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Training and Instruction of Learning and Study Strategies Improve Academic Performance in Rehabilitation Students

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Abstract

Purpose: Prior study has demonstrated that certain learning strategies can be improved with training and instruction. As a result, downstream academic success may be potentiated. However, it is unclear if instructional intervention can influence academic outcomes among rehabilitation students. The purpose of this study was to compare changes in grade point average (GPA) after exposure to a set of standardized self-paced training modules on the Learning and Study Strategies Inventory (LASSI) in Physical therapy (PT) and Occupational therapy (OT) students. **Methods:** A causal-comparative design was used, and a multi-center convenience sample collected N=75 entry-level PT and OT students [PT: 41(55%); OT: 34(45%)] from Florida 32(42.7%); California 21(28%); and Texas 22(29.3%). Participants self-administered the LASSI measurement during the first four weeks of their first academic term. Then, students completed self-paced LASSI Plus+ training modules. Finally, a post-training LASSI measurement was collected at the end of the first term. GPA was collected at the end of term one and year one. Paired samples t-test was performed to compare pre- and post-training LASSI scores and GPA. **Results:** This study demonstrated significant differences between pre- and post-LASSI training for the scales of Concentration (+5.1; $p<0.05$), Self-testing (+8.9; $p<0.01$), Test Strategies (+8.1; $p<0.01$); and Time Management (+5.3; $p<0.05$). Significant relationships were found between change in GPA and the degree to which the LASSI scales of Anxiety (r= -0.68; $p<0.05$), Concentration (r= 0.61, $p<0.01$), Test Strategies (r= 0.42; $p<0.01$), and Time Management (r= 0.54; $p<0.01$) changed after intervention. A post-hoc analysis showed only the LASSI scales of Anxiety (d= -0.31; $p<0.05$), Concentration (d=0.25; $p<0.01$), and Test Strategies (d= 0.29; $p<0.01$) differed significantly between students experiencing academic difficulty (N=18[24%]). **Conclusion:** Training and instruction of learning strategies may modestly influence academic performance. Still, the degree to which these efforts may aid in the prevention or avoidance of academic difficulty is unclear.

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ABSTRACT

Purpose: Prior study has demonstrated that certain learning strategies can be improved with training and instruction. As a result, downstream academic success may be potentiated. However, it is unclear if instructional intervention can influence academic outcomes among rehabilitation students. The purpose of this study was to compare changes in grade point average (GPA) after exposure to a set of standardized self-paced training modules on the Learning and Study Strategies Inventory (LASSI) in Physical therapy (PT) and Occupational therapy (OT) students. **Methods:** A causal-comparative design was used, and a multi-center convenience sample collected N=75 entry-level PT and OT students [PT: 41(55%); OT: 34(45%)] from Florida 32(42.7%); California 21(28%); and Texas 22(29.3%). Participants self-administered the LASSI measurement during the first four weeks of their first academic term. Then, students completed self-paced LASSI Plus+ training modules. Finally, a post-training LASSI measurement was collected at the end of the first term. GPA was collected at the end of term one and year one. Paired samples t-test was performed to compare pre- and post-training LASSI scores and GPA. **Results:** This study demonstrated significant differences between pre- and post-LASSI training for the scales of Concentration (+5.1; $p<0.05$), Self-testing (+8.9; $p<0.01$), Test Strategies (+8.1; $p<0.01$); and Time Management (+5.3; $p<0.05$). Significant relationships were found between change in GPA and the degree to which the LASSI scales of Anxiety (r= -0.68; $p<0.05$), Concentration (r= 0.61, $p<0.01$), Test Strategies (r= 0.42; $p<0.01$), and Time Management (r= 0.54; $p<0.01$) changed after intervention. A post-hoc analysis showed only the LASSI scales of Anxiety (d= -0.31; $p<0.05$), Concentration (d=0.25; $p<0.01$), and Test Strategies (d= 0.29; $p<0.01$) differed significantly between students experiencing academic difficulty (N=18[24%]). **Conclusion:** Training and instruction of learning strategies may modestly influence academic performance. Still, the degree to which these efforts may aid in the prevention or avoidance of academic difficulty is unclear.

Keywords
LASSI, learning strategy instruction, academic performance, physical therapy education, blended learning.

INTRODUCTION

The amount of factors to which a student's academic success may be attributed are seemingly innumerable.[1-3] Nonetheless, there appear to be certain factors within a student's locus of control that readily influence academic performance.[2,4] These include several intrinsic and extrinsic factors that can impact the process of learning, for example, a student's selection of cognitive and non-cognitive learning and study strategies.[5-9] Evidence suggests that certain cognitive and non-cognitive learning and study strategies are highly influential components in one's approach toward knowledge acquisition.[10-14] As a result, an understanding of the nuances of student learning strategies has become an increasingly popular area of research inquiry.[14-16] Some of the most highly studied student learning and study strategies include levels of self-regulation, metacognition, motivation, reflection, and grit/persistence, just to name a few.[6,14,17-18] Additionally, research has shown that students may have an affinity toward certain strategies over others, which may predispose them for either academic success or difficulty, and this phenomenon has garnered much attention.[1,4,11-12] However, the learning and study preferences of students are not static. Rather, they are quite dynamic and likely to change over time in response to learning demands and as the characteristics and needs of learners evolve with each new generation.[3,11,13] Some of the learning strategies utilized during undergraduate study may be more primitive and incompatible with success at the graduate-level as learning content becomes more complex and challenging.[18-21] Therefore, it is important to generate contemporary findings at the professional-level as higher education witnesses' changes in student demographics, learner characteristics, learning technologies, modes of program delivery, and instructional methods.[11,21-24]

To date, much of the research on learning strategies among graduate programs has been predicated on a foundation of evidence from the undergraduate college student population.[3,8-9,16,25-29] While there are sound theoretical bases for applying findings from undergraduate study to graduate-level study, the learning and study strategies required for success may be far more nuanced across each educational setting. Particularly, research on learning and study strategies for graduate health professional students has also been based largely on findings from undergraduate college students.[9,11,28] Furthermore, the evidence specific to graduate students in entry-level Physical Therapy (PT) and Occupational Therapy (OT) programs is less available and has been established on findings from medicine, nursing, and pharmacy education programs.[6-9,11,19,26-29] There may exist differences between the learning strategies needed to be successful in medicine, pharmacy, or nursing programs, and those of PT and OT education. For example, PT and OT education may have a stronger reliance upon psychomotor learning for hands-on and manual clinical skills.[12,18] There is a growing body of evidence that suggests higher-order cognitive processes and self-regulatory behaviors of adult learning are among the most influential in this population of learners.[1,2,12,18] For this reason, PT and OT educators have long emphasized many aspects of self-regulated learning strategies to achieve student outcomes and bolster academic success.[4-20] Among the numerous approaches to learning and studying, self-regulation appears to be very promising and has repeatedly been identified across the body of scientific evidence.[1,2]

Self-regulation refers to a learner's ability to autonomously respond to the demands of learning and strategically monitor their thoughts, emotions, behaviors, and activities.[1,4,5] Self-regulated learning strategies involve higher-order cognitive and non-cognitive processes and have been shown to be significantly related to student performance in graduates and undergraduates.[1,4-20,24,28] There are several assessment tools that measure components of self-regulated learning, including the highly utilized Learning and Study Strategies Inventory (LASSI).[13,34] Prior findings from the LASSI indicate adult college students rely more heavily upon self-regulatory learning processes, and those skills and behaviors can be honed with practice.[13] Although many studies have examined the predictive relationships of self-regulation on academic achievement across diverse settings and samples, few have yet to conduct study on the training of students to improve aptitude.[4,35] Nevertheless, one-on-one student coaching and training on learning strategies has previously shown improvements in college student retention in a variety of settings.[4,35] Furthermore, self-regulated learning strategies of undergraduate students have effectively improved after application of a training and instructional framework of focused student advising, including the students in the medical field.[4,8,29-35] Yet, in many populations it is not well known whether self-regulation strategies can be improved with training and instruction.[4,9,11,19] The scarcity of research on the effectiveness of learning and study strategies as an intervention creates a problem of instructional practice in PT and OT education program implementation. Mainly, PT and OT educators lack a knowledge of whether an instructional intervention on learning and study strategies can impact student academic performance and prevent academic difficulty and attrition.[10,18,23,36] If the training and instruction of learning and study strategies can influence academic performance then PT and OT students may be able to improve upon and readily deploy new skills to prevent difficulty and potentiate academic success.[4,8,10,31-34]

Additionally, if learning and study strategies can be trained and improved upon it may have significant financial implications.[4] According to the Commission on Accreditation in Physical Therapy Education (CAPTE) the average total cost of obtaining an entry-level professional PT education has increased dramatically over the last decade and now reaches up to $120,000 dollars,[36-37] whereas the cost of an OT education reaches upwards of $60,000 dollars.[38] Furthermore, total costs of program completion increases concomitantly as students encounter academic difficulty and disruptions in normal matriculation and academic progression.[37] This fact is compounded by an increasing overall financial burden on society as student loan debt has surpassed

$1.7 Trillion dollars.[37-39] The training and instruction of student learning strategies may be financially value-laden for many stakeholders, and it may provide a cost beneficial means through which a holistic and student-focused support program is operationalized.[4,13] Newly developing PT and OT educational programs, or those with below average performance outcomes, may consider integrating expressly focused learning and study strategy instruction as part of an improved student service delivery model. A deeper knowledge of these aspects is vital for PT and OT students, especially as entry-level programs see shifting trends in blended modes of educational delivery post-COVID-19 pandemic.[21-23] Yet, even prior to the COVID-19 pandemic, hybrid-online and blended PT and OT programs were proliferating.[21,36] As PT and OT programs continue to grow and evolve it is imperative educational researchers develop profession-specific findings that formulate best practices emphasizing student advising and outcomes as the American Physical Therapy Association (APTA) and American Occupational Therapy Association (AOTA) call for research specifically promoting learner development.[9,21,23,31]

As evidence on learning and study strategies continues to blossom in health professional education programs much about the implementation of learning and study strategy intervention is still poorly understood,[6] particularly among PT and OT students.[11-12] According to a recent systematic review,[10] there is a dearth of evidence from higher education that examines learning and study strategy instruction as an educational intervention.[4,11,35] Still, providing explicit, guided instruction and training to college students to improve learning and study strategy skills has been long viewed as a "promising practice".[10,35] To date, the training and instruction of learning strategies has been shown to yield an increase in student aptitude with subsequent improvements in academic performance in a very limited number of samples.[1,4,29,35] However, to our knowledge, there have been no published studies investigating the effectiveness of providing instruction and training on student learning and study strategies as an educational intervention in entry-level PT or OT education. As such, the purpose of this study was to compare entry-level PT and OT student academic outcomes after exposure to a standardized set of LASSI instructional training modules. Specifically, this study examined pre- and post-training scores on the LASSI in relation to professional grade point average (GPA). It was hypothesized that scales of the LASSI would be significantly improved after exposure to the self-paced instructional intervention. It was also hypothesized that the degree to which aptitude changed on each LASSI scale would correlate with changes in academic performance, thus influencing future GPA.

MATERIALS AND METHODS

This multi-center longitudinal cohort study used a causal-comparative design to test the stated hypotheses. All study procedures were approved by IRB and participants acknowledged informed consent prior to completing study procedures. Institutional and departmental approvals and permissions were obtained from academic deans and program directors prior to sampling student participants from each campus and program.

Participants and Setting

Recruitment consisted of entry-level PT and OT students across private institutions during the Spring of 2022. A convenience sample of participants consisted of first-term students from programs in three states: Florida, Texas, and California. Participants were followed through their first academic year of coursework. Participants completed study procedures during their first academic term (Spring of 2022) and were followed longitudinally until the end of the first academic year (Fall of 2022). All participants were enrolled in programs using "blended" curricula. In this study, each PT and OT curriculum was considered "blended" if >51% of learning content was delivered using an online learning management system (i.e., Blackboard, Canvas, etc.). Programs were excluded from sampling if they did not meet this criteria for the educational setting. All participants received a nominal monetary incentive after completion of all study procedures to ensure adherence to the study protocol.

Study Variables

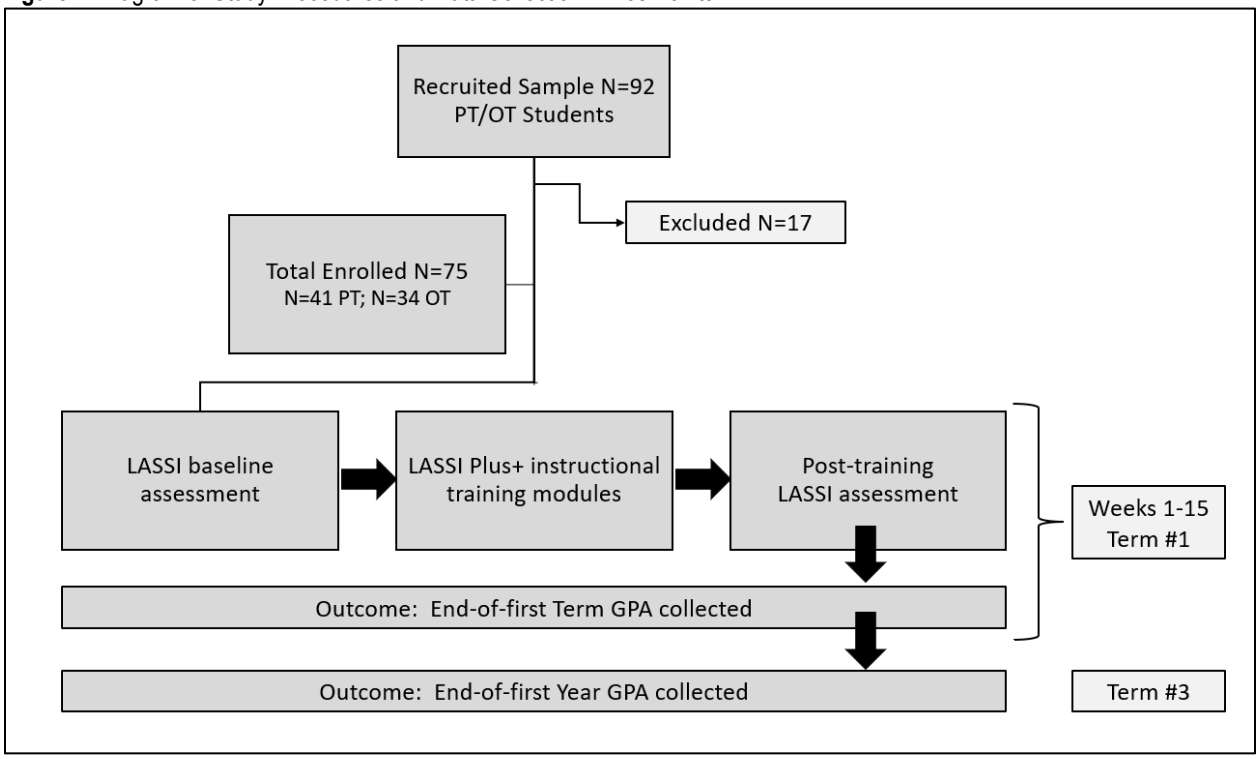
The independent variable in this study was the LASSI measurement and LASSI Plus+ intervention. In this study, the LASSI Plus+ was used to both assess and provide intervention on student learning and study strategies. The LASSI Plus+ consists of two components: The LASSI assessment, and the LASSI Plus+ instructional modules. According to Weinstein et al.,[13] the LASSI can be used as a diagnostic tool to identify areas in which students may benefit from educational interventions.[10,35] The LASSI Plus+ was specifically designed to diagnose, prescribe, and evaluate student learning strategies at the college level.[34] The LASSI is a highly studied valid and reliable 60-item self-reported assessment based on ten scales of learning and study strategies.[3,11,13] Each LASSI scale consists of six individual response items rated on a five-point Likert scale. The ten LASSI scales include: Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-Testing, Test Strategies, Time Management, and Using Academic Resources.[13] The three components measured by the LASSI are: Skill, Will, and Self-regulation.[13] The Skill component includes Information Processing, Selecting Main Ideas, and Test Strategies. The Will component includes Anxiety, Attitude, and Motivation. The Self-Regulation component includes Concentration, Time Management, Self-testing, and Using Academic Resources. The dependent variable collected in this study was academic performance in the form of cumulative grade point average (GPA) on a 0 to 4.0 scale at end-of-first term and end-of-first year.

Study Procedures. The LASSI Plus+ instructional training modules were considered the standardized educational intervention in this study. The study procedures included three main interactions: A baseline LASSI assessment, LASSI Plus+ training and instruction, and a post-test LASSI assessment. A description of the study procedures can be found in Figure 1. First, the LASSI was self-administered electronically by participants during the first four weeks of the first academic term to establish temporal precedence and a baseline measurement of learning and study strategy aptitude. This baseline measurement was considered the "pre-training" score for each student participant. After receiving an automated scoring profile, student participants received an individualized report on relative weaknesses and deficiencies in each LASSI scale when scoring below the 50th percentile. The scoring of the ten scales is automatically calculated by the LASSI measurement electronically.[13,34] Then, students self-administered the prescribed LASSI Plus+ instructional training modules at their own pace between weeks 4-14 of the first trimester. Sets of LASSI Plus+ instructional training modules varied per individual student and were automatically prescribed by the LASSI Plus+ electronic assessment based upon a student's aptitude in each of the ten scales. Participants were not required to complete any LASSI Plus+ instructional training modules if they scored >50% on any of the ten scales. According to H&H Publishing,

> *"There are 50 prescriptions (5 for each LASSI scale) that are designed to be brief, simple, and require the student to do something rather easy. The aim is to make each Prescription a 15-minute experience that is pleasant, interesting, and thought-provoking."*[34]

No further guidance or instruction was given by investigators after participants successfully completed all prescribed LASSI Plus+ instructional training modules. Finally, each participant self-administered a "post-training" LASSI assessment prior to the end-of-first term (weeks 14-15) to detect any changes in each scale score of the measurement after exposure to the instructional modules. Student participants completed their study procedures after the first term concluded and qualified for a small monetary incentive. There was no contact between the investigators and participants after the first term. GPA was collected from institutional databases at the end of the first 15-week trimester (Spring 2022) and again at the conclusion of the first academic year of coursework (Fall 2022) (three consecutive 15-week trimesters).

Figure 1. Diagram of Study Procedures and Data Collection Times Points



Data Analysis. *A priori* statistical power analysis required a minimum sample size of N=78 based on a medium effect size (*d=0.*4) with 80% power and alpha values set at 0.05 for Pearson's correlations and paired-samples t-tests. Descriptive and inferential statistics were performed using IBM SPSS v.27 (Armonk, NY).[40] Data was screened, and assumptions tests were performed for all procedures. The data set conformed to the requirements for parametric analyses. A pre-post comparison was conducted using paired samples t-test to detect any changes between baseline LASSI and post-LASSI Plus+ training scores. Paired samples correlations were calculated to examine any relationships between the degree of change in LASSI scales and change in first term to first year GPA. Paired samples correlation coefficient was calculated to examine the relationship between the LASSI scales and cumulative GPA. A *post-hoc* ROC analysis and McNemar's crosstabulations were calculated to determine the odds-ratio of academic difficulty for students scoring below LASSI scale cut-off scores.

RESULTS

A total N(%) sample of N=75(100%) included PT and OT 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 N=41(55%) PT and N=34(45%) OT students were enrolled, and the mean(SD) age was 24.3(+/-2.2) years. The sample consisted of N=56(75%) females and N=19(25%) males. The ethnicity of the sample consisted of 70% Caucasian, 13% Hispanic/Latino, 8% African American, 6% Asian America, and 3% "other" or "non-disclosed." A description of the participants and study variables can be found in Table 1. Mean(SD) scores for GPA and the LASSI scales and components for each educational program are listed in Table 1. There were no significant differences noted between PT and OT cohorts across the measurements, except for the LASSI scales of Self-testing and Time Management where OT students scored higher than PT counterparts (*p<0.05*). Of the N=75 participants sampled a total of N=18(24%) experienced academic difficulty during any one of the first three trimesters (first year). Academic difficulty in this study was defined as any participant achieving any course grade in any term lower than a 70% or having an overall GPA ≤2.99 at end of first year. There were no significant differences in presence of academic difficulty between PT and OT student participants (N=10 of 41[24%], and N=8 of 34 [23.5%], respectively [*p*=0.39]).

An illustration of the pre- and post-training LASSI scale scores can be found in Figure 2. A paired-samples t-test demonstrated significant differences between pre- and post-training for the LASSI scales of Concentration (+5.1; *p*<0.05; d=0.17), Self-testing (+8.9; *p*<0.01; d=0.31), Test Strategies (+8.1; *p*<0.01' d=0.29); Time Management (+5.3; *p*<0.05; d=0.19); and Self-regulation (+4.6; *p*<0.05; d=0.13). A complete description of the pre- and post-training comparative analysis can be found in Table 2. The degree to which changes in LASSI scale performance correlated with changes in GPA between first term and end-of-first year can be found in Table 3. Significant relationships were found between change in GPA and the degree to which the LASSI scales of Anxiety (r= -0.68; *p*<0.05), Concentration (r= 0.61, *p*<0.01), Test Strategies (r= 0.42; *p*<0.01), and Time Management (r= 0.54; *p*<0.01) changed after LASSI Plus+ instruction. Figure 3 illustrates the divergent relationship between change in the scales of Anxiety and Concentration and GPA after LASSI instruction, where a decrease in anxiety management coincides with an inability to concentrate, and vice versa. Figure 4 displays the relationship between change in the LASSI scales of Test Strategies and Time Management and GPA after instructional training. A post-hoc analysis of covariance revealed that only the LASSI scales of Anxiety (d= -0.31; *p*<0.05), Concentration (d=0.25; *p*<0.01), and Test Strategies (d= 0.29; *p*<0.01) differed significantly between students who experienced academic difficulty during the first three trimesters (N=18 [24%] of the total sample). To interrogate the diagnostic utility in this sample a post-hoc ROC analysis and McNemar's crosstabulation was performed to examine odds-ratios for the state of LASSI scales above/below established cut-off values and the presence of academic difficulty (GPA ≤2.99). According to this post-hoc analysis, the risk of academic difficulty was +2.6-times higher for those scoring lower than established LASSI Anxiety percentile cut-offs. Conversely, students had +2.8-, +2.4-, and +1.2-times higher likelihood for academic success if scoring higher than cut-offs in the LASSI scales of Concentration, Time Management, and Test Strategies, respectively.

Table 1. Baseline Participant Characteristics and Descriptive Statistics.

Measurement	Total PT & OT	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*=0.86
First-year GPA	3.28 (0.32)	3.27 (0.30)	3.30 (0.34)	*p*=0.48
Mean change in GPA	0.03 (0.11)	0.05 (0.10)	0.02 (0.12)	*p*=0.19
Academic difficulty N(%)	18 (24%)	10 (24%)	8 (23.5%)	*p*=0.39
LASSI scale				
Anxiety	43.9 (24.7)	44.4 (21.7)	43.4 (28.3)	*p*=0.17
Attitude	50.4 (28.6)	48.4 (27.8)	52.8 (29.9)	*p*=0.47

Measurement	Total PT & OT	PT	OT	*p value*
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	60.1 (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; OT = occupational therapy; PT = physical therapy.

Table 2. Paired-Samples t-test Comparison of Change in Learning and Study Strategy.

Measurement	Baseline	Post-training	Mean change	*p value two-tailed*	*Cohen's d effect size*
LASSI scale					
Anxiety	43.9 (24.7)	44.4 (21.7)	+0.5	*p*=0.69	0.04
Attitude	50.4 (28.6)	48.4 (27.8)	-2.0	*p*=0.42	0.08
Concentration	48.7 (25.2)	53.8 (23.8)	**+5.1**	***p*<0.05**	**0.17**
Information Processing	58.7 (25.3)	55.6 (25.5)	-3.1	*p*=0.26	0.11
Motivation	48.3 (23.5)	44.4 (23.6)	-3.9	*p*=0.14	0.14
Selecting Main Ideas	43.0 (26.6)	39.2 (24.8)	-3.8	*p*=0.15	0.13
Self-testing	60.3 (27.3)	69.2 (27.8)	**+8.9**	***p<0.01***	***0.31***
Test Strategies	51.1 (25.5)	59.2 (23.9)	**+8.1**	***p<0.01***	**0.29**
Time Management	60.1 (24.9)	65.4 (22.0)	**+5.3**	***p<0.05***	***0.19***
Using Academic Resources	51.7 (25.3)	53.3 (25.5)	+1.6	*p*=0.49	0.09
LASSI component					
Skill	50.9 (18.9)	48.0 (18.1)	-2.9	*p*=0.32	0.10
Will	47.7 (18.1)	46.5 (18.5)	-1.2	*p*=0.47	0.07
Self-Regulation	54.6 (18.7)	59.2 (19.8)	**+4.6**	***p*<0.05**	**0.13**

Table 2. Key. LASSI = Learning and Study Strategies Inventory; N=75.

Table 3. Correlation of Change in Learning and Study Strategy to Change in GPA.

Measurement	Mean Score Change	Paired-samples correlation coefficient	*two-tailed p value*
LASSI scale			
Anxiety	+0.5	**-0.68**	**<0.05**
Attitude	-2.0	-0.07	0.53
Concentration	**+5.1**	**0.61**	**<0.01**
Information Processing	-3.1	0.08	0.52
Motivation	-3.9	0.21	0.08
Selecting Main Ideas	-3.8	-0.09	0.42
Self-testing	**+8.9**	-0.02	0.89
Test Strategies	**+8.1**	**0.42**	**<0.01**
Time Management	**+5.3**	**0.54**	**<0.01**
Using Academic Resources	+1.6	0.17	0.15
LASSI component			
Skill	-2.9	0.03	0.64

Measurement	Mean Score Change	Paired-samples correlation coefficient	*two-tailed p value*
Will	-1.2	-0.15	0.30
Self-Regulation	+4.6	-0.08	0.45

Figure 2 Changes in LASSI Scales in Response to LASSI Plus+ Instructional Scores

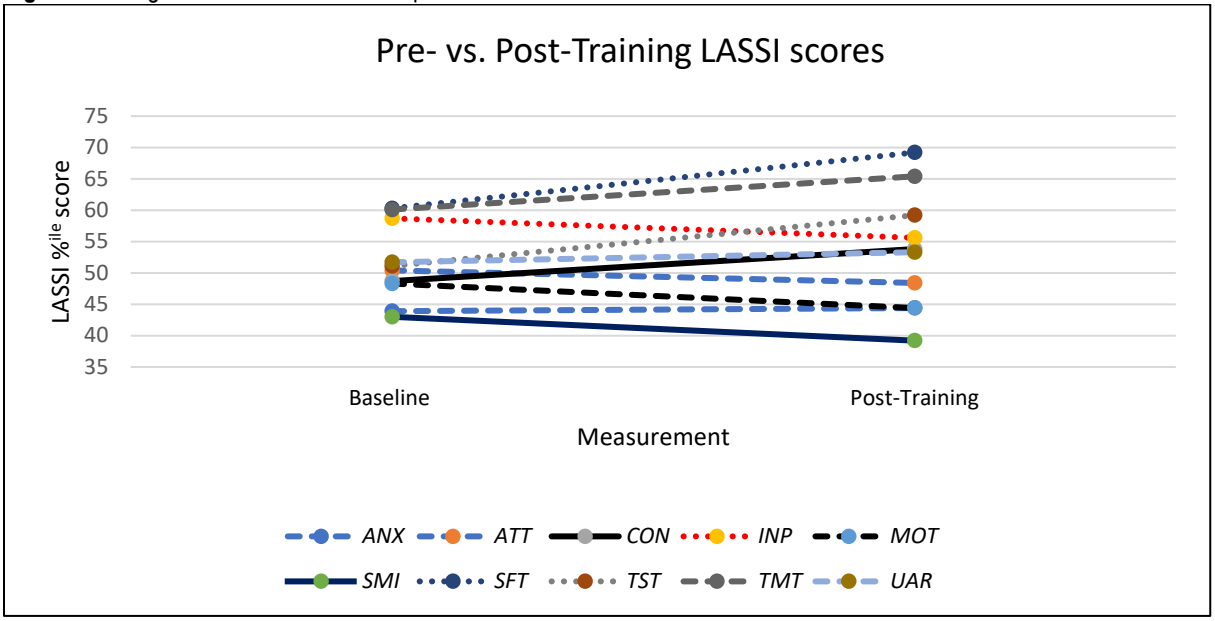


Figure 2. Key. ANX = Anxiety; ATT = Attitude; CON = Concentration; INP = Information Processing; MOT = Motivation; SMI = Selecting Main Ideas; SFT = Self-testing; TST = Test Strategies; TMT = Time Management; UAR = Using Academic Resources. LASSI = Learning and Study Strategies Inventory. Scores represented are truncated LASSI percentile scales ranging from 0-100%.

Figure 3. Relationship Between Change in Anxiety and Concentration and GPA after LASSI Instruction.

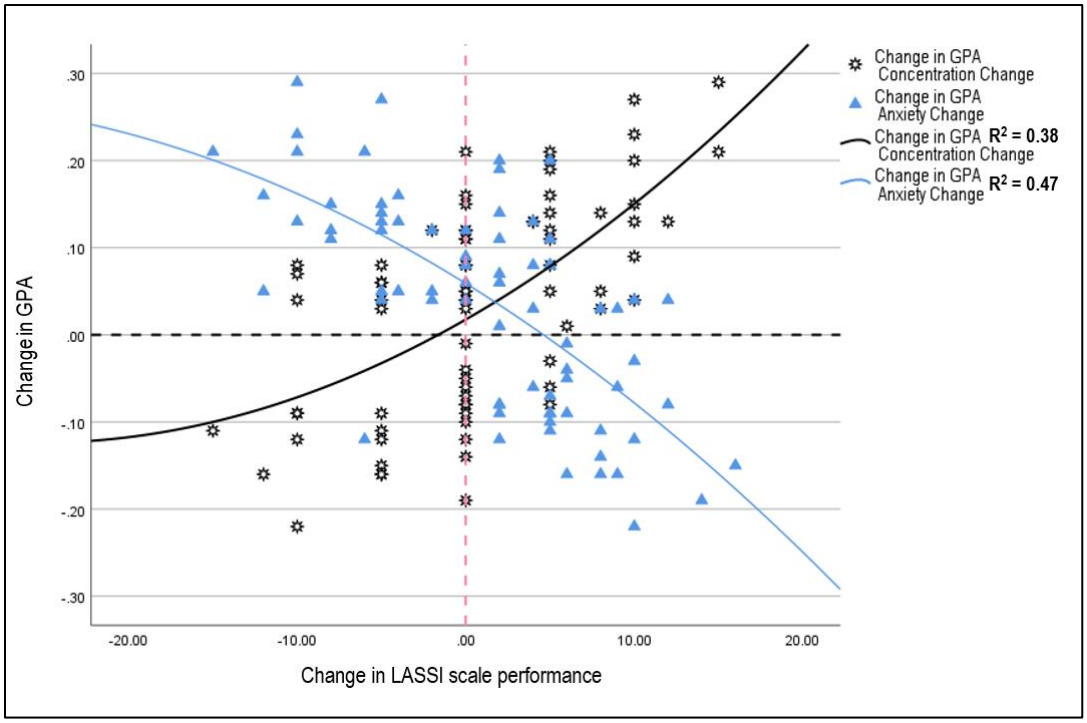


Figure 3. Key. GPA = Grade point average; LASSI = Learning and Study Strategies Inventory.

Figure 4.

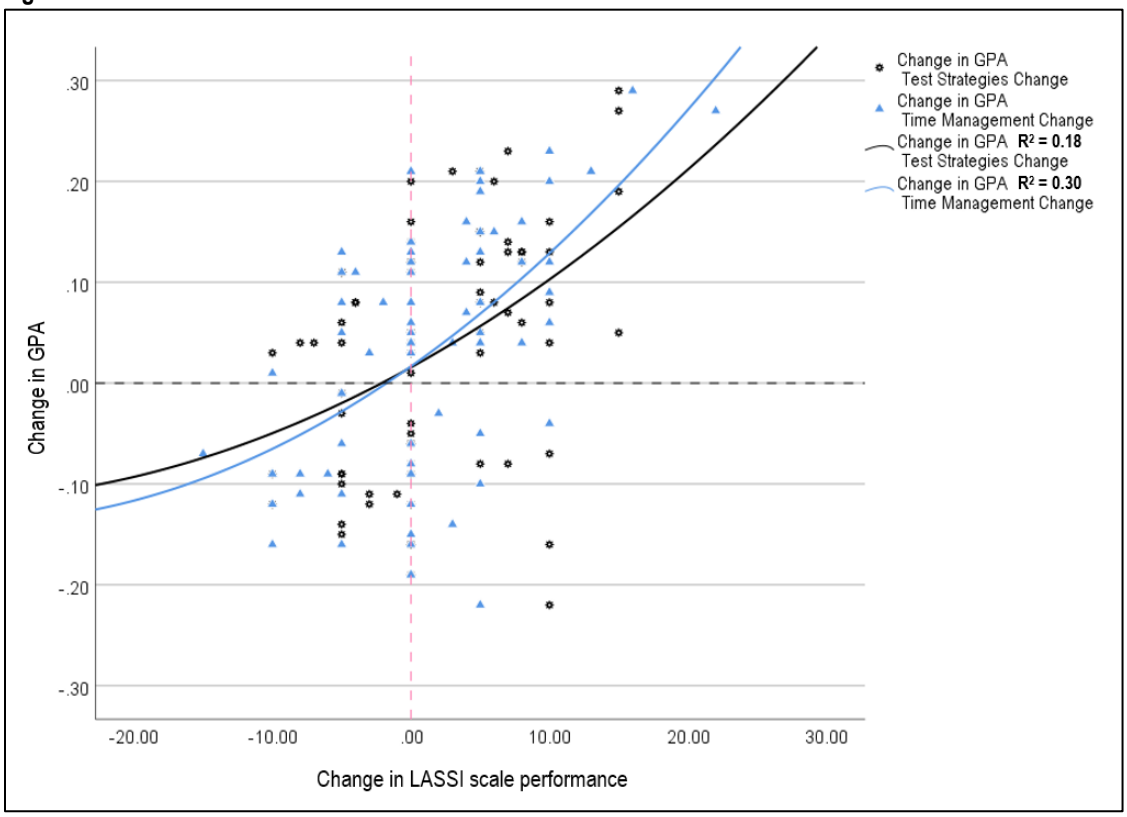


Figure 4. Key. GPA = Grade point average; LASSI = Learning and Study Strategies Inventory.

DISCUSSION

The purpose of this study was to compare entry-level PT and OT student academic achievement in response to a standardized set of prescribed self-paced LASSI Plus+ instructional training modules. To our knowledge, this is the first study of its kind to examine the effects of learning and study strategies instructional training as an educational intervention in this population of learners. Findings from this study showed statistically significant changes between baseline and post-LASSI Plus+ training scores in the LASSI scales of Concentration, Self-testing, Test Strategies, and Time Management. The largest degree of change after exposure to LASSI Plus+ instructional training was found in the scales of Test Strategies (d=0.31, $p<0.01$), Self-testing (d=0.29, $p<0.01$), Time Management (d=0.19, $p<0.05$), and Concentration (d=0.17, $p<0.05$), in order of magnitude. These results suggest that certain scales of the LASSI can be significantly improved with targeted instruction. Findings also indicated that positive changes in the post-LASSI Plus+ training scores of Concentration (r = 0.61, $p<0.01$), Time Management (r = 0.54, $p<0.01$), and Test Strategies (r = 0.42, $p<0.01$) were significantly correlated with first-year GPA. Notably, post-LASSI Plus+ training scores on the Anxiety scale was significantly and inversely correlated with first-year GPA (r = -0.68, $p<0.05$). These findings show that students who improved their aptitude in scales of Concentration, Time Management, and Test Strategies saw improvements in their GPA between first term and end-of-first year. Contrastively, students who displayed decreasing levels of Anxiety management showed a negative change in GPA between first term and end-of-first year. Poor aptitude in the LASSI Anxiety scale was associated with higher odds of academic difficulty. Lastly, results indicated that as levels of student Anxiety increased there was a similar decrease in Concentration which may indicate these two LASSI traits are inherently contradictive.

These results support the use of the LASSI Plus+ assessment as a sound measurement and modestly impactful intervention in this sample of learners. However, the degree to which exposure to instructional training modules of learning and study strategies interventions can prevent or mitigate future academic difficulty remains unknown. Given the lack of a broad and substantial treatment effect across the majority of LASSI scales it is possible that the standardized LASSI Plus+ instructional trainings are not impactful enough to be categorically considered interventional. It is important to note that several LASSI scales and components demonstrated little to no improvement, some even displayed a decrease in score after intervention. This finding directly highlights the need for further study using the LASSI as the properties of responsiveness, including standard error and minimum detectable change, are largely unknown for this measurement. Although there were significant correlations between GPA and the improvement of certain scales of the LASSI after training, when controlling for students who experienced academic difficulty in a post-hoc analysis there were few differences in the sample. That is, the presence of academic difficulty was only modestly explained by the scales of Anxiety, Concentration, and Test Strategies. A students' aptitude in anxiety management and concentration learning strategies may be considered inherently contradictive strategies, whereas one increases the other decreases. Lastly, although the component of Self-regulation achieved statistical significance on a pre- and post-training comparison, it demonstrated a weak signal. The LASSI component of Self-regulation improved an average of +4.6 points after exposure to instructional training (d=0.13, $p<0.05$). Self-regulation has been previously shown to be highly influential in graduate student performance.[1,4-13,26-30] Yet, in this sample, despite notable improvements after LASSI Plus+ training, self-regulation was an insignificant contributor to GPA. This finding contradicts many prior studies on self-regulation learning strategies and suggests that self-regulatory learning strategies may be more resolute and less likely to respond to training over short-term interventions.

Limitations

This study has several limitations. First, the LASSI measurement and LASSI Plus+ instructional trainings were all self-administered by each student at their convenience. Thus, the investigators were unable to control many aspects of the delivery of the educational intervention in focus. For example, the timing, pacing, completeness, and environmental conditions under which the LASSI Plus+ intervention was conducted for each participant is unknown. Undoubtedly, these nuances are intrinsic to the conditions surrounding each student participant and cannot be replicated or examined in a *post-hoc* analysis. There are also threats to the internal validity of this study, including the potential maturation of subjects through time, from baseline assessment to first-term GPA, and to end-of-first year GPA. This study controlled the sequencing of assessment and interventional procedures but did not control for any potential influences of temporality with respect to the LASSI Plus+ instructional trainings. It is possible that variation existed between some participants who may have completed all three procedures in a truncated timeframe, and subsequently altered the outcomes of this study. Furthermore, it was not possible to control for the degree to which an individual's predisposition to academic success may have influenced the outcomes of this study. Controlling these conditions is a recurring challenge among educational research inquiries. That is, students may have naturally improved academically throughout the curriculum, or could have had prior experience with the LASSI or LASSI Plus+ which may have increased their pre-test probability of improvement across the scales measured. There is also the possibility that students behaved differently on their post-training assessments due to a Hawthorne or

training effect. Lastly, the sample of learners included in this analysis was slightly underpowered according to *a priori* calculations. This study achieved roughly 95% of the sample required and did so by aggregating PT and OT students upon enrollment. As such, there may be nuances within each cohort that went undetected in the analysis due to a smaller representation of each educational program.

Recommendations for Future Research

Future research should take steps to control the collection of the LASSI measurement and the administration and exposure to LASSI Plus+ instructional training modules more rigorously. Although the LASSI Plus+ is designed for self-administration it may be more thoroughly prudent in a research environment for investigators to maintain direct oversight to ensure the accuracy and integrity of the instrumentation. For example, studies may involve providing a more controlled face-to-face environment for testing participants during baseline, training, and post-test assessments. That said, future studies may also consider stronger inclusion and exclusion criteria to target certain at-risk populations more strategically. Future studies should also utilize greater scientific rigor and study methodology, perhaps even by including control group comparators and either quasi-experimental or experimental designs. Lastly, future inquiries should seek to sample larger and more geographically and culturally diverse populations to increase the generalizability of findings. This study sampled multiple cohorts of PT and OT students together. Although there may be numerous similarities between these cohorts of students, future research should consider sampling each professional program individually to examine the intricacies more closely. Lastly, the diagnostic and prognostic properties of the LASSI measurement should be closely examined in this sample population. That is, the stratification of much larger samples could aid in the identification of contemporary calculations of reliability, validity, and odds- and likelihood ratios that may distinguish relevant cut-off scores for students by their relative risk of either academic success or difficulty in this sample.

CONCLUSION

As higher education evolves and blended curricula becomes more prevalent in PT and OT programs the learning and study strategies linked to academic success become increasingly important.[18-21,29-30] Providing interventions focused on the training and instruction of learning strategies may be a cost beneficial way to promote academic achievement in PT and OT students.[4,11-13,34] Additionally, a deeper knowledge of the strategies needed for success are extremely relevant moving forward in a post-COVID-19 pandemic educational landscape. As PT and OT education evolves and advances to meet the needs of society, so too, should programs meet to the needs of the ever-changing student body. Promoting self-regulation learning strategies may be a factor in PT and OT education but needs continued exploration. Such advances require a robust body of current literature through continuous and focused investigation on the many nuances of teaching and learning in PT and OT education. Yet, there is a lack of evidence-based assessments and instructional interventions surrounding PT and OT student learning and strategies. The LASSI Plus+ is just one instrument that claims the ability to accurately diagnose deficits in learning strategy and prescribe targeted interventions. Based on the findings from this study, institutions and academic program administrators should carefully consider the use of LASSI Plus+ instructional trainings for their students. The LASSI Plus+ may offer a support mechanism of modest improvement in students' academic outcomes. However, given the costs associated with licensing and purchasing the various LASSI items, it may not provide the most cost-effective means through which academic success is advanced.

Highlights

Completion of standardized self-paced training modules in learning and study strategies was modestly related to significant changes in academic performance for some students. Students who are predisposed to academic difficulty may benefit from training and exercising of certain learning strategies that are more closely related to success.

Abbreviations

AOTA – American Occupational Therapy Association
APTA – American Physical Therapy Association
GPA – Grade point average
LASSI – Learning and Study Strategies Inventory
LASSI PLUS+ – Learning and Study Strategies Inventory Plus+ Instructional Modules
OT – Occupational Therapy
PT – Physical Therapy

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Conflicts of Interest
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Ethical Reporting Statement
The primary investigator has unrestricted access to the data that is presented in this study. He takes full responsibility for the integrity of the data and the accuracy of the analysis contained in this report. We attest that we have read the Journal's position on issues involving ethical reporting and affirm that this report is truthful, accurate, and consistent with stated guidelines.

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