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Metacognition and Self-regulation Influence Academic Performance in Occupational and Physical Therapy Students

Abstract

An understanding of student learning strategies is an important component of supporting academic success and avoiding difficulty. Prior inquiry has demonstrated certain learning strategies are more closely related to academic performance than others. The purpose of this study was to describe predictive relationships between the Metacognitive Awareness Inventory (MAI), Learning and Study Strategies Inventory (LASSI), and grade point average (GPA) in occupational therapy (OT) and physical therapy (PT) programs. A multi-center convenience sample of N=75(100%) entry-level students [OT: 34(45%); PT: 41(55%)] was included from Florida 32(42.7%), California 21(28%), and Texas 22(29.3%). A hierarchical linear regression analysis demonstrated the combination of predictors (MAI, Anxiety, Concentration, and Time Management [r=0.83; p2=0.35; p2=0.34; p2=0.31; p

Keywords

Metacognition, self-regulated learning, time management, blended learning, rehabilitation education

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Metacognition and Self-regulation Influence Academic Performance in Occupational and Physical Therapy Students

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ABSTRACT

An understanding of student learning strategies is an important component of supporting academic success and avoiding difficulty. Prior inquiry has demonstrated certain learning strategies are more closely related to academic performance than others. The purpose of this study was to describe predictive relationships between the Metacognitive Awareness Inventory (MAI), Learning and Study Strategies Inventory (LASSI), and grade point average (GPA) in occupational therapy (OT) and physical therapy (PT) programs. A multi-center convenience sample of N=75(100%) entry-level students [OT: 34(45%); PT: 41(55%)] was included from Florida 32(42.7%), California 21(28%), and Texas 22(29.3%). A hierarchical linear regression analysis demonstrated the combination of predictors (MAI, Anxiety, Concentration, and Time Management [r=0.83; p<0.001]) was able to accurately predict 65% of the variation in GPA. The strongest single predictor of academic success was the LASSI Time Management scale (R^2=0.35; p<0.001), followed by Anxiety (R^2=0.34; p<0.001), and MAI score (R^2=0.31; p<0.001). Anxiety is maladaptive and was associated with 7-times higher odds of academic difficulty. In this sample, metacognitive and self-regulated learning strategies were highly indicative of student GPA, particularly time and anxiety management. It is possible that students who possess stronger aptitude in these behaviors may be more likely to demonstrate higher academic performance.

Occupational therapy (OT) and physical therapy (PT) education programs are striving to meet the growing demands of health and society (Harvison, 2018; Landry et al., 2016; Timmerberg et al., 2022). As OT and PT education programs expand, research into numerous aspects of teaching and learning has become increasingly important

(Barradell, 2017; Gagnon et al., 2020). In 2021, the World Federation of Occupational Therapists (WFOT) declared educational research a critical component to enhancing the development of the profession and preparation of future OT practitioners (WFOT, 2021). Furthermore, the American Occupational Therapy Association (AOTA) has outlined an education research agenda that emphasizes scientific inquiries on "learner characteristics and competencies" to identify elements consistent with success (AOTA, 2018, p.1). Similarly, the American Physical Therapy Association (APTA) has stated educational research should have a focus on amassing evidence that "promotes learner development and outcomes to meet the needs of society" (APTA, 2021, p. 29). These unequivocal positions emphasize the importance and value of study aimed at developing best practice guidelines across OT and PT professional education. To establish such requires a rich and robust body of scientific evidence in OT and PT education. For these reasons, the scholarship of teaching and learning has gained renewed enthusiasm and is now among the top research priorities for both OT and PT professions (AOTA, 2018; APTA, 2021).

One area of educational research involves understanding the cognitive and non-cognitive student learning strategies that are predictive of academic success in health professional education (Calo et al., 2022; Orsini et al., 2016; Stander et al., 2019). Prior studies from medicine, nursing, and pharmacy education programs have yielded a sizable base of evidence (Nisly et al., 2020; Zhou et al., 2016). For example, non-cognitive learning strategies such as motivation, concentration, time management, anxiety, self-regulation, self-efficacy, grit, and resilience, to name a few, are related to higher educational performance outcomes (Calo et al., 2022; Norouzinia et al., 2016; Orsini et al., 2016; Zhang et al., 2018). Furthermore, cognitive learning strategies such as metacognitive aptitude have also been linked to higher academic performance (Furze et al., 2015; Kosior et al., 2019; Nisly et al., 2020; Robinson et al., 2022). Findings from medical education largely indicate strong and significant relationships exist between both cognitive and non-cognitive learning strategies and improved academic performance (Jouhari et al., 2016; Khalil et al., 2018; Martirosov & Moser, 2021; West & Sadoski, 2011). Particularly, the cognitive strategy of metacognition and non-cognitive strategy of self-regulation have continually been linked to superior outcomes (Cera et al., 2013; Orsini et al., 2016; Robinson et al., 2022; Zhang et al., 2018). Yet, prior studies have identified that strategies of metacognition and self-regulated learning are only able to accurately predict between 30-50% of future academic performance – leaving up to half of the variation in student academic performance unexplained (Broadbent & Poon, 2015; Pucillo & Black, 2021).

Metacognition as a learning strategy is defined as one's knowledge of their knowledge and is a result of continuous "self-assessment and self-reflection" during the process of knowledge acquisition (Robinson et al., 2022, p. 3). On the other hand, a definition of self-regulation has been historically vague, but is widely accepted as the degree to which a learner readily controls and monitors aspects of their behavior during learning,

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such as managing time, concentration, motivation, and effort (Greene, 2017; Martini et al., 2016). Metacognition refers to a learner's ability to self-assess learning needs and "use skills and strategies appropriately to achieve a desirable outcome" (Harrison & Vallin, 2018; Martirosov & Moser, 2021). Self-regulation refers to a learner's ability to autonomously respond to the demands required of learning and strategically monitor their behaviors and actions (Cera et al., 2013). Both metacognitive and self-regulated learning strategies have been shown to be significantly related to student performance in medicine education (Jouhari et al., 2016; Khalil et al., 2018; Norouzinia et al., 2016; West & Sadoski, 2011; Zhou et al., 2016). Many of these same relationships may be accurate for OT and PT students. However, contemporary evidence specific to entry-level OT and PT education programs remains underrepresented in the literature (Calo et al., 2022; Robinson et al., 2022). Not until recently has metacognitive and self-regulated learning strategies been explored in OT and PT education, and the results have been mixed (Furze et al., 2015; İlçin et al., 2018; Kosior et al., 2019; Kuo, 2015; Lee, 2018; Pucillo et al., 2020; Stander et al., 2019; Walankar et al., 2019).

In large part, many of the aspects that influence learning in contemporary OT and PT education remain poorly understood, especially metacognition and self-regulation (Robinson et al., 2022; Wolden et al., 2020). For example, much of the prior study on learning strategies in health professions has been predicated on medicine, nursing, and pharmacy education. Those findings may not translate well into OT and PT educational practice as curricula are distinct from those in medicine or nursing. For this reason, it is important for educators to continue exploring the most successful learning strategies of OT and PT students as both professions are witnessing changes in student demographics, curricular models, modes of program delivery, and instructional methods (Gagnon et al., 2020; Vallée et al., 2020). As OT and PT education becomes more dynamic, so too, may the learning strategies of an evolving student body (Gagnon et al., 2020; Mu et al., 2014; Vallée et al., 2020). A sound knowledge of metacognitive and self-regulated learning strategies may represent an important piece of the puzzle for educators. Further, it is equally important for students as entry-level OT and PT programs have adapted instructional delivery to post-COVID-19 pandemic conditions (Gagnon et al., 2020). Therefore, research trends are striving toward a deeper understanding of metacognition and self-regulated learning, and the development of best educational practices follows closely (Orsini et al., 2016; Zhang et al., 2018).

Although evidence is growing there is still much to uncover regarding metacognitive and self-regulated student learning strategies in entry-level OT and PT education (Calo et al., 2022; İlçin et al., 2018; Kuo, 2015; Lee, 2018; Pucillo & Black, 2021; Stander et al., 2019). There are a limited number of studies among OT and PT education programs that specifically examine metacognition and self-regulated learning strategies (Kosior et al., 2019; Martini et al., 2016; Robinson et al., 2022). Therefore, a sizeable gap exists in our knowledge and understanding of OT and PT learning strategies which may have significant financial implications for students and institutions. Professional educators

and faculty advisors among OT and PT programs continually search for strategic targets to support student learning in an ever-changing learning environment. If metacognitive and self-regulated learning strategies can accurately predict academic performance then students may leverage those tactics to prevent academic difficulty (Haghani & Sadeghizadeh, 2011; Jouhari et al., 2016; Ning & Downing, 2010; Skinner et al., 2015; Villareal & Martinez, 2018; Walankar et al., 2019). However, the degree to which these relationships are true is not well understood. As such, the purpose of this study was to explore how self-regulated and metacognitive learning strategies are related to academic outcomes in blended entry-level OT and PT programs. Based on prior evidence, it was hypothesized that students with higher levels of self-regulation and metacognitive skill would show a higher likelihood of increased grade point average (GPA).

Material and Methods

Participants and Setting

This multi-center cohort study used a correlational design to test the stated hypothesis. All study procedures were approved by IRB and participants acknowledged informed consent. The sample consisted of entry-level OT and PT students across private institutions during the Spring of 2022. A convenience sample recruited first-term students from seven individual hybrid-online (blended) programs in three states: Florida, Texas, and California.

Instrumentation

This study utilized the Learning and Study Strategies Inventory (LASSI) and the Metacognitive Awareness Inventory (MAI). The LASSI is a reliable and valid 60-item assessment based on ten scales of learning and study strategies (Villareal & Martinez, 2018; Weinstein et al., 2016). Each LASSI scale consists of six individual response items rated on a five-point Likert scale. The ten scales include: Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-Testing, Test Strategies, Time Management, and Using Academic Resources (Weinstein et al., 2016). The three components measured by the LASSI are: Skill, Will, and Self-regulation (Weinstein et al., 2016). The Skill component encompasses Information Processing, Selecting Main Ideas, and Test Strategies, whereas the Will component includes Anxiety, Attitude, and Motivation. The Self-regulation component includes Concentration, Time Management, Self-testing, and Using Academic Resources (Weinstein et al., 2016).

The MAI is a valid and reliable 52-item true/false self-reported questionnaire based on one’s knowledge and regulation of their own cognition and learning (Harrison & Vallin, 2018). The MAI contains three scales regarding knowledge of cognition: procedural, declarative, and conditional; and five scales regarding regulation of cognition: planning, comprehension monitoring, information management, debugging, and evaluation (Harrison & Vallin, 2018).

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Study Procedures

The LASSI and MAI were self-administered electronically during the first two weeks of the term to establish temporal precedence. Student participants followed the automated LASSI step-by-step instructions to complete the measurement. There was no interaction between investigator and participant during the assessments. Academic performance data (GPA) was later collected from each institutional database at the end of the 15-week trimester and was calculated on a 4.0 scale.

Data Analysis

A priori statistical power analysis required a minimum sample size of N=86 based on a medium effect size and alpha values set at 0.05 for multiple regression analyses (Portney & Watkins, 2015). Descriptive and inferential statistics were performed using IBM SPSS v.27 (Armonk, NY; 2021). Assumptions tests were performed for all procedures and the data set conformed to the requirements for parametric analyses. A hierarchical linear regression was performed to examine the contribution of each predictor variable on future GPA. McNemar's crosstabulations were used to calculate the odds ratios for academic difficulty (≤2.99 GPA) given a dichotomized predictor variable based on above/below established cut-off values.

Results

A total N (%) sample of 75(100%) included OT and PT programs from Florida 32(42.7%); California 21(28%); Texas 22(29.3%). Student participants represented a geographically and culturally diverse sample. A total N (%) of 34(45%) OT and 41(55%) PT students were enrolled and the mean(SD) age was 24.3(2.2) years. The sample consisted of 56(75%) females and 19(25%) males. The ethnicity of the sample consisted of 70% Caucasian, 13% Hispanic/Latino, 8% African American, 6% Asian American, and 3% "other" or "non-disclosed". A description of the variables by professional education program can be found in Table 1. Mean (SD) scores for GPA and the MAI and LASSI scales and component scores are listed in Table 1. There were no significant differences noted between OT and PT cohorts across the measurements, except for the LASSI scales of self-testing and time management where OT students scored modestly higher than PT counterparts ($p<0.05$).

A hierarchical linear regression model revealed the combination of predictors (MAI score, LASSI anxiety, concentration, and time management) were able to explain 65% of the variation in future GPA ($R^2 = 0.65$; $p<0.001$). No other variables or scales of the LASSI were found to be significant in the regression analysis. The results of the hierarchical regression can be found in Table 2. The MAI was able to explain 31% of the variation in academic GPA ($p<0.001$), whereas the LASSI time management scale was able to explain 35% ($p<0.001$). The degree to which the MAI and LASSI anxiety predict GPA is depicted in Figures 1 & 2, respectively. Each figure displays a vertical reference cut-off value for the instrument and a horizontal reference cut-off value for GPA. Figure 2 displays the significant linear relationship between LASSI anxiety and GPA ($p<0.001$).

The amount of GPA that can be explained by scores on the LASSI component of Self-regulation (combination of concentration, time management, and self-testing) can be found in Figure 3. The LASSI self-regulation component achieved an R^2=0.31(*p<0.05*).

Table 3 displays the calculated odds ratios for academic difficulty (≤2.99 GPA) based on McNemar's cross tabulations for each variable of significance from the regression model. Participants were roughly 5-times more likely to experience academic difficulty when scoring below the recommended cut-off values for the LASSI scales of time management and concentration. The LASSI scale of anxiety demonstrated that participants were roughly 7-times more likely to experience academic difficulty when scoring below the cutoff percentile.

Table 1

Participant Characteristics and Descriptive Statistics

Category / Measurement	OT & PT Combined	PT	OT	*p value*
Total N(%)	75 (100%)	41 (54.7%)	34 (45.3%)	p=0.61
First-term GPA	3.25 (0.33)	3.21 (0.33)	3.28 (0.34)	p=0.82
MAI score	78.4 (12.8)	78.3 (12.6)	78.6 (13.2)	p=0.85
LASSI scale				
Anxiety	43.9 (24.7)	44.4 (21.7)	43.4 (28.3)	p=0.07
Attitude	50.4 (28.6)	48.4 (27.8)	52.8 (29.9)	p=0.47
Concentration	48.7 (25.2)	43.8 (23.8)	54.6 (25.9)	p=0.70
Information Processing	58.7 (25.3)	55.6 (25.5)	62.6 (24.7)	p=0.38
Motivation	48.3 (23.5)	44.4 (23.6)	52.9 (22.8)	p=0.91
Selecting Main Ideas	43.0 (26.6)	39.2 (24.8)	47.6 (28.3)	p=0.25
Self-testing	60.3 (27.3)	51.2 (27.8)	71.2 (22.5)	***p<0.05**
Test Strategies	51.1 (25.5)	49.2 (23.9)	53.5 (27.5)	p=0.41
Time Management	59.6 (24.9)	55.4 (22.0)	64.7 (27.6)	***p<0.05**
Using Academic Resources	51.7 (25.3)	53.3 (25.5)	49.8 (24.5)	p=0.95
LASSI component				
Skill	50.9 (18.9)	48.0 (18.1)	54.5 (19.6)	p=0.75
Will	47.7 (18.1)	46.5 (18.5)	48.6 (17.6)	p=0.20
Self-Regulation	54.6 (18.7)	50.2 (19.8)	60.0 (15.9)	p=0.16

Table 1. Key. GPA = Grade point average (0-4.0 scale); LASSI = Learning and study strategies inventory; MAI = Metacognitive Awareness Inventory; OT = occupational therapy; PT = physical therapy.

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Table 2

Hierarchical Regression Analysis Summary of First-term GPA

Variable	R	R^2	Beta	t value	Sig.
**Constant*	0.83	0.65		13.4	*p<0.001*
MAI score	0.56	0.31	0.36	4.90	*p<0.001*
Anxiety	0.58	0.34	0.37	3.53	*p<0.001*
Concentration	0.58	0.34	0.19	2.38	*p=0.02*
Time Management	0.59	0.35	0.37	4.98	*p<0.001*

Table 2. Key. ***Constant** = MAI score, Anxiety, Concentration, Time Management; N=75.*

Table 3

McNemar's Cross-Tabulations for Presence of Academic Difficulty

Variable *state of cut-off variable*	Academic Difficulty Odds Ratio **No** (≥3.0 GPA)	 **Yes** (≤2.99 GPA)
MAI score		
above	0.91	
below		1.50
LASSI Time Management		
above	0.60	
below		**4.97**
LASSI Anxiety		
above	0.67	
below		**6.82**
LASSI Concentration		
above	0.68	
below		**4.95**

Table 3. Key. N=75 records in calculations. GPA = Grade point average. LASSI = Learning and Study Strategies Inventory

Figure 1

Metacognitive Awareness Inventory and GPA

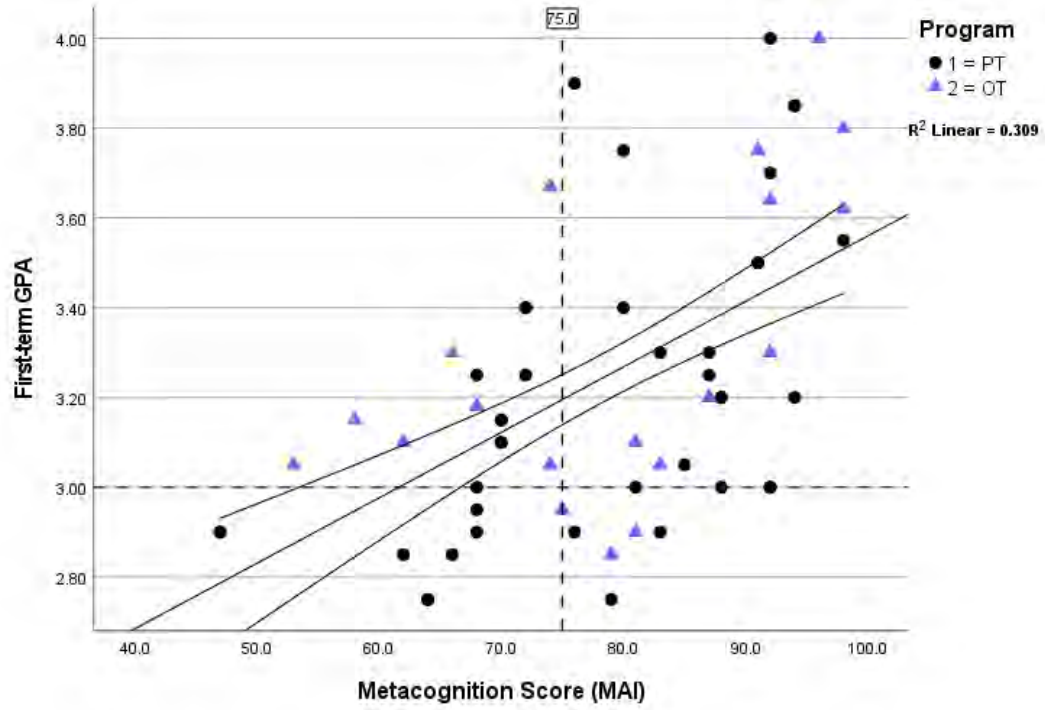

Figure 2

LASSI Anxiety and GPA

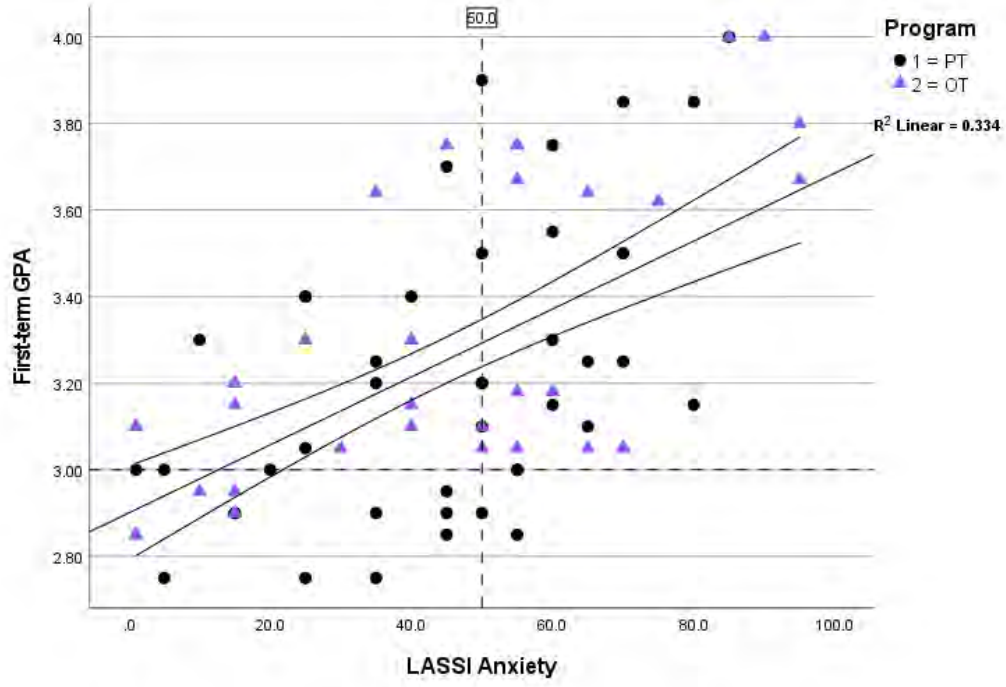

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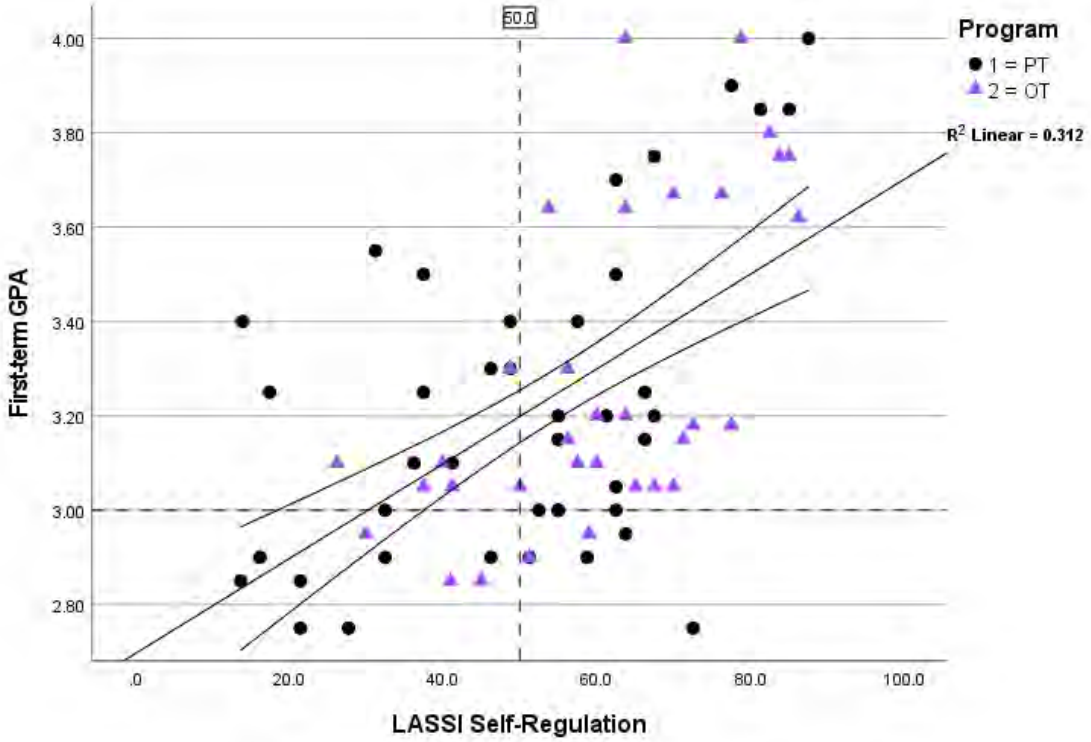
Figure 3

LASSI Self-regulation and GPA



Discussion

The purpose of this study was to examine predictive relationships between learning strategies and academic performance in entry-level OT and PT students. Findings of this study largely support the prior evidence on the degree to which aspects of self-regulated learning (SRL) influence health professional education outcomes (Broadbent & Poon, 2015; Honicke et al., 2020; Jouhari et al., 2016; Khalil et al., 2018; Ning & Downing, 2010; Norouzinia et al., 2016; Orsini et al., 2016). There was a strong and significant predictive relationship between aspects of SRL, metacognition, and academic outcomes in this sample of learners. The strongest signals were identified between MAI score and GPA, LASSI Time Management and GPA, and LASSI Anxiety and GPA. Oddly, however, the Self-regulated component of the LASSI (Concentration, Time Management, Self-testing, and Using Academic Resources scales) was not an independently strong predictor of academic performance. Furthermore, the likelihood that a student experienced academic difficulty increased 5-fold if they had low scores on the LASSI Concentration and Time Management scales, and nearly 7-fold if they had poor LASSI Anxiety scores. Yet, the MAI was not independently associated with an increased odds for academic success or difficulty.

Overall, these findings suggest there a certain few scales of the LASSI that may have diagnostic utility for students with low scores on Anxiety, Concentration, and Time Management. Collectively, however, all ten scales of the LASSI may not be a sound diagnostic measurement in this population of learners as many of the scales demonstrated no relationships to the outcome of GPA. Only three of the ten LASSI scales, Anxiety, Concentration, and Time management, were able to accurately predict future academic performance. Intuitively, an inability to manage levels of anxiety resulted in poor academic performance and is supported in prior evidence (West & Sadoski, 2011; Zhou et al., 2016). A student's inability to properly regulate levels of anxiety in coursework appears to be a maladaptive behavior that results in poor academic performance. Perhaps, students could be screened for anxiety management and prospectively categorized as being at-risk for difficulty and targeted with advising, tutoring, and academic support mechanisms (Haghani & Sadeghizadeh, 2011; Skinner et al., 2015). In large part, findings from this study support previous studies in other health professional education programs where aptitude on scales of self-regulation, metacognition, time management, and anxiety appear to be strong predictors of academic success or difficulty.

Limitations

There are limitations to this study. Mainly, this modest sample of learners was slightly under powered and achieved only 90% of the required minimum sample size based on *a priori* calculations. For these reasons, generalizing to the broader population of OT and PT learners in entry-level programs is cautioned. Additionally, although the data conformed to the assumptions for parametric testing, GPA occurred in a reduced range and may have artificially inflated some calculations. Historically, this has been a downfall of using GPA to measure success, yet there are few surrogate measures on which to rely. This study only captured academic outcomes across the first term and may not accurately represent longitudinal outcomes and future performance. Lastly, the MAI may measure facets of SRL like those represented in the LASSI and could have represented a duplicative set of assessment items (Harrison & Vallin, 2018; Skinner et al., 2015; Weinstein et al., 2016). It is possible that these two assessments possess such a large degree of overlap in measuring self-regulation and metacognition that results may be contaminated or exaggerated. As such, future investigations should consider examining cross-correlations and factor analyses between these two instruments and the validity of each measure in this population.

Future Directions

Despite significant findings, this study suggests the LASSI may not offer the best overall profile of success for entry-level OT and PT learners as very few scales were indicative of outcomes. Therefore, future studies should further examine the diagnostic utility of other SRL measurements in larger samples of this population. Interestingly, there were a few students who scored above the cut-off values on the LASSI or MAI but performed

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poorly on GPA outcomes. Unfortunately, the degree to which this can be explained lay outside the scope of this study due to statistical power. Future research should more closely examine larger samples of students who struggle academically to identify potential targets of programmatic support. Additionally, future studies should examine if cognitive learning characteristics can be improved upon with targeted training. At best, current estimates of cognitive characteristics and learning skills assessments can only predict between 30-50% of academic outcomes (Broadbent & Poon, 2015; Honicke et al., 2020; Khalil et al., 2018; Orsini et al., 2016). Therefore, future studies should consider examining exactly how non-cognitive measures may influence health professional student academic success or difficulty (Calo et al., 2022).

In conclusion, strong and significant predictive relationships were identified between entry-level OT and PT student GPA and aspects of SRL and metacognition. Mainly, the MAI, and LASSI Anxiety, Time Management, and Concentration scales predicted performance in GPA. Strong odds ratios were also identified for the presence of student academic difficulty with low performance in LASSI Anxiety, Concentration, and Time Management. Effectively, these findings suggest that a maladaptive pattern may exist for students who find it difficult to concentrate in class, poorly manage their time outside of class, and have unmanaged levels of anxiety. If program administrators can identify students who fit this pattern early in a curriculum, then perhaps there may be an opportunity to prescribe learning interventions and avoid academic attrition. This may be especially true as hybrid and blended online learning curricula become more prevalent in rehabilitation education (Gagnon et al., 2020; Mu et al., 2014; Vallee et al., 2020).

Implications for Occupational Therapy Education

This study revealed several important relationships regarding entry-level learning strategies for OT students. Chief among them, student time management skills and the inability to manage levels of anxiety were strongly predictive of, and increased the risk for, academic difficulty. OT educators, faculty advisors, program administrators, and academic institutions may target student support services in these areas to help avoid difficulty and attrition in entry-level coursework. Specialized assessment tools that help screen for these aptitudes may aid in identifying students in need of extra support services to promote normal matriculation through OT curricula.

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