted to examine the predictive utility of intrinsic motivation, metacognition, and depth of study strategies on GPA. Predictor variables were entered in three sequential blocks based on theoretical consideration (1) the three intrinsic motivation subscales (stimulation, accomplishment, to know), (2) metacognition subscales (metaknowledge, metaregulation), (3) the three subscales of the RASI. This hierarchical approach allowed examination of the incremental variance explained by each construct after controlling for the previously entered variables.

At Step 1, the intrinsic subscales accounted for 2.9% of the variance in GPA (adjusted $R^2 = 0.029$). Adding MAI subscales at step 2 increased the adjusted R^2 to 0.041 ($\Delta R^2 = 0.012$, $p = 0.009$), and adding RASI depth of study subscales at Step 3 further increased the adjusted R^2 to 0.092 ($\Delta R^2 = 0.051$, $p < 0.001$). The final model was significant, $F(8, 282) = 4.65$, $p < 0.001$. In the final model, strategic ($\beta = 0.182$, $p = 0.011$) and surface depth of study ($\beta = -0.176$, $p = 0.006$) emerged as significant predictors.

A second hierarchical multiple regression was conducted to examine the predictive utility of extrinsic motivation, metacognition, and depth of study strategies on GPA. Predictor variables were again entered in three sequential blocks (1) the three extrinsic motivation subscales (regulation, introjected, identified), (2) metacognition subscales (metaknowledge, metaregulation), (3) the three subscales of the RASI.

At Step 1, the extrinsic subscales accounted for 4.1% of the variance in GPA (adjusted $R^2 = 0.041$). Adding MAI subscales at step 2 increased the adjusted R^2 to 0.056 ($\Delta R^2 = 0.021$, $p = 0.039$), and adding RASI depth of study subscales at Step 3 further increased the adjusted R^2 to 0.113 ($\Delta R^2 = 0.066$, $p < 0.001$). The final model was significant, $F(8, 282) = 5.64$, $p < 0.001$. In the final model, extrinsic identified ($\beta = 0.292$, $p = 0.002$), strategic ($\beta = 0.200$, $p = 0.004$) and surface depth of study ($\beta = -0.174$, $p = 0.006$) emerged as significant predictors.

4. Discussion

4.1. General Findings

All three subscales of intrinsic motivation were positively correlated with metacognitive knowledge and metacognitive regulation, confirming that students who are motivated by their own interest, personal accomplishment, or enjoy the stimulation of learning, engage in greater metacognitive awareness and processes. Also, the introjected and identified subscales were positively correlated with metacognition, which was reasonable because they represent more internalized forms of extrinsic motivation relative to external regulation. Although individuals acting from introjected regulation have internalized external contingencies to some degree, their behavior is still controlled by these pressures rather than being fully autonomous (Assor et al., 2009). Ryan and Deci (2000) suggested that one might behave in a certain way because they like the outcome or they might maintain their self-worth. Although both are seen as extrinsic motivators, identified regulation is closer to autonomous factors compared to external regulation or acting solely for rewards or to avoid punishments. These findings support the idea that there are specific motivational factors that could work together to help facilitate SRL.

Students who scored higher on intrinsic and extrinsic motivation also reported greater deep and strategic study skills but scored low on surface learning strategies meaning that students who are motivated and are better self-regulators tend not to use maladaptive strategies, which supports Zimmerman's framework (Zim-

merman, 2002; Zimmerman & Moylan, 2009). Deep learning strategies are active cognitive processes, like connecting ideas together and critically examining the evidence or the information coming in, which is reflected in the performance phase of Zimmerman's SRL cycle (Winne & Hadwin, 1998; Zimmerman & Moylan, 2009). Additionally, the negative correlation with motivation and surface study skills might suggest an absence of SRL.

GPA did not correlate with all dimensions of SRL, but it was positively related to metacognitive knowledge, strategic study skills and extrinsic identified motivation. These findings suggest that GPA can perhaps capture some component of self-regulation within the contexts of academic institutions but may not reflect intellectual curiosity and deeper cognitive processing and understanding. With undergraduate education a large portion of GPA is accounted by summative assessments, including testing, which may capture some aspects of deeper processing, but performance on assessments may be driven more by surface and strategic study use. In other words, students who achieve good grades might appear to have knowledge and skills, like time management and awareness of task demands, but grades may not capture or reward deep processing and metacognitive regulation needed for learning (Richardson et al., 2012).

Additionally, results of multiple regressions predicting GPA, supported the importance of surface and strategic study strategies, but may not require deeper study strategies. These findings suggest that behavioral implementation may matter more than underlying motivational or metacognitive orientations. They may be highly motivated and may possess metacognitive skills, but what ultimately influences their grades are how they approach studying.

4.2. Limitations and Future Research

Several limitations should be considered when interpreting these findings. Reliance on self-report measures may come with elevated social desirability and limited awareness of metacognitive strategies and learning techniques. Future research could incorporate additional behavioral measures to help validate the self-reported measures.

GPA as an outcome of academic success may also be problematic as it is a measure across several factors, including different courses, instructors, grading assessments and standards. The completed surveys were cross-sectional measures of strategies and beliefs, but GPA is cumulative and reflects performance over time. Cross-sectional methods may not capture temporal precedence or dynamic changes.

Given that GPA correlated with strategic skills but not deep learning or intrinsic motivation, incorporating self-efficacy and locus of control could explain why students adopt different learning strategies. Self-efficacy beliefs influence whether students persist with challenging deep learning strategies or resort to surface approaches (Bandura, 2001). Additionally, locus of control may moderate the relationship between motivation types and strategy, so follow up research could in-

clude this variable (Landine & Stewart, 1998). Also, a longitudinal design following students across multiple semesters would address the temporal mismatch between cross-sections motivation measures and cumulative GPA, allowing the examination of how self-efficacy and locus of control influence SRL over time. Future research could also include advanced classes that might require deeper strategies compared to introductory classes, where strategic skills may be sufficient.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper or the collection of the data.

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