THE PREDICTIVE NATURE OF LEARNING AND STUDY STRATEGIES IN ONLINE PHYSICAL AND OCCUPATIONAL THERAPY EDUCATION

by

Evan Michael Pucillo

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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APPROVED BY:

Dr. Ellen Lowrie Black, EdD, Committee Chair

Dr. Kurt Michael, PhD, Committee Member

ABSTRACT

There is a nationwide shortage of health professionals and a growing demand for education programs. As physical therapy (PT) and occupational therapy (OT) education programs rapidly expand to generate more candidates for the health workforce, they have increasingly adopted online instruction. The PT and OT programs can be rigorous, and it is beneficial for educators to understand how to best support academic outcomes in an online environment. Students may adhere to specific learning and study strategies to ensure success. Prior work indicates Anxiety, Attitude, Concentration, Time Management, Motivation, and Self-regulation strategies are significantly related to academic outcomes (Crede & Kuncel, 2008; Khalil et al., 2018b, 2019; Zhou et al., 2016). However, these relationships have yet to be fully explored in PT and OT education. A predictive correlational study examined the ability of the Learning and Study Strategies Inventory (LASSI) to accurately predict cumulative professional grade point average (cpGPA) in PT and OT students in an online curriculum. Convenience sampling consisted of 149 student participants. Multiple regression analyses were run and the researcher found no significant predictive relationships for any of the LASSI scales and predict cumulative professional grade point average. The LASSI may not be an accurate diagnostic measure in this population of online learners. However, it may still be beneficial to improve student awareness of these skills.

Keywords: physical therapy education, occupational therapy education, learning strategies, study strategies, predictive ability

Copyright Page

Dedication

I would like to dedicate this work to my wonderful wife, Marie. She has been a perpetual source of unconditional love, encouragement, and motivation throughout my journey to degree completion. I would also like to dedicate this manuscript to our daughter, Elena Rose. She has brought immense joy into our lives, serves as a continuous beacon of hope, and is the reason I wake each morning and strive for greatness. I love you, both, more than words could ever express. Lastly, I dedicate this work to our beloved brother, Joseph B. Cross. His life serves as a continual reminder of how I can strive to be a better father, brother, and husband. He continues to live in all our hearts.

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Table of Contents

ABSTRACT....3

Copyright Page....4

Dedication....5

Acknowledgments....6

List of Tables....11

List of Figures....12

List of Abbreviations....13

CHAPTER ONE: INTRODUCTION....15

- Overview....15
- Background....15
  - Theoretical Overview....17
  - Historical Overview....19
- Problem Statement....21
- Purpose....23
- Significance of the Study....23
- Research Questions....27
- Definitions....27

CHAPTER TWO: LITERATURE REVIEW....31

- Overview....31
- Theoretical Framework....31
  - Andragogy and Adult Learning Theory....31
- Related Literature....38

A New Generation of Adult Learners 38
Online Education 41
Learning and Study Strategies 48
Learning and Study Strategies Inventory 51
The Professional Imperative 70
Summary 73
Conclusion 73
Gaps in the Literature 74
CHAPTER THREE: METHODS 75
Overview 75
Design 75
Research Questions 76
Null Hypotheses 76
Participants and Setting 76
Statistical Power Analysis 77
Inclusion and Exclusion Criteria 78
Participant Demographics 79
Instrumentation 80
Test Administration and Measurement 81
Outcome Variable (cpGPA) 84
Procedures 85
Data Collection 87
Data Analysis 89

CHAPTER FOUR: FINDINGS 91
Overview 91
Research Questions 91
Null Hypotheses 91
Descriptive Statistics 92
Results 96
Null Hypothesis One 96
Assumptions Tested 97
Null Hypothesis Two 100
Assumptions Tested 100
CHAPTER FIVE: CONCLUSIONS 104
Overview 104
Discussion 104
Implications 109
Limitations 111
Recommendations for Future Research 114
Conclusion 116
REFERENCES 117
Appendix A: The LASSI third edition 142
Appendix B: Sample LASSI Score Report 143
Appendix C: Host Institution – IRB Informed Consent 144
Appendix D: Host Institution – Letter of Approval to Conduct Study 148
Appendix E: Liberty University Informed Consent 149

Appendix F: Host Institution Recruitment Letter 152

Appendix G: Liberty University Recruitment Letter.....153

Appendix H: LASSI Log-on Instructions.....154

Appendix I: Host Institution – IRB approval letter 155

Appendix J: Liberty University IRB Approval Signature Page.....156

List of Tables

Table 1. Responses Rates of Participants by Characteristic 79

Table 2. The Learning and Study Strategies Inventory third edition.....80

Table 3. Study Procedures and Timeline 87

Table 4. Descriptive Statistics of the Criterion and Predictor Variables 94

Table 5. Descriptive Statistics of the Criterion and Predictor Variables by Gender 95

Table 6. Descriptive Statistics of the Criterion and Predictor Variables by Academic Program ..96

Table 7. Standard Regression Model Summary for $H_0$1.....98

Table 8. Contribution of Predictor Variables to cpGPA for the Sample Population.....99

Table 9. Standard Regression Model Summary for $H_0$2.....102

Table 10. Contribution of the Predictor Variables to cpGPA for the Sample Population.....102

List of Figures

Figure 1. Histogram of the Distribution of cpGPA.....93

Figure 2. Scatter plot Matrix of Scales of the LASSI and cpGPA 98

Figure 3. Scatter plot Matrix of Components of the LASSI and cpGPA 101

List of Abbreviations

American Occupational Therapy Association (AOTA)

American Physical Therapy Association (APTA)

Andragogy Learning Theory (ALT)

Anxiety (ANX)

Attitude (ATT)

Commission on Accreditation in Physical Therapy Education (CAPTE)

Concentration (CON)

Cumulative Professional Grade Point Average (cpGPA)

Doctor of Occupational Therapy (OTD)

Doctor of Physical Therapy (DPT)

Grade Point Average (GPA)

Information Processing (INP)

Institutional Review Board (IRB)

Learning and Study Strategies Inventory (LASSI)

Masters of Occupational Therapy (MOT)

Motivation (MOT)

National Board of Physical Therapy Examiners (NPTE)

National Board Certification for Occupational Therapist (NBCOT)

Occupational Therapy (OT)

Physical Therapy (PT)

Primary Investigator (P.I.)

Selecting Main Ideas (SMI)

Self-testing (SFT)

Strategic Learning Theory (SLT)

Test Strategies (TST)

Time Management (TMT)

United States Medical Licensing Examination (USMLE)

Using Academic Resources (UAR)

Variance Inflation Factor (VIF)

CHAPTER ONE: INTRODUCTION

Overview

Chapter One describes the prior evidence investigating learning and study strategies and academic performance, particularly using the Learning and Study Strategies Inventory (LASSI) in the realm of higher and health professional education. The problem statement explores the gap in the current literature. Gaps in knowledge of this topic are evident and provide a sound basis from which to draw logical research questions and hypotheses for this study. Finally, this chapter culminates with a rationale and practical significance regarding the predictive relationship between learning and study strategies and grade point average (GPA) for physical therapy (PT) and occupational therapy (OT) students.

Background

Entry-level PT and OT education programs are experiencing nationwide growth as the United States braces for the increased demand for health care providers (Landry et al., 2016). According to 2018 aggregate data from the United States Bureau of Labor Statistics, 11 of the 20 fastest-growing occupations between 2016-2026 are in the health professions, including both physical and occupational therapy. It is anticipated that these two health professions will experience growth rates between 28-31% by the year 2026 (US Bureau of Labor Statistics, 2018). The demand for these health care professions is very high and is the result of an undeniable shortage in the health workforce (Landry et al., 2016). Subsequently, the Commission on Accreditation in Physical Therapy Education (CAPTE) reports the number of accredited PT education programs in the US has increased by 21% from the years 2000 to 2017, a total increase of 54 additional programs (CAPTE, 2019). According to CAPTE, the number of practicing physical therapists is expected to grow to over 250,000 nationwide by the year 2025 (Wolden,

2018). As health care expands to meet the needs of a growing global population “it is vital that PT education systems grow and evolve to meet the challenges of an increasingly complex and demanding health system” (Wolden, 2018, p. 1).

This budding development in health care professions creates an enormous need for health professional education programs across the US. In turn, the concomitant growth in these educational programs creates an urgent need to prioritize focused educational research inquiry (Jensen et al., 2016, 2017). Jensen et al. (2017) make distinct and urgent calls to bolster the evidence base for teaching and learning in PT education from many angles, including exploring “the teaching and learning strategies that prepare adaptive learners…grounded in strong self-monitoring skills, and a lifelong commitment to learning” (p. 880). To this end, Jensen et al. (2017) express the position of the American Council on Academic Physical Therapy and specifically state that professional “resources should be expended on using sound educational research to identify the best array of options that lead to success” to achieve the best academic outcomes for graduates entering the health workforce (p. 881). Furthermore, the need for educational research that can drive programmatic decision-making, in addition to promoting student success, is equally paramount in health care professions (Jensen et al., 2016, 2017; Wolden, 2018; 2020). Possessing an intimate knowledge of the factors most closely linked to academic success in PT and OT education will help to ensure that graduates are adequately prepared to enter the health workforce (Waite et al., 2019; Wolden, 2018, 2020).

Additionally, curricula in health professional education, especially PT and OT programs, have undergone a fundamental change. According to aggregate program data from CAPTE (2019) and the American Occupational Therapy Association (AOTA) (Harvison, 2018), curricula have transitioned from traditional face-to-face instruction to mostly hybrid-online. Across the

US, entry-level PT curricula have moved from 42.4% hybrid-online and 25.8% traditional-based to 75% hybrid-online and 10.2% traditional-based between the years of 2002 and 2017, respectively (CAPTE, 2019). The AOTA (Harvison, 2018) report the percentage of masters and doctorate-level OT programs that are offered with at least half of their curriculum delivered online as 85% and 90%, respectively. This represents the sheer magnitude of the paradigm shift that has occurred in professional PT and OT educational programs.

Prior to 2019, many health professional education programs were already scaling up the extent to which online instruction was deployed across curricula. However, most recently, the novel coronavirus, known as COVID-19, sent shockwaves through the higher education system forcing widespread campus closures (Centers for Disease Control and Prevention, n.d.; Gardner, 2020). In 2019-2020, COVID-19 caused a pandemic and forced hundreds of millions of college students to entirely online learning as face-to-face campus operations were halted to mitigate the spread of disease (Gardner, 2020). This unprecedented event prompted a fundamental change to the entire framework of higher education in the US with great haste. As a result, institutions responded by rapidly adopting online instruction to fulfill the needs of students, accrediting bodies, and federal, state, and local governing agencies (CAPTE, 2020). Therefore, in the wake of this global health crisis, there has been no greater time to possess a more complete understanding of the learning and study strategies that are predictive of success in the online education of PT and OT students.

Theoretical Overview

This educational research study was grounded in the theory of andragogy, a theory of adult learning, originally posited by Malcolm Knowles in 1983 (Knowles, 1983; Knowles et al., 2012). Andragogy has been defined as “a set of core adult learning principles that apply to all

adult learning situations" (Knowles et al., 2012, p. 2). Andragogy learning theory (ALT) is grounded in the assumption that adults learn in fundamentally distinct ways that are dissimilar from children (Knowles, 1983; Knowles et al., 2012). The hallmarks of ALT include many elements that contextually overlap with many philosophies like motivational learning, self-regulated learning, and strategic learning theories (Bennett et al., 2012; Broadbent & Poon, 2015; Weinstein & Hume, 1998). ALT touts the importance of a learner's intrinsic motivation and desire to learn, a developed self-concept, prior experience, readiness to learn, and their orientation to learning (Knowles et al., 2012). Together, many of these theoretical components are woven into Weinstein's strategic learning theory (SLT) (Weinstein et al., 2016). The underpinnings of SLT include elements such as cognitive skill, motivation and the will to learn, self-regulation and effort-related activities, and goal orientation (Finch et al., 2016; Weinstein et al., 2016). Many of the elements that have become staples in the understanding of adult learning are also integrated into the principles of strategic learning for college students. As a result, ALT and SLT share several similarities, many of which are well represented in the Learning and Study Strategies Inventory (LASSI).

Weinstein, Palmer, and Schulte developed the LASSI in 1987 as an evidence-based approach to assess adult college students according to 10 scales of SLT (Weinstein et al., 1988; Weinstein & Hume, 1998; Weinstein et al., 2016). These 10 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). Together, these scales assess how proficient an adult learner may be at utilizing each aspect of strategic learning to maximize their academic success. The LASSI also measures three major components of strategic learning, including: Skill, Will, and Self-Regulation (Weinstein et al.,

2016). The LASSI measurement has been well studied in higher education, has undergone much refinement to its content and structure, and has been widely analyzed for its psychometric properties (Cano, 2006; Marland et al., 2015; Melancon, 2002; Prus et al., 1995).

After decades of research, the LASSI has demonstrated acceptable validity and reliability across levels of education, settings, and in a wide range of demographics (Cano, 2006; Finch et al., 2016; Flowers, 2003; Marland et al., 2015; Weinstein et al., 2016). To date, the LASSI has also been studied in many areas of health professional education (Donaldson, 2018). In large part, these studies revealed significant relationships between scales of the LASSI and academic performance. Attitude, Motivation, Concentration, Time Management, and Self-testing strategies appear to be significantly related to superior academic performance, while Anxiety is negatively related (Bernier, 2009; Jouhari et al., 2016; Khalil et al., 2018b, 2019; Schutz et al., 2013; West & Sadoski, 2011; Zhou et al., 2016). Reliability of the LASSI measurement has been cited by numerous studies and reported values range from 0.72 to 0.89 across the 10 scales (Cano, 2006; Deming et al., 1994; Flowers, 2003; Moak, 2002; Melancon et al., 2002). Overall, the LASSI is a stable measurement that provides educators valuable information on one's aptitude across a variety of learning and study strategies and provides normative-referenced scores to help diagnose and prognosticate success (Weinstein et al., 2016).

Historical Overview

Since the inception of the LASSI in 1987, much study has been conducted using this measurement across a variety of educational levels and contexts. This has generated a rich body of evidence from which to identify gaps in understanding of the tool's application and utility across educational settings (Weinstein et al., 2016). Historically, the primary utilization of the LASSI has been directed at adult students transitioning from high school into college as they

experience a shift in academic expectations (Cano, 2006; Crede & Kuncel, 2008; Mathes, 2003; Rodriguez, 2014). Appropriately, the majority of scientific inquiry from the previous 30 years on the LASSI has been conducted across various educational programs from two- and four-year colleges and universities. For example, the tool has been well studied in transitioning college freshman and undergraduates, community colleges, and even in military cadets (Cano, 2006; Haught, 1996; Haught et al., 1998; Heard, 2002; Ince & Priest, 1998; Mathes, 2003; Rodriguez, 2014; Slaybaugh, 2012).

In large part, studies have shown certain learning strategies of the LASSI may be viewed as pillars of success for adult college students (Crede & Kuncel, 2008; Griffin et al., 2012). For example, the LASSI scales of attitude, motivation, concentration, test strategies, and time management appear to be consistently linked to superior academic outcomes regardless of the setting (Crede & Kuncel, 2008). Furthermore, there is a growing body of literature that has examined the LASSI in graduate education. Generally, findings from these studies have supported the results obtained in many previous inquiries (Carson, 2011; Kuo, 2015; Jouhari et al., 2016; Zhou et al., 2016) and have occurred through a range of theoretical frameworks, including self-regulated, adult, and strategic learning.

Through the turn of the 21st century, investigations using the LASSI gained significant momentum as educators sought meaningful ways to better understand factors linked to student performance. In large part, for adult learners, findings implicate that success is related to self-regulated LASSI components such as attitude, time management, motivation, self-testing, test taking strategies, and concentration (Carson, 2011; Crede & Kuncel, 2008; Gatto, 2010; Griffin et al., 2012; Jouhari et al., 2016; Khalil et al., 2018b, 2019; Marrs et al., 2009; Slaybaugh, 2012; West & Sadoski, 2011; Zhou et al., 2016). Furthermore, these scales of SLT have demonstrated

the ability to predict success for adult students (Bernier, 2009; Chevalier et al., 2017; Kuo, 2015; Lobb et al., 2006; Primus, 2003; Pringle & Lee, 1998; Schutz et al., 2013). Indeed, the elements of ALT and SLT embedded in the LASSI have been well studied in higher education (Bierema, 2018; Broadbent & Poon, 2015; Hicks, 2010; Orsini et al., 2016). However, it has not been until more recently that the LASSI has been specifically investigated in graduate health professional education (Bernier, 2009; Hicks, 2010; Zhou et al., 2016).

The PT and OT programs are just two of the areas of higher education where the LASSI has yet to be fully explored (Lee, 2018; Waite et al., 2019). The explosive growth of these two areas of higher education is met with the shift to hybrid-online curricular models that include varying degrees of online instruction (Jensen et al., 2016). Online and hybrid-online education present new challenges and opportunities to both educators and students when measuring the influence of learning and study strategies on academic performance. Typically, PT and OT programs include a large portion of hands-on laboratory instruction that focuses on the acquisition and mastery of technique-sensitive psychomotor skills (Plack & Driscoll, 2011). Therefore, the inclusion of hybrid and online instruction into PT and OT professional curricula necessitates a better understanding of the learning and study strategies that are most closely associated with, or predictive of, academic performance (Cook et al., 2008; 2010; Griffin et al., 2012; Liu et al., 2016; Zhou et al., 2016). To date, however, learning and study strategies for PT and OT students in an online curriculum are poorly understood (Pucillo et al., 2020).

Problem Statement

Online education in PT and OT programs may present students with unique challenges given the complexity of content across anatomical and movement sciences. This represents a problem of great interest as the number of course withdrawals or failures has recently climbed to

new heights at the university in focus. According to recent institutional data for this university in the calendar year 2017-2018, the DPT and MOT programs reported a total of 33 course withdrawals and 17 failures, and 8 course withdrawals and 9 failures, respectively (University of Saint Augustine for Health Sciences, 2019b). This amounts to 67 students required to repeat a course due to experiencing academic difficulty. If certain scales of the LASSI measurement are able to accurately predict academic success, then perhaps the tool may be used to prospectively identify students who are at risk for academic difficulty and offer opportunities to mitigate withdrawals and promote retention and progression (Pucillo et al., 2020; Villareal & Martinez, 2018). Currently, however, the understanding of the LASSI in this population of learners is reliant upon work conducted in other professions (Lee, 2018; Waite et al., 2019). Therefore, the rapid growth of hybrid and online education in PT and OT curricula necessitates a better understanding of the learning and study strategies are able to accurately predict academic performance (Pucillo et al., 2020).

There is a growing body of evidence that suggests there are particular learning and study strategies linked to, and predictive of, superior academic outcomes in some health professions (Lee, 2018; Waite et al., 2019). Students that have high aptitude in certain learning and study strategies may be more likely to achieve academic success (Villareal & Martinez, 2018). Conversely, students who have low aptitude in certain learning and study strategies may be at risk for greater academic difficulty (Crede & Kuncel, 2008; Villareal & Martinez, 2018; Weinstein et al., 2016). Therefore, it is possible that there may exist learning strategies that are better suited for online learning in PT and OT students. However, prior studies have not fully examined the LASSI in PT and OT education (Lee, 2018; Pucillo et al., 2020; Waite et al., 2019). Although a few prior relationships have been established, evidence is greatly limited and

there have been no formal reports on the predictive nature of the LASSI scores for PT and OT students engaged in hybrid or online learning. As a result, the learning and study strategies that are able to accurately predict grade point average in the online education of PT and OT students remains largely unknown.

Purpose

The purpose of this quantitative predictive correlational study was to examine the ability of the LASSI scale and component scores to accurately predict cumulative professional grade point average (cpGPA) for physical and occupational therapy students enrolled in an online curriculum. The predictor variables were the 10 scale scores (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources), and the 3 component scores (Skill, Will, and Self-regulation) of the LASSI. The outcome variable was cumulative professional GPA.

Significance of the Study

As many institutions seek to more broadly implement hybrid- or fully-online instruction, a working knowledge of the learning and study strategies that are able to predict academic outcomes may be advantageous for making broad programmatic decisions on institutional effectiveness (Fleming et al., 2011; Griffin et al., 2012; Hicks, 2010; Pucillo et al., 2020; Zhou et al., 2016). Similarly, predictive information on a student's learning strategies can be useful to prognosticate and guide student advising (Weinstein & Hume, 1998; Weinstein et al., 2016). This knowledge may aid educators with refining existing instructional methods to better promote specific strategies that are predictive of success in online health professional programs (Chevalier et al., 2017; Cook et al., 2010, Kuo, 2015; Schutz et al., 2013). For example, "Less successful learners may know what they need to learn, but do not know how to learn it most

effectively" (Hoveland, 2006, p. 3). Therefore, this study may identify the learning and study strategies that PT and OT students should choose to implement when faced with more challenging online coursework. Thus, helping PT and OT educators endorse and inculcate specific learning and study strategies for their students. For example,

> Information from these [LASSI] assessments may enable faculty to better identify and understand students' weaknesses, as well as their strengths, in regard to their learning and study strategies. In doing so, faculty gain a better understanding of the issues that plague students' academic achievement and use this knowledge to improve students existing learning and study strategies. (Alkhateeb & Nasser, 2014, p. 949)

Furthermore, as the cost of higher education becomes increasingly more burdensome for health professional students, ensuring academic success is of principal importance. In the wake of rising tuition, maintaining normal academic progression is of equal significance for both educators and students (Jette, 2016; Shields & Dudley-Javoroski, 2018). According to the U.S. Department of Education, student loan debt among citizens exceeds $1.5 trillion and is "now the second highest consumer debt category – behind only mortgage debt – and higher than both credit cards and auto loans" (Friedman, 2019, p. 1). For many, the extraordinary cost of higher education can be quite burdensome (Ambler, 2020). However, this may be further compounded when students withdraw, fail, or require remediation due to the academic difficulties experienced in a rigorous health professional education program.

The university of interest in this study is a large private, for-profit, health professional institution that aims to prepare a variety of allied health providers for clinical excellence. In the year 2018-2019, the cost to attend the Doctor of Physical Therapy (DPT) and Masters of Occupational Therapy (MOT) programs at the host university was between $13,000 and $14,000

U.S. Dollars (USD) per trimester, respectively (USAHS, 2019b). At nearly $800 per credit hour, tuition costs can exceed $42,000 each year. Tuition costs to degree completion for these programs total between $85,000 and $106,000 per student (USAHS, 2019a), respectively. Despite these alarming figures, PT and OT education tuition costs are expected to increase well into the future (Jette, 2016; Shields & Dudley-Javoroski, 2018).

Although costs may vary greatly from school to school, this problem is not unique to this university and certainly occurs at other institutions (Ambler, 2020; Jette, 2016). According to CAPTE (2019), the median cost of a DPT education in 2019 ranged from $62,000 to $111,000 USD, for in-state and out-of-state schools, respectively. Brown et al. (2015) highlight rising out-of-pocket tuition costs for OT students as the profession transitions from a masters to an entry-level clinical doctorate degree. According to WebPT (2018), over 37% of PT and OT graduate students will incur educational debt greater than $100,000. In a recent study, Ambler (2020) found that nearly a third of entry-level PT students surveyed anticipated total educational debt exceeding $150,000. These figures represent the staggering financial woes that some PT and OT students may experience and highlight the growing trend in health professional education (Ambler, 2020; Shields & Dudley-Javoroski, 2018).

Specifically, at the host institution there exists the opportunity to make significant intellectual contributions to the broader community of professional PT and OT educators. This university has a large academic infrastructure, multiple campuses in three states with multiple PT and OT programs, and graduates the largest nationwide number of entry-level PT and OT professional candidates per annum. Over the academic year of 2017-2018, this institution collectively awarded a total of 1,616 PT and OT degrees (USAHS, 2019b). As such, the host

institution is uniquely poised to study large numbers of student cohorts and better understand the intricacies of health professional education.

These numbers also highlight the direct capacity of the host institution to influence the number of health professional candidates entering the health workforce in a time of great shortage. However, between the Fall trimesters of 2017 and 2018, PT and OT programs collectively reported a total of 67 course withdrawals and failures requiring remediation, the large majority of which were in the core sciences (USAHS, 2018). This figure represents the impact of academic difficulty on PT and OT students and includes hardships such as increased financial burden and tuition costs, postponing clinical fieldwork, and lost wages due to a delay of entry into the health workforce (Pucillo et al., 2020).

Of course, any delay in natural academic progression due to failures and withdrawals requiring remediation will result in an increase of out-of-pocket tuition costs for students. Students experiencing academic difficulty may be forced to delay professional candidacy and the ability to take the national licensure examinations required for legal practice. As such, academic difficulty can greatly increase financial hardships by postponing one's ability to begin earning a professional salary and compounding student loan debts from added tuition expenses. For these reasons, there is an economic imperative to study the factors that may be related to, or predictive of, student success in PT and OT education (Shields & Dudley-Javoroski, 2018).

Avoiding failure and ensuring academic success can potentially mitigate a myriad of downstream socioeconomic issues. The findings from this study may be influential to PT and OT educators on a national scale to help prepare students for academic success, avoid difficulty and attrition, and expedite graduation to the health workforce. Overall, the knowledge gained from

this study may be readily implemented internally across institutional initiatives that seek to improve graduate outcomes and academic retention.

Research Questions

The research questions for this study are:

RQ1: How accurately are the ten scales of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

RQ2: How accurately are the three components of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

Definitions

1. *Learning and Study Strategies Inventory (LASSI)* – The LASSI is a normative referenced measurement developed by Weinstein, Palmer, and Schulte in 1987. The tool quantifies 10 scales and three components of strategic learning (Weinstein et al., 2016). The LASSI is an online self-administered survey and consists of a 5-point Likert-style response.
2. *Anxiety (ANX)* – This LASSI scale measures a student's ability to manage their fear of failure or performing poorly on examination and manage levels of angst during studying (Weinstein et al., 2016).
3. *Attitude (ATT)* – This LASSI scale measures a student's orientation toward learning new material including their thoughts, behaviors, and actions toward studying (Weinstein et al., 2016).

4. *Concentration (CON)* – This LASSI scale measures a student's ability to focus on pertinent material during instruction or school-related tasks and mitigate distractions while studying (Weinstein et al., 2016).
5. *Information Processing (INP)* – This LASSI scale measures a student's ability to make meaning out of new information and how best to organize it into existing knowledge and experiences (Weinstein et al., 2016).
6. *Motivation (MOT)* – This LASSI scale measures a student's effort and persistence to achieve academic goals in the face of rigor (Weinstein et al., 2016).
7. *Selecting Main Ideas (SMI)* – This LASSI scale measures a student's ability to differentiate the important from non-pertinent information from readings, lectures, discussions, or other course content (Weinstein et al., 2016).
8. *Self-testing (SFT)* – This LASSI scale measures the student's ability to perform regular comprehension monitoring as they learn new material (Weinstein et al., 2016).
9. *Test Strategies (TST)* – This LASSI scale measures a student's ability to prepare for, take, and adapt to various modes of examinations (Weinstein et al., 2016).
10. *Time Management (TMT)* – This LASSI scale measures a student's ability to adequately plan their schedules, take responsibility in their studies, and appropriately manage the non-academic aspects of their lives to maximize performance (Weinstein et al., 2016).
11. *Using Academic Resources (UAR)* – This LASSI scale measures a student's awareness of and utilization of learning support services like writing centers, library services, academic advising, and other helpful resources in college (Weinstein et al., 2016).

12. *Skill* – This is the first of the three component structures of the LASSI. The Skill component is measured through the LASSI scales of Information Processing, Selecting Main Ideas, and Testing Strategies (Weinstein et al., 2016).
13. *Will* – This is the second of the three component structures of the LASSI. The Will component measures the LASSI scales of Anxiety, Attitude, and Motivation (Weinstein et al., 2016).
14. *Self-regulation* – This is the third of the three component structures of the LASSI. The Self-regulation component measures the LASSI scales of Time Management, Self-testing, Concentration, and Using Academic Resources (Weinstein et al., 2016).
15. *Andragogy Learning Theory (ALT)* – This is the term used to describe the theory of adult learning as originally posited by Malcolm Knowles in 1983. This encompasses six major tenets, including an adult's need to know new information, a desire and motivation to learn relevant information, the importance of prior experiences, personal orientation toward learning, readiness to learn, and a developed self-concept (Knowles et al., 2012).
16. *Academic Performance* – This term is used to describe student outcomes in terms of grades. Cumulative professional grade point average (cpGPA) was the primary metric by which outcomes will be assessed in this study. This calculation was obtained from the official student record and was captured at the end of the Spring 2020 trimester.
17. *Grade Point Average (GPA)* – This term is used to describe student performance in the online curriculum. This measurement is based on a 4.0 scale, ranging from 0 to 4.0, where a 4.0 is equivalent to full and complete achievement of the highest grades possible across all courses.

18. *Online/hybrid-online Education* – In this study, hybrid-online education is used to describe course instructional methods that are delivered at least 51% through an online learning management system. Hybrid-online learning incorporates the use of various educational technologies and instructional media to deliver information (Liu et al., 2016).
19. *Strategic Learning Theory (SLT)* – This term is used to describe Weinstein's theory of strategic learning and shall refer to the how a learner deploys the strategies of Skill, Will, and Self-regulation to moderate academic performance (Weinstein & Hume, 1998; Weinstein et al., 2016).
20. *Physical Therapy (PT)* – This term is used to describe the profession of physical therapy, which focuses on the conservative management of persons with various health conditions to promote or restore function, movement, and prevent future disability.
21. *Occupational Therapy (OT)* – This term is used to describe the profession of occupational therapy, which focuses on the holistic rehabilitative management of a patient or client to promote or restore function, hobbies, occupations, or activities of daily living through therapeutic techniques and environmental adaptations.
22. *National Board Certification in Occupational Therapy (NBCOT)* – This is the standardized examination used in the US to determine a candidate's readiness for clinical practice. A student must pass this examination in to practice legally in the U.S (Zadnik et al., 2017).
23. *National Physical Therapy Examination (NPTE)* – This is the standardized examination used in the US to determine a PT candidate's readiness for clinical practice. A student must pass this examination in order to practice legally in the US (Kuo, 2015).

CHAPTER TWO: LITERATURE REVIEW

Overview

A thorough review of the literature was conducted to identify the prior evidence surrounding the Learning and Study Strategies Inventory (LASSI) and academic performance in higher education. This chapter provides an overview and summary of the most current literature that exists surrounding this topic. First, the theoretical framework of andragogy learning theory (ALT) is outlined as it comprises the underpinnings of the phenomenon of interest. The tenets that govern ALT are connected to the theoretical assumptions of strategic learning theory (SLT) that govern the structure and content of the LASSI. Next, a comprehensive review of the literature examines the prior evidence surrounding the use of the LASSI and offers deficiencies in our understanding of learning and study strategies for the selected population. As a result, professional imperatives emerge and justify the importance of this study. Finally, the literature review will culminate by providing a rationale and practical significance for this line of scientific inquiry. Upon conclusion of the literature review, gaps in current knowledge and understanding of this topic become evident and provide a sound basis from which to draw research questions and hypotheses for this study.

Theoretical Framework

Andragogy and Adult Learning Theory

This educational research study was grounded in the theory of adult learning, coined andragogy learning theory (ALT), originally posited by Malcolm Knowles in 1983 (Knowles et al., 2012). This study focused specifically on physical therapy (PT) and occupational therapy (OT) students whom meet the assumptions of the adult learners described in this theory. Grounding this research in the theoretical framework of ALT allows one to gain valuable new

insights into adult learners in hybrid-online health professional education programs and is congruent with previous studies (Donaldson, 2018; Hicks, 2010; Rosenbaum, 2015). Gaining a better understanding of how accurately the LASSI can predict academic performance in adult PT and OT students may possess broader contextual applications for this population of learners (Fell et al., 2015). Therefore, due to its appropriateness with the population of interest, the principles of ALT were used as the primary theoretical framework of this study.

Andragogy

Adult learning and education may be considered a complex phenomenon for which there are various theories or philosophies that attempt to offer explanations (Knowles et al., 2012). In large part, there is no single unified theory to accurately describe adult learning in all of its complexities (McCombs, 2017). Instead, there are many working theories that postulate various aspects and principles governing the processes by which adults learn. Andragogy learning theory (ALT), among the most popular, is just one of these theories and attempts to explain how adults learn most effectively (Knowles, 1983; Knowles et al., 2012).

The ALT has been defined as “a set of core adult learning principles that apply to all adult learning situations” (Knowles et al., 2012, p. 2). The ALT is grounded in the assumption that adults learn in fundamentally distinct ways that are incongruent with children and adolescents, whom are traditionally subjected to pedagogical instructional strategies (Knowles, 1983). The hallmarks of ALT include many elements that contextually overlap with motivational learning, self-regulated learning, and strategic learning theories (Bennett et al., 2012; Broadbent & Poon, 2015; Knowles et al., 2012; Weinstein & Hume, 1998). The elements of ALT are of great importance because they share striking similarities with the structures that exist in the LASSI measurement.

Overall, there are six major tenets of ALT: the need to know, the learner's self-concept, the role of experience, readiness to learn, orientation to learning, and motivation (Knowles et al., 2012, p. 4). "The need to know" refers to the adult learner's desire to understand the what, why, and how surrounding a concept as they discover the need for new knowledge and information (p. 4). "The learner's self-concept" refers to how adults learn best through autonomous and self-directed knowledge acquisition, instead of authoritative instruction (p. 4). "The role of experience" can refer to either the manner in which adults interact with and experience new knowledge or ideas, or the prior levels of experience of the adult learner (p. 4). This element takes into account not only how adult learners experience the learning process, but also the summation of their prior life experiences and cognitive preferences for learning. A "readiness to learn" refers to the notion that adults learn best when presented with information that is relevant to their lives and current phase of development (p. 4). An "orientation to learning" refers to the life-centered contextual applications and problem-centered approach that may help adults learn best (p. 4). Lastly, "motivation" refers to the concept that adults will learn best when they are more intrinsically motivated to acquire knowledge and there is a perceived personal benefit to such pursuits (p. 4). Although learners will respond to extrinsic sources of motivation such as promotions and financial incentives, there is a strong body of evidence that suggests intrinsic levels of motivation are stronger motivators for adults (Bennett et al., 2012; Carson, 2011; Cohen, 2012; Donker et al., 2014). Collectively, these are the major tenets of ALT and they have helped to drive many curricular models in higher education.

The History of ALT

Many prominent scientists have made enormous contributions to the development of the theory of andragogy, including Eduard Lindeman, Carl Rogers, Sigmund Freud, Carl Jung, Erik

Erikson, Abraham Maslow, Martha Anderson, and John Dewey, to name a few (Abela, 2009; Knowles et al., 2012). Perhaps, the most influential of which was the work of Eduard Lindeman. Lindeman originally postulated five major assumptions of adult learning that persist in ALT to this day (Knowles et al., 2012). The five major pillars of adult learning, as described by Lindeman, state that adults: (1) are motivated to learn intrinsically through their interests, (2) have a life-centered orientation to their learning contexts, (3) have a deep need to be self-directed instead of being taught by an authoritarian and rigid manner, (4) learn best through experiences that are relevant to their lives, and (5) have a wide variety of needs as individuals become more heterogeneous as they age (Knowles et al., 2012, p. 40).

The underlying premise for ALT emerged from the fundamental conflict between adult learning and traditional pedagogy. Pedagogy, or pedagogical theory, explains the art and science of teaching and instructing children (Knowles et al., 2012, p. 61). Throughout history, the pedagogy model has been highly implemented in the US, whereby teachers were given nearly full responsibility and authority over what, and how, material would be learned (Knowles et al., 2012). Pedagogy models govern the vast majority of educational programs and are aimed at teaching children, and therefore, may not be contextually appropriate for adult learners (Bennett et al., 2012). Adults in many educational systems "have by and large been taught as if they were children" (Knowles et al., 2012, p. 61). Lindeman and Knowles, among other adult educational theorists, postulated that adults did not appear to conform to the traditional pedagogy model of education, and subsequently, may not learn best in that model (Knowles et al., 2012). Therefore, it was proposed that there must exist a set of principles that govern how adults interpret, interact with, and learn new knowledge, facts, information, or ideas.

Many more prominent psychologists, cognitive scientists, and educational researchers throughout history have made countless contributions to ALT. Their ideas, work, and empirical findings have helped shape the theory as it is known today. Additionally, there exists an extensive body of publications surrounding the topic since the 1960s as andragogy has grown in popularity (Knowles et al., 2012). Furthermore, there is a growing body of evidence that supports ALT in human resource management, undergraduate and graduate programs, and other realms of higher education (Knowles et al., 2012). Evidence is continually emerging on the applications of ALT across various programs and educational settings and there are contemporary reports of how andragogy have shaped curricula for adult learners, especially online education (Abela, 2009; Bennett et al., 2012; Bierema, 2018; Knowles et al., 2012; Wright & Benoit, 2019).

Overall, ALT offers a lens through which one can examine unique aspects of adult education. The ALT has been increasingly used as a theoretical framework for the study of adult learners in areas such as health professional education (Bennett et al., 2012; Bierema, 2018; Plack & Driscoll, 2011). Most importantly, principles of ALT have been widely integrated into programs with online learning components (Bennett et al., 2012; Wright & Benoit, 2019). For these reasons, ALT is an appropriate theoretical framework on which to base this study involving adult health professional learners in online education.

Who is an Adult?

Before one can muster any meaningful applications regarding ALT, this report must first ascribe to a standardized definition of what constitutes an “adult” learner. This definition has tremendous practical applications on which this research study will be established. Knowles et al. (2012) highlight the four main accepted approaches through which persons are labeled adults, including: biologically, legally, socially, or psychologically. For the purposes of educational

research inquiry, this study focused solely on the psychological definition of an adult learner. This definition of an adult rests upon the assumption that adults possess the cognitive ability to arrive at a fully developed self-concept and responsibility for making their own decisions (Knowles et al., 2012). This operationalized definition is not exclusive from the other three approaches, and indeed, biological, sociological, and legal considerations influence one's maturation and development of a fulfilled self-concept (Knowles et al., 2012). However, for the purposes of this study, the assumption was made that the population of interest, graduate students of an entry-level PT and OT program, possess a fully developed self-concept. Therefore, these learners fulfill the criteria of adult learners by virtue of their age and prior academic and cognitive abilities.

The Convergence of Two Theories

Strategic learning is an essential component for adults in an online education setting (Hicks, 2010). Educational experts classify Weinstein's strategic learning theory (SLT) as a composition of self-regulated, motivational, and cognitive strategies (Hicks, 2010; Weinstein & Hume, 1998). The SLT maintains that adult learners will employ specific sets of beliefs, attitudes, behaviors, and motivations that contribute significantly to their academic success (Weinstein & Hume, 1998; Weinstein et al., 2016). The SLT has been highly studied and blends together elements described in ALT and self-regulated learning theories. In both ALT and SLT, there is strong emphasis on individual autonomy in capacities such as Skill, Will, and Self-regulation. These components have also been identified as goal-oriented, effort-related, and self-regulation strategies (Finch et al., 2016; Olaussen & Braten, 1998; Olejnik & Nist, 1992; Prevatt et al., 2006). Psychologists have long expressed the importance of one's knowledge of performing specific tasks and its influence on their learning and cognitive processing (Weinstein

et al., 1998). However, studies have repeatedly shown that adult learners must additionally utilize the Skill, Will, and Self-regulation qualities that are proposed in SLT (Carson, 2011; Cohen, 2012). Therefore, successful adult learning appears to rely heavily on the intrinsic motivation of an individual, their pursuit and desire for new knowledge that is relevant to their lives, and the incorporation of new concepts into their existing cognitive frameworks (Abela, 2009; Bennett et al., 2012; Knowles et al., 2012).

Herein lies the convergence of two complementary theories of learning in adult education. It is imperative to ascertain the intersection of ALT and SLT for this population of learners as this phenomenon is explored. As the fundamental concepts underpinning the theory of Knowles' ALT are brought into light there becomes a clear relationship to the elements of SLT that sustain the framework and structures in Weinstein's LASSI measurement. The amalgamation of these two theories lay at the intersection between the Skill, Will, and Self-regulation learning strategies commonly used in a successful approach to adult learning (Crede & Kuncel, 2008; Finch et al., 2016). The six main concepts on which ALT was founded are also the key components found in the Skill, Will, and Self-regulation components of SLT. For example, the major pillars of ALT include intrinsic motivation, life-centered orientation, self-direction, and experience (Knowles et al., 2012). Whereas, the concepts of SLT include self-regulation, motivation, and cognitive skill. Many of these are evident in scales of the LASSI measurement and can be tied directly back to ALT. For example, the LASSI scales of attitude, concentration, motivation, self-testing, test strategies, and time management.

Indeed, during the development of the LASSI, Weinstein et al. (1998) cite the combination of elements from ALT into SLT (McCombs, 2017). However, in Weinstein's SLT, the motivational, cognitive, and self-regulated learning and study strategies are facets of one's

conscious and subconscious that can be taught and improved upon with instruction (Weinstein & Hume, 1998). Meaning, educators have the capability to help a student harness the most appropriate learning strategies and target superior academic outcomes through training (Primus, 2003; Renzulli, 2013). It may be possible for health professional educators to help students unlock maximum potential in online learning through directed acquisition and refinement of the learning strategies linked to superior academic outcomes (Haghani & Sadeghizadeh, 2011; Renzulli, 2013). For this reason, possessing an intimate knowledge of the learning and study strategies can be widely beneficial in the future of health professional education (Haghani & Sadeghizadeh, 2011; Renzulli, 2013).

In this study, graduate-level health professional students enrolled in entry-level PT and OT hybrid-online education programs were the population of interest. As such, it was assumed they possessed the intrinsic characteristic of an adult, as previously defined. This sample was examined through the lens of ALT as the elements overlap with the components of SLT that are measured in the LASSI. Although the primary theoretical framework to be used as a guidepost in this study is ALT, it is important to understand the overlap between the scales of SLT from the LASSI and how they relate back to ALT. As such, in this study, the LASSI measurement will be viewed through the lens of ALT for adult PT and OT students in a hybrid-online curriculum.

Related Literature

A New Generation of Adult Learners

A new generation of adult learners has transitioned into graduate school and health professional programs across many disciplines (Liu et al., 2016). This population of learners, whom are often coined millennials, are known as “digital natives” (Prensky, 2001, p. 1) due to their life-long exposure and access to online informational technologies (Worley, 2011). This

generation of learners now makes up a large portion of college students in graduate and professional education (Holder, 2007; Liu et al., 2016; Worley, 2011). Also referred to as the "Net" generation (Tapscott, 1998, p. 4), millennial learners were born approximately from 1978 up to the year 2000 (Smith, 2012; Tapscott, 2008). These individuals were raised in a world where the Internet and various informational technologies grant rapid and immediate access to new knowledge and ideas (Tapscott, 2008). As a result, institutions have catered many educational programs to be inclusive of online technologies to meet the emerging needs of this generation of learners as they progress into higher education (Dziuban et al., 2005). Importantly, the population of interest in this study includes adult learners born during this time period and could be considered millennials. Therefore, it is important to take into consideration the prior research findings on their learning characteristics.

Millennial's Learning Characteristics

Generational differences in teaching and learning can be traced throughout history, and it appears that millennials are no exception (Dziuban et al., 2005; Prensky, 2001; Smith, 2012; Worley, 2011). Much study has also gone in to understanding the internal characteristics of millennials and how such traits impact the way in which these individuals interact with an online learning environment (Borges et al., 2010; DiLullo et al., 2011; Werth & Werth, 2011; Worley, 2011). It has been widely hypothesized that these learners are uniquely adept with, and tend to prefer, online learning technologies for many reasons (Borges et al., 2012; DiLullo et al., 2011; Macznik et al., 2015; Smith, 2012). Dziuban et al. (2005) found that millennials strongly favored online learning compared to other generations, and they also had a greater sense of autonomy and respect for self-directed learning. There now exists a large body of evidence suggesting millennials have an affinity for online education and instruction (Dziuban et al., 2005; George et

al., 2014; Tapscott, 2008). Evidence is continually emerging, and there has been a shift toward more online instruction across many educational programs and institutions around the nation (Cook et al., 2008; 2010; Worley, 2011).

The literature reveals broad efforts focused on better understanding this population to more fully address their learning needs, much of which has been conducted using adult learning frameworks (Tapscott, 2008). It had been postulated that this generation possessed a unique set of online learning characteristics due to the immersion in informational technologies that transpired through the majority of their cognitive development and physical maturation (DiLullo et al., 2011; Dziuban et al., 2005). As online education programs blossomed, the scientific community called into question its quality and effectiveness in this population of students. As a result, the paradigm shift to online education and the study of millennials have been met with both harsh criticism and increasing support (Dziuban et al., 2005; Smith, 2012; Worley, 2011).

Recent systematic reviews and meta-analyses have deeply examined the effectiveness of online learning in light of these trends. The breadth of evidence now demonstrates that online and hybrid-online instruction is generally as effective of a method as traditional instruction for this population of adult learners (Cook et al., 2010; Liu et al., 2016; Macznik et al., 2015; Voutilainen et al., 2017). Although online and blended learning initially faced great scrutiny, the current body of evidence largely refutes the prior claims of inferiority and now favors online and blended learning as an effective method for adult learners.

Studies have also specifically examined the intrinsic preferences and characteristics of these learners in relation to online learning (Cook et al., 2008; Liu et al., 2016). Despite the notable evidence of the differences in internal characteristics of millennials compared to previous generations, there is continued debate surrounding the exact learning and study strategies of

these digital native learners and how best to address their needs (DiLullo et al., 2011; Smith, 2012; Worley, 2011). Evidence exists to both support and negate the idea that this generation is a homogenized group of learners whom tend to prefer, and learn best from, online education and instruction (Liu et al., 2016; Voutilainen et al., 2017). Recent evidence now suggests that millennials may, in fact, be more diverse and less homogeneous in their learning styles and strategies than originally hypothesized (DiLullo et al., 2011; Dziuban et al., 2005; Rodriguez, 2014; Smith, 2012). As such, the debate over millennials' intrinsic traits and the effects of online education has become a widely contested national issue that lacks definitive answers. However, problems arise when one considers the possibility that researchers and educators may have over-generalized, and potentially mischaracterized, the learning profiles of adult millennial students (DiLullo et al., 2011).

Online Education

Over recent years, and across levels of learning, educational priorities have shifted from face-to-face to online instruction in an effort to address the needs of adult learners (DiLullo et al., 2011; Holder, 2007). Since the 1990s, higher education has been front stage in the explosion in online education and continues at a staggering pace (Holder, 2007). Online education may be deployed in a number of ways. Courses and curricula can be fully online, as with most distance education programs (Dziuban & Moskal, 2011; Holder, 2007), hybrid or blended with face-to-face instruction, or used as a supplemental resource to learning materials (Liu et al., 2016). Furthermore, the delivery of online education can either be synchronous or asynchronous, occurring with or without the presence of live instructor interactions, respectively (Dziuban & Moskal, 2011). Courses that maintain asynchronous components of instruction may archive videos, lectures, and material online for the students to be able to continually review and study at

their convenience, and whenever schedules may permit (Dziuban et al., 2005). This allows for students that require more repetition of content and access to various modes of instruction the ability to do so outside of the traditional face-to-face classroom (Dziuban et al., 2005). However, this also places greater emphasis on the student's autonomy and ability to effectively manage their time and study efforts.

Online and hybrid-online education may place a greater emphasis on the responsibility and autonomy of the individual learner (Liu et al., 2016). Thus, online educational programs have historically been catered toward non-traditional adult learners and college students (Allen & Seaman, 2016). Indeed, the obvious trend in US higher education is toward the incorporation of more online instruction for adult learners (Allen & Seaman, 2016). As online instruction becomes more robust and widespread in health professional programs there may exist learning and study strategies that better equip adult learners for success in this environment (McCombs, 2017). According to Knowles, adults are less likely to be successful in a traditional classroom that may be "authoritative and uncompromising" (Knowles et al., 2012, p. 38). This suggests that adult learners are better suited to learn in online environments (Dziuban & Moskal, 2005).

In recent years, efforts have been made to better understand online adult education and empirical evidence has led educators toward certain best practices (Cook et al., 2010; Sit et al., 2005). In large part, systematic reviews and meta-analyses have compared the effectiveness of online instruction to traditional face-to-face instruction in adult learners and have found similar results in outcomes (Liu et al., 2016; Macznik et al., 2015). This supports the idea that online instruction can be as effective as traditional instruction and is not an inferior form of education, as was once previously contested (Childs et al., 2005). More recently, effort has been placed into evaluating the effectiveness of online education in health professionals (Broadbent & Poon,

2015; Cook et al., 2010; George et al., 2014; Liu et al., 2016; Macznik et al., 2015; Voutilainen et al., 2017).

As online education becomes more commonplace across institutions and various levels of learning, there has been a tremendous push to study its effectiveness in comparison with traditional face-to-face programs (Liu et al., 2016). There is a growing body of evidence that has examined the effectiveness of online education compared to traditional instruction (Broadbent & Poon, 2015; Cook et al., 2010; Liu et al., 2016). In large part, the scientific evidence supports the use of online education as an effective means for knowledge acquisition across a wide variety of settings and populations (Cook et al., 2008; Liu et al., 2016). Dziuban and Moskal (2011) cite a large meta-analysis that was conducted that investigated the impact of online instruction on learning outcomes. In this report it was found that adult students performed better in online environments when compared to traditional face-to-face instruction (Dziuban & Moskal, 2011). Although controversial at the time, these findings support the self-regulated elements of adult learning and suggested that online instruction may cater toward the unique needs of adult college learners.

Dziuban and Moskal (2011) also examined and compared end-of-course perceived learning in face-to-face instruction with blended and fully online courses in graduate education. The report found that there were no significant differences between the three groups and students generally had a positive perception of perceived learning in online graduate education (Dziuban & Moskal, 2011). Regardless of the style of instruction, either blended, face-to-face, or online, there were no statistically significant differences that would suggest a preference in this higher education setting. These findings suggest that adult students may not have a strong preference for one method of delivery over another, nor do they appear to consider the mode of instruction to be

as important as one might assume. This has been coined the “no significant difference” argument that favors online education (Dziuban & Moskal, 2011, p. 236). Other studies have since supported a predilection for online and hybrid learning in adult college students (Macznik et al., 2015; Ruggeri et al., 2013; Ruiz et al., 2006; Sit et al., 2005; Worley, 2011).

Online Health Professional Education

Much study surrounding online education has now taken place in graduate-level health professional programs. A strong basis of empirical support is mounting for the theoretical application of online education for adult learners. For example, a large meta-analysis was conducted that specifically explored the effectiveness of internet-based learning in health professional programs (Cook et al., 2008). Cook et al. (2008) found large positive effect sizes with certain types of online instruction and knowledge, skills, and satisfaction outcomes. These included online instructional learning activities such as discussion boards, wikis, and interactive video lectures. In this meta-analysis, online education was associated with improved learning outcomes. Certain online instructional strategies have been implemented into programs of higher education to encourage elements of active, motivational, and self-regulated learning to engage this generation of learners. To that end, more recent studies have identified learning preferences in dental, pharmacy, and medical education using similar online modalities that cater to the needs of adult learners (Beebe et al., 2014; Desy et al., 2017).

George et al. (2014) performed a more recent systematic review examining online learning in undergraduate health professionals and its impact on knowledge and skill. As a result, this study displayed mixed findings. George et al. (2014) included a total of 59 studies ranging from years 2000-2013 where a very large amount of variance was noted between the studies. Bias was also found to be high across the literature that was included. Many studies showed

significant positive results favoring the online program's ability to influence superior academic performance. However, a few studies were unable to reach the same conclusions where online education was considered to be as good as, or no better than, traditional face-to-face education for academic outcomes. This systematic review generated findings that resulted in a cautious recommendation for online education and its ability to improve knowledge and skills in pharmacy, medicine, dentistry, nursing, and PT education. Overall, there is a blossoming body of evidence from meta-analyses that supports the effectiveness of these online instructional strategies, specifically in health professional education programs, to improve learning outcomes.

In a similar study, Liu et al. (2016) casted a much wider net and conducted a systematic review and meta-analysis encompassing the effectiveness of blended learning for many health professionals. Liu et al. (2016) reported that across the 56 studies that met the inclusion criteria up to 2014 and variance, heterogeneity was also quite large. Overall, this study found very large and statistically significant pooled effect sizes [$d = 1.4$ ($p < 0.001$)] that favored using online blended learning as an intervention ($n = 20$) across multiple different health professional programs. These programs included medicine, nursing, pharmacy, and dental education programs. Furthermore, the synthesized findings of prior studies that examined purely online learning compared to purely face-to-face traditional programs revealed that online learning had a strong positive and significant pooled effect size on outcomes. When comparing knowledge outcomes, a large pooled effect size (0.81, $p < 0.001$) was observed across 56 studies with an intervention of online learning versus face-to-face instruction. It should be noted that the studies included varied in design, analyses, context, and population of learners. However, these recent findings strongly support the use of online learning in health professional education.

More recently, Voutilainen et al. (2017) conducted a systematic review and meta-analysis on studies surrounding the effectiveness of online education compared to conventional face-to-face programs for nursing students. Overall, this report examined the results of 10 prior investigations that met the inclusion criteria comparing online to traditional programs. In large part, online nursing education programs had a strong and positive effect size on student knowledge and skill outcomes. Pooled mean differences across all studies favored online learning in nursing education for superior academic outcomes. Although statistically significant relationships were found supporting online education, this meta-analysis noted that variance was high between studies, and the broader relationships that were uncovered may be due to situational contexts (Voutilainen et al., 2017). Therefore, the authors cautioned drawing any deeper conclusions regarding the effectiveness of online education outside of nursing and other health professions.

Germane to the population of interest in this study, Macznik et al. (2015) conducted a systematic review of the literature on the effectiveness and perceptions of online education for PT students. A total of 22 studies met the inclusion criteria and ranged in the level of evidence from case study to randomized controlled trials. The primary results supported the use of online learning for deepening knowledge acquisition through critical thinking and reflection in PT students (Macznik et al., 2015). These findings are also supported by the work investigating online reflective learning activities in PT education conducted by Gummesson and Nordmark (2012). Findings revealed the majority of adult PT students supported the use of online education in their programs and cited reasons such as flexibility, ease of use, and engagement (Macznik et al., 2015). Furthermore, Mu et al. (2014) found there was no significant difference in cumulative GPA or board examination performance in a study of 81 OT graduate students enrolled in either

hybrid online or traditional face-to-face programs. The unification of these findings consistently demonstrate that hybrid-online education programs are as effective as their traditional face-to-face counterparts.

After synthesizing many systematic reviews and meta-analyses, one can conclude that there remains no clear consensus on the precise degree of effectiveness of online education for the health professions and adult learners. Broad trends across the US indicate that online education has gained significant traction and its widespread implementation has come without detriment to the learner. Therefore, it appears that there are few downsides of such an approach to health professional education, and online courses may be considered as equitable as traditional face-to-face education for knowledge and skill acquisition outcomes. As such, the widespread incorporation of online education in health professional learners aligns with the theories of ALT and SLT. However, it appears that outcomes depend highly on the context, population, and the mechanisms by which the online content is being delivered.

Online Physical and Occupational Therapy Education

Until recently, many entry-level health professional programs, especially PT and OT, have been largely based on a traditional education model that emphasized face-to-face instruction (Macznik et al., 2015). Gradually, more health professional education programs have adopted either hybrid or fully online models in an effort to fulfill the needs of adult learners (Harvison, 2018; CAPTE, 2019; Liu et al., 2016). Rapid advances in online health professional education may have led to deficiencies in the understanding of the learning strategies linked to success. For this reason, professional leaders have made specific calls to bolster educational research in the rehabilitation professions (Jensen et al., 2016). Across many disciplines, basic

science and experimental research on health interventions typically take funding priority, leaving educational research inquiries to a select few experts with limited resources (Jensen et al., 2016).

Online education in health professional programs has been shown to offer relevance to adult learners with a variety of learning styles and preferences (Childs et al., 2005; Luke et al., 2009; Plack & Driscoll, 2011). As online health professional education gains significant traction, there is a clear need for a deeper understanding of learning and study strategies of this population (Boulos et al., 2006; Broadbent & Poon, 2015; George et al., 2014; Liu et al., 2016; Thompson et al., 2011). As new PT and OT programs develop utilizing online curricula, there is a growing need to understand the influence of learning strategies on academic performance.

Although the effectiveness of online education has become more well understood, it is still not entirely clear which learning and study strategies are most closely associated with, or predictive of, success for this population of online learners. It is possible that there may be a set of learning and study strategies best suited for adult online health professional learners. Indeed, every adult learner has unique preferences, strengths and weaknesses, and there may not be an exact recipe of learning and study strategies for ensuring academic performance in this population of online learners (Bernier, 2009). However, there may exist a set of strategies predictive of success in particular settings, such as online health professional education. A gap exists in the understanding of this phenomenon as adult millennial learners transition into health professional education. Therefore, due to gaps that exist in the literature, the learning and study strategies that can accurately predict academic performance in the online education for health professionals remain largely unknown.

Learning and Study Strategies

Adult students are fundamentally unique in many ways. Among these are variations in self-selected learning and study strategies. Differences in learning and study strategies have been well documented across levels of education, and between generations (Dziuban et al., 2005; Hoveland, 2006). Each individual student has intrinsic strengths and weakness according to how one prefers to interact with, and cognitively process, information (Bernier, 2009; Donaldson, 2018). Learning strategies can be thought of as a student's thoughts, actions, and behaviors that help them acquire and understand new knowledge and skill (Bernier, 2009; Weinstein et al., 1988). In essence, learning and study strategies are the specific things that students do to maximize their success when learning new information. These strategies can range greatly and may include aspects like time management skills, attitude and motivation, test taking skills, or concentration. The overall aim for educators in the understanding of learning and study strategies is to help students learn how to "improve their ability to learn, to remember, and to think" (Weinstein et al., 1988, p. 21).

Accordingly, there has been a shift in educational research toward helping students with learning "how" to learn (Dziuban et al., 2005). This emphasizes the old adage of "working smarter, not harder" (Rust, 2010, p. 1) where students take a more focused and tactical approach to how they learn most efficiently (Lipsky, 1998), instead of simply spending more time studying. For these reasons, emphasis has been placed on gaining a better understanding of these strategies (Weinstein et al., 2016). Educators may be able to help their students more effectively leverage the strengths and weaknesses of their learning and study strategies to their advantage to improve outcomes (Bernier, 2009; Rosenbaum, 2015). For example, in more challenging coursework where expectations are elevated, instructors may promulgate time management,

concentration, motivation, and test-taking strategies to help students elevate their performance (Hoveland, 2006; Weinstein et al., 2016).

According to SLT, learning strategies refer to the behaviors that manipulate one's cognitive processes during learning (Weinstein et al., 1988). For example, a student may endorse time management skills by choosing to organize their schedules and plan out dedicated study time. One might also take certain steps to improve their attention or concentration while studying through minimizing distractions. A student may also perform self-testing on material, deploy certain test-taking tactics, or use positive thoughts to sustain motivation and mitigate anxiety prior to taking examinations (Lipsky, 1998; McCombs, 2017). Students might also fundamentally process information in various ways through visual, auditory, reading, or kinesthetic processing techniques (Hoveland, 2006). Additionally, there are many meta-cognitive and reflective approaches to learning and studying that a student may choose to deploy (Gummesson & Nordmark, 2012; Weinstein et al., 1988). Overall, there are a myriad of learning and study strategies and it is generally agreed upon that no two students choose to process and learn from information the exact same way (Bernier, 2009). However, there do appear to be distinct sets of learning and study strategies to which many learners adhere to ensure their success (Cano, 2006; Weinstein et al., 1988).

It is generally understood that course content and expectations can vary greatly across the spectrum of study; for example, the sciences, languages, arts, and mathematics. All of these fields have very different cognitive demands and expectations that are placed on each learner. Incoming college students are typically well prepared in understanding *what* to learn from their coursework. Unfortunately, however, students are often underprepared in understanding *how* to learn best in each content area (Dziuban et al., 2005; Hicks, 2010). The learning strategies and

study skills that make a student successful in areas such as the language arts may not ensure the same successes in the sciences, or vice versa. Evidence has shown that training students on how to best utilize specific learning strategies has resulted in improved academic achievement and testing (Donker et al., 2014; Weinstein et al., 1988). Therefore, colleges and universities across the nation have long adopted supplemental courses and training programs for students transitioning into higher education to teach them how best to incorporate these strategies into their repertoire (Haghani & Sadeghizadeh, 2011; Kwong et al., 2009; Peter, 1996; Proctor et al., 2006; Renzulli, 2013).

Overall, there are a number of targeted educational interventions frequently used by educators aimed at improving a student's learning and study strategies. There is a growing body of evidence that has demonstrated that weaknesses in certain areas are more like to result in poor academic achievement (Bickerdike et al., 2016; Hicks, 2010; Hoveland, 2006; Weinstein et al., 2016). As a result, researchers have developed many tools that aim to quantify the learning and study skills of learners. The LASSI is just one of these and is a highly regarded measurement that aims to quantify this information (Bernier, 2009; Donaldson, 2018; Rosenbaum, 2015).

Learning and Study Strategies Inventory

Weinstein, Palmer, and Schulte developed the Learning and Study Strategies Inventory (LASSI) in 1987. The LASSI is a self-reported measurement that is designed to quantify student aptitude in various aspects of SLT strategies. The SLT is comprised of elements of adult learning as they relate to metacognitive skill, motivation, and self-regulation. The tool has been highly utilized around the US and abroad and is actively operated at thousands of colleges and universities (Weinstein et al., 2016). As online education has gained momentum and received much attention from the scientific community, so too has the LASSI measurement. Since its

inception the LASSI has undergone extensive examination and revision to its items and structures as a result of scientific inquiry (Cano, 2006). Continual study, mostly among traditional educational programs, has led to the most recently published third edition of the LASSI by Weinstein et al. (2016). According to McCombs (2017), the impetus for the creation of the third edition of the LASSI was to more adequately address the learning and study skills that are required with the rapidly expanding growth in online education.

The LASSI third edition is a 60-item assessment based on 10 scales of learning and study strategies. 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). Each LASSI scale consists of 6 individual response items, totaling 60 items. Additionally, the LASSI quantifies three structural components of strategic learning, including Skill, Will, and Self-regulation, and generates percentile ranks for each scale based on normative referenced data from college students across the US (Weinstein et al., 2016).

Skill, Will, and Self-regulation

The three components measured by the LASSI are Skill, Will, and Self-regulation (Weinstein et al., 2016). The Skill component of SLT measures how students process information, select main ideas, and utilize test-taking strategies (Weinstein et al., 2016). Skill quantifies how one “prepares for and demonstrates new knowledge on tests” (Bernier, 2009, p. 30). Appropriately, the three LASSI scales that encompass the skill domain are Selecting Main Ideas (SMI), Information Processing (INP), and Test Strategies (TST). The INP scale examines how a student chooses to absorb, make meaning of, study, and accommodate new knowledge or information (Hicks, 2010; Weinstein & Hume, 1998). This scale overlaps with some aspects of

other learning theories that emphasize the role of cognition and dual-coding working memory (Hicks, 2010). The SMI scale of the LASSI measures the student's ability to correctly identify relevant from irrelevant information while learning and studying (Hicks, 2010). Essentially, this refers to the ability to distinguish what information is important for the topic at hand and is a critical component of efficiently arriving at key concepts (Hicks, 2010; Weinstein & Hume, 1998). Lastly, the TST scale of the LASSI examines one's ability to adequately prepare for, and take, an examination. This also includes the student's actions and behaviors that influence the execution of taking a test (Hicks, 2010).

The LASSI also measures Will. The Will component of SLT measures the influence of a student's Anxiety (ANX), Attitude (ATT), and Motivation (MOT) (Weinstein et al., 2016). This LASSI domain quantifies "students' receptivity to learning new information and the willingness to exert the effort necessary to successfully complete academic requirements" (Bernier, 2009, p. 30). The ANX scale examines how feelings of fear, worry, and uncertainty pertaining to one's involvement with a course and their sentiments toward the likelihood of success (Hicks, 2010). However, it is important to note that the ANX scale of the LASSI is not synonymous with a medical diagnosis of anxiety disorder. The LASSI is not meant to diagnose medical or health conditions and simply takes into account the influence of one's level of anxiety on their learning habits. The ATT scale of the LASSI measures a student's orientation toward learning and their willingness to achieve academic goals (Hicks, 2010; Weinstein et al., 2016). Lastly, the MOT scale of the Will component of the LASSI examines one's level of determination, persistence, and the lengths to which they are willing to go to ensure their academic success (Hicks, 2010).

Lastly, the LASSI measures Self-regulation. This domain quantifies how students "manage the whole learning process" (Bernier, 2009, p. 30). As previously noted, self-regulation

is a well-studied field in higher education. The Self-regulation component measures the influence of the LASSI scales of Concentration (CON), Time Management (TMT), Self-Testing Ability (STS), and Using Academic Resources (UAR) (Weinstein et al., 2016). The CON scale of the LASSI measures a student's ability to focus on their materials and put aside distractions while reading or studying. The TMT scale examines how a student is able to manage "self-paced study, scheduling, setting priorities, and self-awareness for what works online" (Hicks, 2010, p. 70). The STS scale measures a student's ability to perform knowledge checks in a metacognitive fashion to evaluate understanding as they learn information. Finally, the scale of UAR on the LASSI measures a student's willingness and ability to incorporate study aids and various tools aimed at facilitating their learning of new information (Weinstein et al., 2016).

Overall, the LASSI has been widely used as both a diagnostic and prescriptive assessment for improving learning outcomes at colleges and universities (Weinstein et al., 2016). The LASSI is primarily a diagnostic measurement, yet it has demonstrated the ability to prospectively identify areas of weakness that can be strengthened with intervention (Haghani & Sadeghizadeh, 2011; Slaybaugh, 2012; Weinstein et al., 1998). The LASSI has demonstrated the ability to help students improve outcomes when utilized as an intervention (Haghani & Sadeghizadeh, 2011; Weinstein et al., 2016). A recent large meta-analysis examined the impact of training students on how to best use strategies to improve their performance. Motivation and self-regulation learning strategies demonstrated statistically significant positive effect sizes in college science and mathematics outcomes (Donker et al., 2014). It is important to note that the LASSI is not an all-encompassing measurement tool and its scales may not measure all aspects of learning and study strategies that can be quantified (Griffin et al., 2012). However, it has been shown to give academicians the ability to guide students on areas for growth that may potentially

improve their overall academic performance. For these reasons, the prior evidence demonstrates an adequate degree of practical utility to which this measurement may be applied in hybrid-online learning for health professional students (Carson, 2011).

Evidence from recent studies in adult education has demonstrated significant relationships between the LASSI components of Skill, Will, and Self-regulation (Abulela & Davenport, 2020; Dill et al., 2014). According to a mounting body of evidence, it appears that the LASSI scales of anxiety, motivation, test strategies, time management, and self-regulation are correlated with academic performance outcomes (Yip & Chung, 2005). Findings suggest the LASSI components of Will and Self-regulation have an important influence in adult health professional learners. These components are primarily comprised of the Anxiety, Attitude, Concentration, Motivation, Self-testing, Test Strategies, and Time Management skills. Conveniently, both Motivation and Self-regulation learning strategies are well represented within the theoretical framework of andragogy and are measured with accuracy and reliability in the scales of the LASSI.

A hallmark study in this field of inquiry was published in 2008 by Crede and Kuncel, in which they conducted a large meta-analysis that examined the predictive validity of the scales of the LASSI, particularly the components of Skill, Will, and Self-regulation. The findings of this study are important as they contradicted popular theories at the time and helped investigators refine their understanding of the importance of strategic learning strategies in academic performance. Importantly, this meta-analysis found that LASSI scale scores were largely independent of incoming grades and admissions tests, which was contrary to some previously held assumptions (Crede & Kuncel, 2008). Historically, it was commonly thought that admissions criteria and incoming GPA were the best predictors of future academic success.

Although that assertion may still be true for many, this study suggested that there are specific sets of learning and study strategies on the LASSI measurement that are able to predict outcomes and may have a profound influence on future success and performance.

Crede and Kuncel (2008) found that motivation and self-regulation were significantly associated with GPA outcomes, and anxiety was found to be significantly and negatively associated with GPA. Motivation and self-regulation have commonly emerged as being significantly related to superior academic outcomes in many other fields of study as well (Chacko & Huba, 1991; Holder, 2007; Kumrow, 2007; Ning & Downing, 2010; Simons et al., 2004). Overall, Crede and Kuncel (2008) concluded from this meta-analysis that many factors influence academic achievement and the LASSI measurement itself, although highly valuable in many aspects, may not provide educators with the most accurate prediction of student success. Instead, Crede and Kuncel propose the LASSI measurement should be used to supplement decision-making along with other reliable and valid metrics. It should be noted that this study was limited by moderate to large amounts of heterogeneity between the studies included and focused nearly entirely on traditional face-to-face programs at colleges and universities. To that end, Crede and Kuncel (2008) excluded much representation from online programs and higher, or professional, education.

There are many factors that influence learning outcomes in students of any age or academic program, some of which are inherent behavioral characteristics (Orsini et al., 2016). Of these behavioral factors, self-regulation and motivation consistently appear to be important factors in the outcomes of health professional learners and are present in the Will and Self-regulation components of the LASSI (Jouhari et al., 2016; Zhou et al., 2016). Elements of self-regulated learning have been shown to be important influencers on student performance in many

academic programs of higher education (Broadbent & Poon, 2015; Skinner et al., 2015; Yukselturk & Bulut, 2007). For example, Misch (2002) and Borges et al. (2010) highlight the significance of motivation on educational outcomes in their reports involving health professionals and online learning. Similarly, intrinsic motivation is a component of self-regulation and is significantly related to academic performance in programs of intensive study (Broadbent & Poon, 2015; Carson, 2011; Ning & Downing, 2010). Supporting evidence has come from a systematic review of 12 studies by Broadbent and Poon (2015). This study found the self-regulated strategies of time management and effort-regulation skills showed significantly positive effect sizes in online higher education. Furthermore, Orsini et al. (2016) conducted a systematic review of 17 empirical studies surrounding motivation in health professional learning and found that high levels of motivation were associated with superior learning outcomes.

Specifically, in health professional education, Chacko and Huba (1991) found that the scale of motivation on the LASSI explained 46% of the variance in academic achievement among nursing students. Kusurkar et al. (2011) synthesized over 50 articles that identified motivation as a significant factor in medical school academic outcomes and later supported these findings. Self-regulated learning strategies and levels of motivation have been shown to be critical components of success in PT and OT education, among other fields like nursing (Ning & Downing, 2010; Plack & Driscoll, 2011; Rodriguez, 2014; Tutor, 2006; Zhou et al., 2016). Henry et al. (1996) identified a large sample of graduate OT students that time management strategies were significantly related to academic outcomes. Nouhi et al. (2008) also demonstrated a significant correlation between educational achievement and self-regulated study skills in medical students. Additionally, Rodriguez (2014) found that levels of internal motivation had significant impacts on college student GPA outcomes. Collectively, these findings highlight the

importance of both self-regulated and motivational learning strategies in supporting academic achievement across a variety of learners and represent just a few of the litany of studies that exist (Skinner et al., 2015; Williamson et al., 2015).

Cano (2006) conducted an analysis of the overall structures that exist within each scale and the three components of strategic learning in the LASSI assessment. This study identified three major latent structures from two large and independent samples of college freshmen and seniors. Using a confirmatory factor analysis, the results from Cano (2006) suggest that in addition to the three components of Skill, Will, and Self-regulation, there exists three latent structures of the LASSI, including: affective strategies, goal-oriented strategies, and comprehension monitoring strategies (Abulela & Davenport, 2020). These indicate the broader influence of affective, cognitive, and goal-oriented abilities measured in the LASSI items that could impact student achievement. Cano (2006) identified significant positive relationships between academic achievement and the structures of affective and goal strategies. These include the LASSI scales of motivation, attitude, anxiety, time management, and self-testing strategies, which have been implicated in other seminal studies (Crede & Kuncel, 2008).

Multiple studies have reported relationships between LASSI scales and academic performance and indicate effort-related, motivational, and goal-oriented strategies are significant factors in many educational settings (Carson, 2001; Dill et al., 2014; Marrs et al., 2009; Mathes, 2003; Rodriguez, 2014; West & Sadoski, 2011). These include all levels of undergraduate education, college-level psychology, medicine, osteopathy, physiotherapy, anatomical sciences, nursing, and chiropractic (Bernier, 2009; Fleming et al., 2011; Gatto, 2010; Heikkila & Lonka, 2006; Hoveland, 2006; Jouhari et al., 2015; 2016; Khalil et al., 2018a, 2018b, 2019; Kuo, 2015; Kwong et al., 2009; Marrs et al., 2009; Mathes, 2003; Yip, 2009; West & Sadoski, 2011; Zhou et

al., 2016). West and Sadoski (2011) identified time management and self-testing subscales of the LASSI as being significant predictors of academic performance in first-term medical students and accounted for a modest amount of variance. Similarly, Loomis (2000) found that the LASSI scales of time management, concentration, and using academic resources were significantly correlated with success in undergraduate business students. Time management was the strongest predictor of final course grade. Loomis (2000) also identified poor performance in the LASSI scale of attitude was a significant predictor of whether or not a student withdrew from an online course. Wernersbach et al. (2014) reported the ability of the LASSI scales of anxiety, motivation, and test strategies to differentiate high from low performers in GPA of undergraduate students enrolled in a "Strategies for Academic Success" course (p. 17). Contrastively, anxiety appears to be consistently negatively associated with academic performance, whereby higher levels of anxiety, or an impaired ability to mitigate fear of failure may result in lower grade outcomes (Crede & Kuncel, 2008). Mathes (2003) found the LASSI scales of anxiety and attitude were the only significant predictors of academic success in online learning for a community college.

Griffin et al. (2012) conducted an empirical investigation to examine the association between scores on the LASSI scales in undergraduate business students and grades at a large public institution. In this study, Griffin et al. identified positive significant relationships between components of the LASSI scales and student GPA, the strongest of which included attitude, concentration, and motivation. Importantly, this study also found significant differences between gender on LASSI scores and academic performance. However, the significant difference between genders was explained by variance in the LASSI scores, and ultimately females were not found to be superior in their grade outcomes (Griffin et al., 2012). These findings contradicted previous reports that claimed significant differences exist between males and

females in their LASSI scores and academic outcomes (Borges et al., 2010). It remains unclear if gender plays any significant role in predicting student outcomes in relation to LASSI scale scores, and there is little evidence to warrant deeper inquiries on gender.

The LASSI in Health Professional Education

There are many factors that are related to, and able to accurately predict, academic performance in health professional students. Among them is performance on the LASSI scales. Much study has gone into gaining a deeper understanding of which factors may impact an individual's success in academic coursework, or performance on national licensing examinations. To date, a number of studies have specifically examined the scales of the LASSI in various health professional programs. There appears to be a small degree of variation in the findings from studies across this population of learners. However, in large part, findings show that motivation and self-regulation strategies for learning in adult health professional learners are significantly related to academic performance.

Sleight and Mavis (2006) found that the LASSI scales of motivation, using academic resources, concentration and attention were significantly correlated with higher academic achievement in second-year medical students. This study also found that the LASSI was able to accurately detect differences in top, middle, and bottom performers whereas time spent studying was not a significant indicator on examination outcomes (Sleight & Mavis, 2006). These findings speak to the importance of the strategies that students choose and how to utilize them most effectively, instead of the amount of time spent studying when preparing for examinations. This is supported by findings from similar studies in nursing education (Simons et al., 2004).

Schutz et al. (2011) and Schutz et al. (2013) found that LASSI scales were significantly related to Chiropractor student performance on a national board licensure examination. Schutz et

al. (2011) and Schutz et al. (2013) identified the LASSI component of goal-orientation was an overall significant predictor of successful student grade outcomes, as were the scales of motivation (Schutz et al., 2011), anxiety, concentration, selecting main ideas, and self-testing strategies (Schutz et al., 2013). Yet, Donaldson (2018) was not able to find similar relationships in a large sample of 165 chiropractic students where concentration and self-regulation approached significant levels but failed to meet thresholds. The authors point out the importance of having an understanding LASSI scores to support development in areas that have been correlated to superior outcomes. However, Lobb et al. (2006) report contradictory findings from a similar study using the LASSI to predict future outcomes in pharmacy students where the most significant predictor of academic performance was undergraduate student GPA, and not any scale score or domain of the LASSI.

Pringle and Lee (1998) demonstrated similar findings in chiropractic education (Primus, 2003; Hoveland, 2006; Mathes, 2003; Hicks, 2010). Additionally, West et al. (2014) found in their study of medical students the LASSI scale of concentration was a significant predictor of successful outcomes on the United States Medical Licensing Examination (USMLE). West and Sadoski (2011) identified the LASSI scales of time management and self-testing as significant predictors of academic performance in medical students. Similarly, Norouzinia et al. (2016) found that the LASSI scales of motivation and test strategies were strongly and significantly related to superior performance in overall GPA in an Iranian graduate medical school. Kuo (2015) found that the effort-related activities measured by the LASSI were significant predictors of success in the Taiwanese National Physical Therapy Examination (NPTE). Among the strongest LASSI scale predictors were attitude, anxiety, concentration, motivation, selecting main ideas, and test strategies (Kuo, 2015). It should be noted that this study included a small

sample of Taiwanese PT students and that was not doctoral level, nor were the courses delivered online. Although the findings from Kuo (2015) have merit and may be contextually appropriate for this study, they may not be directly transferable to the sample of interest in this research and should be interpreted cautiously.

Bernier (2009) conducted a study on doctoral-level pharmacy students where there was no relationship found between LASSI scales and academic performance in the hybrid-online program. Despite the absence of any significant relationships, Bernier (2009) discusses the importance of having an intimate knowledge of students' learning and study strategies to support the online learning experience. Jouhari et al (2016) found significant relationships in Persian medical students where the test strategies scale was the highest mean LASSI score and there were significant differences noted between male and female students. Khalil et al. (2018a) found that the LASSI scale scores can accurately predict scores on the USMLE step 1 examination and, depending on the LASSI scale, can explain between 60-82% of the variance in outcomes. In this same study, Khalil et al. (2018a) identified motivation and time management as being significantly correlated with academic performance in medical school.

These findings are similar to those described by Zhou et al. (2016), West and Sadoski (2011), and West et al. (2014). These studies further support the LASSI scales of attitude, concentration, motivation, test strategies, and time management that are strongly linked to performance in medical education. Although in the study by Zhou et al. (2016) the LASSI scales of concentration, motivation, time management, and test strategies were significantly correlated to academic performance, they explained less variance (between 10-49%) in outcomes. Zhou et al. (2016) recommends examining this topic much deeper in health professional education to better understand the variation in the amount of explained variance found in outcomes that can

be attributed to individual LASSI scales. It was also recommended that the LASSI scales be used diagnostically for medical students and those that score lower in the areas of concentration, motivation, time management, and test strategies be offered institutional support to bolster these habits (Zhou et al., 2016).

It has not been until very recently that the LASSI has been explored in professional PT and OT education (Pucillo et al., 2020). Lee (2018) reported results of a study at a professional conference presentation that found significant correlations between the LASSI scales of anxiety, test strategies, selecting main ideas and academic performance in an OT program. This was the first formal report of its kind in this profession that closely examined the scales of the LASSI related to academic success, specifically in OT education. A small pilot study involving professional PT and OT students was conducted in 2018 (Pucillo et al., 2020). This study identified the LASSI scales of Information Processing and Self-testing to be modestly and significantly correlated to academic difficulty in an online neuroanatomy course (Pucillo et al., 2020). This study was characterized by a rather small sample size and was only able to observe positive statistical significance between the scale of Test Strategies and final course grade. More recently, Waite et al. (2019) described results from a study in a professional conference abstract where the LASSI scale of anxiety was significantly correlated to first-year PT students' academic performance in a musculoskeletal anatomy course. Waite et al. (2019) demonstrated the importance of coping with anxiety on testing performance. These findings are important for the direction of this current study because they are supported by previous findings from other health professions using the LASSI and it solidifies the need to examine the LASSI scales at a deeper level in PT and OT students (Lee, 2018; Waite et al., 2019).

Additionally, information from the LASSI has also been collected to help educators build programs and resources that target professional achievement. For example, Alexander et al. (2015) utilized the findings from student performance in the LASSI to develop a test preparation course for the National Board Certification for Occupational Therapist (NBCOT) examination. This knowledge can be useful in helping students avoid potential failure on the NBCOT and improving their academic performance. Indeed, among the health professions the LASSI has gained momentum (Lee, 2018; Pucillo et al., 2020; Waite et al., 2019). In addition to being studied in relationship to academic performance it has also been examined in a select few areas for its predictive ability on certain performance measures. These findings give future researchers an opportunity to improve their understanding of the predictive relationships between learning and study strategies and academic performance.

There is a large, and continually growing, body of evidence that anchors the theoretical framework of adult learning to the LASSI measurement. Although results surrounding the relationships of the LASSI and academic performance appear to be mixed depending upon the field of health profession in focus, one cannot discount the merit in attaining such information to guide decisions for supporting student success. To date, investigations have merely examined relationships or established significant differences using the LASSI at a superficial level in PT and OT education. Consequently, there are no published reports examining the predictive ability of the LASSI measurement in the online education of PT and OT students. Therefore, given the synthesis of current literature, the LASSI may be able to accurately predict student success in PT and OT education and has yet to be explored through scientific inquiry in these learners.

Why Predict Academic Success?

There are a number of reasons why educators may want to accurately predict academic success (Khalil et al., 2018a, 2019). For example, students who are at a greater risk for academic difficulty may be able to anticipate, and pursue actions to mitigate, future difficulty and/or failure (Griffin et al., 2012). Perhaps the strongest and most compelling argument for understanding the measures that can accurately predict success is that knowledge could aid institutions in more fully servicing the needs of increasingly diverse student populations (McCombs, 2017). For example, Riddle et al. (2009) identified a random sample of PT students from across various programs in the US and found that a history of academic difficulty was a significant predictor of failure on the National Physical Therapy Examination (NPTE). This study identified the potential to proactively address a student's academic difficulties while in a professional program (Riddle et al., 2009). As health care in the US becomes increasingly complex and demanding on its workforce, students who struggle may not be adequately equipped with the knowledge base that the professions require (Hoveland, 2006).

Avoiding failure and mitigating academic difficulty can be widely beneficial for both students and institutions (Jewell & Riddle, 2005). Each year, there are enormous economic costs associated with academic failure and attrition (Norouzinia et al., 2016). Identifying students who may not be successful in rigorous programs may help to avoid tremendous financial burden as the costs of attending college continue to skyrocket (Norouzinia et al., 2016). Similarly, institutions can benefit from accurately predicting success as it may help to mitigate rates of attrition and promote higher levels of student retention and progression in rigorous programs (Riddle et al., 2009). As such, institutions could more adequately prepare larger numbers of graduates to address the underlying shortages of health care workers that plagues the US. Furthermore, there are robust downstream societal and political implications of understanding

educational measurements able to accurately predict outcomes. For example, policy makers could incorporate this information to help pass new legislation and educational reforms that aim to drive more large-scale systemic changes with the future of education in mind.

As such, there is a momentous body of evidence that has examined predictors of success in various health professions (Wolden et al., 2020). However, these studies have been mostly confined to investigating passing rates on professional board examinations (Kuo, 2015). For those pursuing a health profession degree the education traditionally culminates with the successful completion of a national licensing examination that grants a candidate the legal authority to practice his or her profession. Without the successful completion of the licensure examinations, the years of education and thousands of dollars in tuition costs are potentially obsolete and the student will be unable to legally practice. Therefore, being able to accurately predict success has incredible financial implications and should be considered an educational imperative (Hoveland, 2006).

GPA as a Predictor of Academic Success

Historically, GPA has been heavily relied upon in higher education due to its ability to actively monitor performance and predict academic success (Salvatori, 2001; Utzman et al., 2007). The GPA in higher education is traditionally reported on a 4.0 scale and takes into account a student's average cumulative performance among didactic coursework. Clear relationships between GPA and academic success across many health professions have been long established and supported by extensive literature (Salvatori, 2001). Furthermore, the criterion and concurrent validity of other measurements of academic success have been established using GPA (Salvatori, 2001). Thus, elevating GPA to a reference standard.

The GPA is frequently used for making admissions decisions and has been well established as a valid measurement of scholastic success and academic progression across virtually all institutions of higher education (Jewell & Riddle, 2005). According to Fell et al. (2015), to date, the best-known predictor of academic success in professional PT education programs is undergraduate science and cumulative GPA. Utzman et al. (2007) conducted a broad study of 20 masters or doctorate physical therapist education programs from across the US and analyzed the ability of undergraduate GPA and other measures to predict academic difficulty. Although large variation existed across each program, this study demonstrated that the best predictor of academic difficulty was undergraduate GPA compared to the graduate readiness examination (GRE) scores and other demographic factors (Utzman et al., 2007). Similarly, Jewell and Riddle (2005) demonstrated that combined undergraduate GPA in mathematics and sciences was a significant predictor of academic difficulty in PT education.

More importantly, GPA is used in health professions to monitor and actively track academic progression throughout a curriculum. Naidoo et al. (2013) found significant correlations between GPA and rates of matriculation in a graduate OT program in South Africa, indicating GPA is linked to academic success and progression. Although GPA has continually demonstrated the adequate ability to function as a significant predictor of academic performance in PT and OT education, there are conflicting reports of the influence of GPA beyond graduation. Galleher et al. (2012) found that GPA was not a significant predictor in future success on the NPTE in their sample. However, these results conflict with previous reports of the importance of GPA as a predictor of academic success that are demonstrated in a similar report by Kosmahl (2005) and Kuo (2015).

Kosmahl (2005) identified professional GPA as being significantly correlated with future performance on the national licensing examination for graduates of a Master of Physical Therapy program. The findings of that study explained 47% of the variance in performance in the NPTE. Additionally, Thieman et al. (2003) and Luedtke-Hoffmann et al. (2012) achieved similar results in their study where professional GPA was the single most significant academic predictor of future performance on the NPTE. In a large study of over 400 students involving OT educational programs in England, Shanahan (2004) identified similar findings where GPA had a positive predictive effect on academic performance in the curriculum.

In OT education, cpGPA has been implicated as a significant predictor of success across many studies (Zadnik et al., 2017). For example, Zadnik et al. (2017) identified cumulative GPA as the single most significant predictor in future NBCOT performance. In another recent study involving a master's program in OT education, it was found that cpGPA was a significant predictor of passing the NBCOT in a linear regression analysis (Novalis et al., 2017). Feldman (2006) identified strong, but not statistically significant, correlations between admissions GPA from undergraduate and success in an OT curriculum. However, Feldman (2006) did not explore the relationship of professional GPA to future outcomes.

In a recent systematic review and meta-analysis, Wolden (2018) investigated the ability of cpGPA in first-year PT students to accurately predict performance on the NPTE. The synthesis of results demonstrates an overwhelming majority of findings that indicate GPA is a significant predictor of outcomes on national licensing examinations (Wolden, 2018). In one study by Adams et al. (2008), the odds of success on the NPTE were 2.2 times greater for every 10% increase in student GPA. Professional GPA has also demonstrated significant odds ratios when predicting success on future NPTE scores. For example, Wolden (2018) identified a study

by Meiners in 2015 that found every 0.1-point increase in GPA accounted for a 72 times likelihood of successfully passing the NPTE. Huhn and Parrott (2017) uncovered similar results where every 0.1-point increase in first-year professional GPA resulted in a 9 times likelihood of success in NPTE performance. Adams et al. (2008) found that every 0.1 increase in GPA above a level of 3.0 the odds of passing the NPTE increased by 2.3 times. Furthermore, several studies have found similar results that demonstrate first-year GPA in professional PT education programs accounts for between 31-47%, and in some cases up to 60-70%, of the variance in scores on the NPTE (Wolden, 2018). Collectively, these findings demonstrate the significant role that GPA plays in monitoring and predicting successful outcomes in this realm of health professional education.

In other areas outside of PT and OT educational programs there is evidence supporting the use of GPA to monitor academic outcomes. For example, Ward et al. (2010) conducted a large study of dental hygiene education and found that GPA at the end of the first academic year was a statistically significantly predictor of future academic success and also performance on the National Board of Dental Hygiene Examination. Additionally, Shulruf et al. (2012) reported that the most significant predictors of future academic success in a study involving undergraduate health science students in New Zealand were preadmission cumulative and science GPA, when compared to demographic factors and other measures of scholastic achievement. The study concludes by reiterating that GPA appears to consistently be the most significant predictor in the first year of university health science programs (Shulruf et al., 2012). As the result of a large systematic review and meta-analysis, Wolden (2018) concluded that,

> First-year [professional GPA] should be seriously considered as an early indicator of PT students who are at risk for failing the NPTE on their first-attempt, so that PT programs

> could provide additional learning opportunities and resources to improve the NPTE rates for those students at risk of passing the NPTE on their first-attempt. (p. 86)

Although literature widely supports its use, even a well-known measure like GPA is not without flaws or shortcomings, and there are many critics of the utility of GPA in educational research. There is a potential for grade inflation as a confounding factor in measuring GPA. Furthermore, Wolden (2018) discusses the important consideration of a reduced range in GPA between excellent and average students, where the vast majority of professional students typically maintain a cumulative GPA between a 3.0 and 4.0. As such, a narrow range can make detecting true significance differences, relationships, or predicting success from GPA more challenging and elusive (Wolden et al., 2020). Lastly, selection bias may exist and skew results in studies using GPA as an outcome measure as students included may have an increased chance of success due to a rigorous admissions process. However, in large part, a review of the current body of scientific evidence supports the use of GPA as a valid and reliable outcome measure (Fell et al., 2015; Kosmahl, 2005; Riddle et al., 2009). Despite notable limitations, the preponderance of evidence that exists in this area of health professional education supports the use of professional GPA as a valid outcome to monitor and predict future academic performance and success on standardized testing. Therefore, GPA is a valid metric by which to examine a student's likelihood of success in a professional PT or OT curriculum, and the scales and components of the LASSI may be intimately related with GPA.

The Professional Imperative

Entry-level PT and OT education programs are witnessing unparalleled growth as the US braces for an explosive demand for health providers due to a boom in the aging population (Landry et al., 2016). The number of accredited PT education programs in the US has surged by

21% since the year 2000 (CAPTE, 2019). Health professional education programs have also seen a transformation in the curricular models of many programs, thus, changing the educational landscape. According to CAPTE (2019) and the AOTA (Harvison, 2018), curricula have moved from mostly traditional to hybrid-online as a new generation of learners has entered professional education (Pucillo et al., 2020).

According to Allen and Seaman (2016), by the year 2015 there were over 2.8 million students engaged in online learning among higher education programs. Specifically in health professional education, curricular models in PT education programs have transitioned to 75% hybrid-online and 10.2% traditional-based since 2002 (CAPTE, 2019). The AOTA reports the amount of hybrid-online OT programs nationwide have gone up to 90% (Harvison, 2018). These data represent an indisputable change in the educational landscape using online learning.

Although online education may not be best suited for each learner, there are many reasons to support the transition toward more online instruction for PT and OT programs (Macznik et al., 2015). For example, online education offers increased accessibility to content and course materials, scheduling flexibility, and relevance to persons fluent in navigating the Internet (Macznik et al., 2015; Tapscott, 2008). The general consensus from recent literature suggests that online education in these settings is as effective as traditional instruction (Liu et al., 2016). As a result, institutions appear to be increasingly turning toward online and blended instruction in an attempt to meet the growing needs of the population for whom they serve (George et al., 2014; Macznik et al., 2015; Mann, 2011). Overall, it has become widely accepted that a blended approach to online learning synthesizes the best features of traditional face-to-face instruction with the flexibility of online learning (Liu et al., 2016).

Regardless of the profession of interest, there appears to be a wide variety of learning and study strategies that an individual student may choose to safeguard their academic success (Crede & Kuncel, 2008; Heikkila & Lonka, 2006; Kumrow, 2007). Students may find it challenging to succeed in graduate school for any number of reasons (Lobb et al., 2009; West & Sadoski, 2011). There exists a large body of evidence to support the difficulty in transitioning from undergraduate to graduate or professional-level learning due to increased rigor and higher expectations in academic performance (Jouhari et al., 2016; Proctor et al., 2006; Yip, 2009). The literature also suggests that academic difficulty in particular courses, like the biological and anatomical sciences, are related to increased rates of failure on national licensing examinations among select professions (Peterson & Tucker, 2005; Riddle et al., 2009).

Core science courses in higher education often have the reputation of being challenging given the complexity of content and may present students with additional challenges when placed in an online environment (Khalil et al., 2018b, 2019; Thompson et al., 2011; Waite et al., 2019). Therefore, for reasons quite evident, courses that appear to be academic hurdles tend to be the core anatomical and physiological sciences and typically occur in the first year of health professional programs (Khalil et al., 2018b; Pucillo et al., 2020; Thompson et al., 2011). The PT and OT programs traditionally emphasize a deep understanding of the anatomical sciences. The academic challenges students face in these courses may be amplified when content is placed online, as one may need to rely more heavily on time-management and self-regulated learning strategies (Kumrow, 2007; McCombs, 2017; Thompson et al., 2011). It is reasonable to hypothesize that there may exist a particular set of learning and study strategies that are accurately able to predict academic outcomes in an online health professional curriculum. Therefore, as online PT and OT education programs continue to expand, it is imperative to study

the factors that are most accurately able to predict success to foster academic progression and expedite candidates to the health workforce.

Summary

This quantitative educational research study was grounded in ALT as postulated by Knowles (Knowles, 1983). The tenets governing this adult learning framework have considerable overlap with the components of SLT, upon which the LASSI measurement was constructed. This study of health professional education focused specifically on adult PT and OT students engaged in hybrid-online education and are considered to be representative of those described in ALT. This population of PT and OT students was made up of millennial students, whom tend to prefer and gravitate toward online instructional methods.

Over the years, and across levels of learning, education of adult learners has shifted from face-to-face to include more online instruction. As online instruction becomes more widely integrated into adult health professional curricula there exists a need to better understand the learning and study strategies that are most closely associated with, and are able to accurately predict, academic achievement (Pucillo et al., 2020). An intimate knowledge of these strategies can be beneficial for supporting student success through targeted interventions and may aid institutions and educators with future programmatic decisions and curriculum development.

Conclusion

The LASSI is a highly studied, valid and reliable tool that has been shown to identify specific scales of learning and study strategies associated with, and predictive of, positive learning outcomes (Crede & Kuncel, 2008; Moak, 2002; Melancon et al., 2002; Weinstein et al., 2016; Wernersbach et al., 2014). The LASSI has been studied in many fields of health professional education such as medicine, nursing, dental, pharmacy, and chiropractic education.

In large part, these studies revealed significant relationships between particular LASSI scales and academic performance and, in some cases, the ability to accurately predict success on national licensure examinations. Anxiety, Attitude, Motivation, Concentration, Time Management, Test Strategies, and Self-testing strategies appear to be the most significantly correlated scales of the LASSI measurement in these populations.

Gaps in the Literature

The GPA has been shown to be a significant predictor of outcomes in health professional education. Despite this knowledge, educational researchers have yet to identify the learning and study strategies that are predictive of GPA in PT and OT students. The LASSI gives investigators in health professional education programs an opportunity to explore such information. At best, the understanding of the items measured by the LASSI is severely lacking in health professional education, especially when considering hybrid or online learning. As a result, an understanding of the LASSI scales and components that are able to accurately predict GPA in online health professional education programs have gone largely neglected and are currently underrepresented in the scientific literature.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative research study was to examine the ability of the Learning and Study Strategies Inventory (LASSI) to accurately predict cumulative professional grade point average (cpGPA) in a sample of physical therapy (PT) and occupational therapy (OT) students engaged in an online curriculum. Chapter Three includes information about the design of the study, the research questions and null hypotheses, participants and setting, and instrumentation, as well as procedures that were used in data collection and statistical analysis.

Design

The purpose of this study was to examine the ability of the LASSI scale and component scores to accurately predict cpGPA for PT and OT students enrolled in an online curriculum. This quantitative study utilized a predictive correlational design to examine each research question. A predictive correlational design is especially valuable when attempting to validate the prognostic or diagnostic utility of a test (Portney & Watkins, 2015). The study was conducted in response to calls from previous inquiries to expand upon the understanding of the predictive nature of the LASSI measurement in higher education (Bernier, 2009; Carson, 2011; Chevalier et al., 2017; Crede & Kuncel, 2008; Griffin et al., 2012; Khalil et al., 2018a, 2018b, 2019; Mathes, 2003; Primus, 2003; Rosenbaum, 2015; Schutz et al., 2011; Slaybaugh, 2012; Waite et al., 2019; West et al., 2011; West & Sadoski, 2011; Zhou et al., 2016).

A predictive correlational design is consistent with prior studies on this topic and allowed the investigator to explore each research question. More specifically, this study design allowed the investigator to identify the predictive nature of the predictor variable of LASSI scale and component scores. A standard multiple linear regression analysis was used to test each stated

null hypotheses. Multiple linear regression analyses tested the amount of variance in the outcome variable of cpGPA (*Y'*) that were attributed to fluctuations in the predictor variable (*x*) of LASSI scale and component scores (Rovai et al., 2013).

Research Questions

The research questions for this study were**:**

RQ1: How accurately are the ten scales of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

RQ2: How accurately are the three components of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

Null Hypotheses

$H_0$1: None of the ten scale scores of the LASSI (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum.

$H_0$2: None of the three components of the LASSI (Skill, Will, and Self-regulation) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum.

Participants and Setting

In this study, a convenience sampling technique was utilized to select first-term PT and OT students engaged in hybrid-online coursework at a large, for-profit health science university.

This study included the sampling and recruitment of first-term Masters of Occupational Therapy (MOT), Doctor of Occupational Therapy (OTD), and Doctor of Physical Therapy (DPT) students enrolled in resident programs in campuses across Texas, Florida, and California. A convenience sampling technique allowed the investigator to recruit enough participants needed to achieve statistical power and was consistent with many prior inquiries.

The MOT, OTD, and DPT programs enroll students in the Spring, Summer, and Fall trimesters each year and participants of this study began these programs during the Spring 2020 academic trimester, which is 15 weeks in length. In this study, PT and OT students were sampled as a single group due to their shared academic characteristics. Indeed, these are two distinct professional programs and have differences. However, they share many similarities. For example, undergraduate preparations and prerequisite coursework tend to focus on psychosocial and physiological sciences and both programs share similarities in professional admissions criteria. Lastly, these first-term PT and OT programs offer two interdisciplinary health science courses where PT and OT students are enrolled in classes together due to shared learning objectives and outcomes. For these reasons, the decision was made to sample PT and OT students together and also to increase the likelihood of achieving statistical power for analysis.

Statistical Power Analysis

The sample size needed for a multiple linear regression analysis was calculated using Portney and Watkins (2015) and Warner (2008). Based upon previous studies, it was hypothesized that the predictor variable (x) would account for up to 40% of the variance noted in the outcome variable (Y') of cpGPA ($R^2 = 0.4$) for both research questions (Faul et al., 2009). The LASSI measures 10 scales. Therefore, there were 10 levels of the predictor variable (x_1-x_{10}) for RQ1. To answer RQ1, using a large effect size (0.25) with 10 ($k = 10$) predictor variables, a

minimum sample size of n = 130 was required to appropriately power a standard multiple regression and detect statistical significance (Portney & Watkins, 2015; Warner, 2008).

The LASSI also measures three components. Therefore, there were three levels of the predictor variable (x_{11}-x_{13}) for RQ2. To answer RQ2, using a large effect size (0.25) with three (k = 3) predictor variables, a minimum sample size of n = 74 was required to power a standard multiple regression and detect statistical significance (Portney & Watkins 2015; Warner, 2008). Therefore, a total minimum sample size of n = 130 participants was required to achieve 80% power with a set level of significance at $p < 0.05$ for a standard linear multiple regression analysis.

Typically, at the university in focus, each DPT cohort enrolls around 50 students, and MOT/OTD enrolls roughly 30-40 students each term. Sampling from three cohorts of 50 PT students and three cohorts of 30 OT students would result in 260 potential participants. Therefore, a total of N = 260 participants were targeted for recruitment to participate in this study. Of the N = 260 total potential participants, this study sought to recruit an equal distribution of males and females. It was anticipated that students recruited would have an approximate 50% response and completion rate on the LASSI measurement. This would result in an adequately powered sample of at least 130 participants for statistical analysis.

Inclusion and Exclusion Criteria

Participants were included if they had successfully completed all prerequisite coursework and undergraduate preparations according to institutional policies and met enrollment criteria for first-term coursework. First-term male and female PT and OT students from the DPT and MOT/OTD resident programs of Florida, Texas, and California were included in this study. Participants were excluded from the study if they were under the age of 18, or had previously

dropped, withdrawn, failed, or remediated any first-term class for any reason. The guidelines for course failures, withdrawals, and remediation are outlined in the institutional handbook and served as the guide for exclusion criteria in this study. The LASSI measurements submitted after the completion of week three of the Spring 2020 term were excluded from analysis. This was done to establish temporal precedence such that the administration of the LASSI measurement occurred prior to any course examinations that may have confounded GPA.

Participant Demographics

A total population of N = 260 students was targeted for recruitment. Of that number, n = 153 participants completed the LASSI measurement online; a 59% response rate. There were a total n(%) of 51(33.3%) male and 102(66.7%) female participants. Of this sample, there were total n(%) of 61(39.9%) OT students (50 MOT) and 92(60.1%) DPT students. The survey response rate and participant demographics can be found in Table 1. The mean(SD) age of the n = 153 surveyed participants was 25.4(1.8) years with a range of 21.7-40.3 years.

Table 1

Response Rates of Participants by Characteristic

Characteristic	Target Number	Response Rate	Completed n(%)
Male	n/a	n/a	51 (33.3%)
Female	n/a	n/a	102 (66.7%%)
Total	260	58.8%	153 (100%)
MOT	120	41.7%	50 (32.7%)
OTD	30	36.7%	11 (7.8%)
DPT	150	61.3%	92 (60.1%)
Texas	90	57.8%	52 (34%)
Florida	80	55%	44 (28.8%)
California	90	63.3%	57 (37.3%)

Instrumentation

The instrument used in this study was the Learning and Study Strategies Inventory third edition (LASSI). A copy of the LASSI and its content items can be found in Appendix A. The LASSI is a 60-item self-reported assessment tool based on 10 scales of learning and study strategies. These 10 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). Each LASSI scale consists of six individual response items. The LASSI also measures three broader underlying frameworks of strategic learning. These three components measured by the LASSI are: Skill, Will, and Self-Regulation. The Skill component measures how students process information, select main ideas, and utilize test-taking strategies. The Will component measures anxiety, attitude, and motivation. The Self-regulation component measures concentration, time management, self-testing ability, and competency with using academic resources. A diagram of the LASSI scales and components can be found in Table 2.

Table 2

The Learning and Study Strategies Inventory third edition

Scales	Components
Anxiety (ANX)	*Skill*
Attitude (ATT)	INP, SMI, TST
Concentration (CON)	
Information Processing (INP)	*Will*
Motivation (MOT)	ANX, ATT, MOT
Selecting Main Ideas (SMI)	
Self-testing (SFT)	*Self-Regulation*
Test Strategies (TST)	CON, SFT, TMT, UAR
Time Management (TMT)	
Using Academic Resources (UAR)	

Test Administration and Measurement

The LASSI is administered electronically and typically takes under 12 minutes to complete (Weinstein et al., 2016). There is no time limit associated with the administration, and results are calculated immediately upon completion. Each question item contains a 5-point Likert-style response scale ranging from: *1-"not at all typical of me", 2-"not very typical of me", 3-"somewhat typical of me", 4-"fairly typical of me", and 5-"very much typical of me"* (Weinstein et al., 2016, p. 35). This 5-point scale of responses has been shown to be a valid and reliable method across self-reported surveys (Gall et al., 2007).

Scoring of the LASSI

The LASSI measurement is automatically scored upon completion of the assessment through the online platform made available from the publisher, H&H Publishing, Inc. in Clearwater, Florida. Each individual student receives a report that highlights and explains the scores across all scales and components. A sample of a LASSI score report can be found in Appendix B. Participants of this study had the ability to view their score report and retain a copy for their records. In addition, each institution hosts an administrator that has access to all reports that are generated by students of a particular school. The institutional administrator may receive access to all completed LASSI assessments from the H&H Publishing online repository. This feature is not available to participants and protects the contents of the database where individual LASSI reports are securely stored by H&H Publishing, Inc. This feature was used in the data collection process later described.

There is no total score generated on the LASSI, as it is inherently a diagnostic measurement (Weinstein et al., 2016). Instead, each individual scale is scored on a normative-referenced percentile rank where higher scores indicate higher performance (Weinstein et al.,

2016). The only exception to this is the scale of anxiety, where the scale is scored inversely and lower performance in this area indicates a higher level of anxiety (Carson, 2011). A student who scores low in the anxiety scale may experience difficulty with fear of failure and other anxiety-arousing stimuli that could impact academic performance (Weinstein et al., 2016). Lower scores on the anxiety scale indicate difficulty managing one's level of anxiety, typically during test taking (Waite et al., 2019).

Generally, LASSI scores on any individual scale are interpreted as relative weaknesses in need of further development when below the 50th percentile, and relative strengths occur at or above the 75th percentile (Griffin et al., 2012). These cut-offs give evaluators and students a measure by which to further develop the skills measured in each scale. The score reports generated from the LASSI offers educators and academic advisors a unique opportunity to gain valuable insight into a student's strengths and weaknesses (Zhou et al., 2016). Furthermore, the results present individual students the ability to improve academic outcomes by strengthening weaknesses in specific LASSI scales, and educators the opportunity to offer targeted support for these areas (Zhou et al., 2016).

Reliability and Validity

The reliability and validity of the LASSI has been thoroughly examined across a large number of previous inquiries (Carson, 2011; Khalil et al., 2018a). It is important to note that the majority of previously published reports include the first or second editions and may be considered to possess slightly weaker psychometric properties when compared to the third edition of the LASSI (Marland et al., 2015; Melancon, 2002; Moak, 2002; Weinstein et al., 2016). Earlier versions of the LASSI underwent great scrutiny over their content and structure (Cano, 2006; Finch et al., 2016; Olaussen & Braten, 1998; Prevatt et al., 2006). As a result, the

previous versions of the LASSI have been highly studied. Since, the LASSI has been refined according to prior research findings and has repeatedly demonstrated stable psychometric properties (Opperman & Mason, 2020; Weinstein et al., 2016).

Generally, studies that have examined the validity of the LASSI measurement have been able to establish score profiles on national normative data that are within standard error and, in large part, agree with the original report by Weinstein et al. (1987) (Cano, 2006; Moak, 2002; Flowers, 2003; Flowers et al., 2012; Deming et al., 1994; Mason, 2018; Yip, 2013). Furthermore, the LASSI validity has been established with relationship to other measurements that quantify learning skills. For example, Wernersbach et al. (2014) cite convergent validity for the LASSI between the Meta-cognitive Awareness Inventory and the Motivated Strategies for Learning Questionnaire. Overall, reports agree on the validity of the LASSI measurement and have been consistent through time (Abulela & Davenport, 2020; Alkhateeb & Nasser, 2014).

There are some reports that call into question the stability of the tool, particularly the first and second editions of the LASSI (Marland et al., 2015). However, Marland et al. (2015) noted “strong internal cohesion” for the LASSI with a reliability of 0.85 across all 10 scales (p. A-39). Overall, the reliability and validity for the LASSI across all 10 scales measured is reported to range from 0.73-0.89 (Weinstein et al., 2016). Test-retest reliability of the tool has been reported as ranging from 0.72 to 0.86 (Deming et al., 1994; Marland et al., 2015; Mason, 2018; Moak, 2002; Obiekwe, 2000; Yip, 2013), and from 0.59 to 0.76 (Flowers, 2003). Sleight and Mavis (2006) reported similar values for reliability across the LASSI scales. The general agreement of values from multiple investigations indicates adequate reliability and measurement stability (Alkhateeb & Nasser, 2014; Marland et al., 2015; Mason, 2018).

Since the report by Marland et al. (2015), H&H Publishing has released the third edition of the LASSI measurement. The more recent development of the LASSI in 2016 holds promise as it has been revised based on extensive research findings. However, the LASSI third edition is nascent and not as well represented in the current scientific literature. Nevertheless, the third edition is even less studied among graduate and professional education. In the latest version of the LASSI, the reliability coefficients for internal consistency range from 0.76 to 0.87 (Weinstein et al., 2016). Normative values for the LASSI have been updated in 2016 to reflect the demographics of student bodies in higher education across national colleges and universities, including "higher percentages of nontraditionally-aged students, students of lower income, and students of underrepresented ethnic minorities" (Weinstein et al., 2016, p. 30). For these reasons, the LASSI is regarded as a reliable, valid, and contextually appropriate measure with which to investigate the population of PT and OT students in online education.

Outcome Variable (cpGPA)

The outcome variable of interest in this study was cumulative professional GPA (cpGPA). Historically, GPA has been heavily relied upon, specifically in higher education, due to its renowned ability to actively monitor and predict future academic performance (Salvatori, 2001; Utzman et al., 2007). The GPA is frequently used for making graduate admissions decisions and has been well established as a valid measurement of scholastic success and academic progression across programs of higher education and in health professions (Jewell & Riddle, 2005). According to Fell et al. (2015), to date, the best-known predictor of academic success in professional PT education programs is undergraduate science and cpGPA. Kosmahl (2005) identified cpGPA as being significantly correlated with future performance on the national licensing examination for graduates of a PT program. Additionally, Thieman et al.

(2003) and Luedtke-Hoffmann et al. (2012) achieved similar results where cpGPA was the single most significant academic predictor of future performance on the national board of physical therapy examiners. In a large study of over 400 students involving OT educational programs in England, Shanahan (2004) identified similar findings where GPA had a positive predictive effect on future academic performance in the curriculum. For these reasons, cpGPA was chosen as a valid and reliable measurement to accurately assess the academic outcomes of PT and OT students. For this study, cpGPA was recorded on a traditional 4.0 scale.

Procedures

This study enrolled first-term PT and OT students at a large, for-profit health science university in residential programs from Florida, Texas, and California campuses. Sampling these campuses represented both PT and OT programs across their first academic term and a geographically and culturally diverse sample of professional students. The LASSI was electronically sent to all first-term MOT, OTD, and DPT students during the first three weeks of the Spring 2020 trimester on the three campuses. Participant recruitment primarily took place during new student orientation events. The primary investigator (P.I.) was removed from directly contacting participants. For a concise list of study procedures, see Table 3.

Written permission to conduct this study was obtained from the Dean of the College of Rehabilitative Sciences at the host institution (see Appendix D). Then, permission to conduct the study was obtained from the program directors for the PT and OT departments of the resident programs at each host institution campus. Institutional Review Boards (IRB) from both Liberty University and the host institution approved all study procedures (see Appendices I & J). All participants completed an informed consent and had the ability to retain a copy for their records.

Participation in this study was strictly voluntary, and subjects could withdraw at any time for any reason by contacting the P.I. or local IRB liaison.

This study was awarded an intramural research grant for the year 2020 and included a financial incentive to participants for completing the study procedures. The first 150 participants were eligible to claim a $10 Amazon.com electronic gift card for their participation and completion of the LASSI. A link containing this information was made available to the first 150 participants to complete the procedures.

The P.I. was removed from directly soliciting student participants to avoid injecting bias or coercion. The P.I. did not have any influence over participants' grades. The P.I. does not teach on any of the three campuses, and this eliminated the potential for coercion of subjects. This helped to protect the subjects from any outside influence from the P.I. Participants were notified in the informed consent process that the study was voluntary, they may withdraw at any time, and participation would not impact their grades. See Appendices C and E for the host institution and Liberty University consent forms, respectively.

Recruitment was conducted primarily through the new student orientation event on each campus. Campus administrators introduced the opportunity to participate in this research study and provided the potential subjects with all study related materials. This included the informed consent document, recruitment letter, and LASSI log-on instructions during the institution-wide new student orientation on January 10, 2020. See Appendix F for the host institution recruitment letter. See Appendix G for the Liberty University recruitment letter.

Once informed consent was obtained from participants, they used an institutional access code to log on to the secure LASSI website and self-administer the measurement tool. Student identification numbers were used to protect the identity of the subjects, shield the names of

participants from the P.I., and connect the LASSI record to the individual's academic performance record upon collection of the outcome variable. See Appendix H for log-on instructions to the LASSI.

When establishing the predictive nature of a measurement it must adhere to temporal precedence (Warner, 2008). As such, all LASSI measurements were completed prior to the collection of any graded examinations that could influence GPA. The LASSI responses that were submitted after the conclusion of week three (February 2, 2020) of the Spring 2020 term were excluded from analysis due to potential contamination and interaction between the LASSI measurement and academic performance. There are no courses in these curricula that administer any examinations in the first three weeks of the course. This allowed the P.I. adequate time to recruit participants and to ensure temporal precedence was achieved.

Table 3

Study Procedures and Timeline

Timeframe	Procedure
January 10th, 2020	New student orientation event for all first term resident PT and OT students on the Florida, Texas, and California campuses. Students were sent electronic recruitment materials. Enrollment period began. Ongoing solicitation for participation.
February 2nd, 2020 End of week 3	Conclusion of solicitation for participation in study. Enrollment period concluded.
April 23rd, 2020 (end-of-term)	Program administrator downloaded LASSI results for all participants from H&H Publishing, Inc. Records were stripped of identifiers to protect anonymity. Student ID used to link LASSI records to cpGPA from the host institutional registrar.
May 1, 2020	Final data set containing LASSI scores and cpGPA sent to the P.I. by program admin. Data entered into SPSS for analysis.

Data Collection

The P.I. was not directly responsible for the procurement of study related data. A third-party administrator for the DPT program was used as a proxy to assist in the data collection procedures. The program administrator, whom holds current Collaborative Institutional Training Initiative (CITI) training for ethical conduct in human subjects research, assisted the P.I. in data collection to protect the identity of participants. The program administrator accessed data for the predictor variable by downloading the LASSI score reports from the repository made available through H&H Publishing, Inc. at the conclusion of the Spring 2020 semester. The H&H Publishing maintains the rights and accessibility to the LASSI measurement and stores data on a secure server that maintains confidentiality and may be readily accessed by researchers and educators. Upon data collection, student identification numbers were used to identify records and link LASSI results to cpGPA. Data that could be used to identify subjects such as name, email, and date of birth were removed and de-identified to protect participant anonymity prior to being sent to the P.I for analysis. However, demographic factors were retained (age, gender, campus, and professional program).

At the conclusion of the Spring 2020 trimester, cpGPA was downloaded from the registrar grade-entry system for all records that met the inclusion criteria. The DPT program administrator solicited the cpGPA records from the host institution Registrar and Office of Institutional Research. Data was omitted for subjects that had not met the inclusion criteria, declined to participate in the study, or failed to complete the LASSI measurement in the allotted timeframe prior to the conclusion of week three of the Spring 2020 term. The predictor and outcome variables were compiled in a single document and sent to the P.I. for data analysis.

Data Analysis

Data was analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 26 software (IBM Corp.). In this study, alpha significance levels were set at 0.05 for all analyses. A standard multiple linear regression analysis was used to test each hypothesis. The first standard multiple regression analysis tested $H_0$1: None of the ten scale scores of the LASSI (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum. The second standard multiple linear regression analysis tested $H_0$2: None of the three components of the LASSI (Skill, Will, and Self-regulation) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum.

According to Warner (2008) and Green and Salkind (2014), the simultaneous statistical analysis is the most conservative method of a multiple linear regression when testing the ability of multiple predictor variables ($k > 2$) to accurately predict the outcome in a criterion variable. This is performed by simultaneously entering all 10 of the predictor variables of LASSI scale scores at the same time into the regression model to test RQ1, instead of a hierarchical or step-wise manner (Warner, 2008). Data from the predictor and outcome variables were entered into SPSS. The data set was then screened for errors by an independent consultant to ensure accuracy prior to analysis. Mean scores were calculated for each of the three LASSI components of Skill, Will, and Self-regulation. Descriptive statistics were performed for the predictor and outcome variables. Similarly, mean composite scores for the predictor variable of the components of the

LASSI for Skill, Will, and Self-regulation were entered simultaneously in the subsequent regression analysis to test RQ2.

Assumptions tests were conducted for a fixed-effects model of a standard linear multiple regression using the guidelines set forth by Warner (2008) and Green and Salkind (2014). First, the outcome variable of cpGPA was tested for a normal distribution across combinations of levels for the predictor variable (Warner, 2008). Secondly, the outcome variable was tested for homogeneity of variances across combinations of the predictor variable (Warner, 2008). Next, the scores from one participant to the next were tested for independence of observations and were assessed using the Durbin-Watson statistic (Warner, 2008). Furthermore, the assumptions of multi-collinearity were tested (Gall et al., 2007). That is, the correlations between individual predictor variables, either scale or component scores on the LASSI-3, were not to exceed a coefficient of 10. Multicollinearity was assessed using the variance inflation factor (VIF) and levels >10 were considered violations to the assumption of non-multicollinearity (Portney & Watkins, 2015; Warner, 2008). Acceptable values were between 1 and 6 (Warner, 2008). Scatterplot matrices with lines of best fit were created to screen for linearity and Box plots with error bars screened for extreme outliers across all levels of the independent variables.

CHAPTER FOUR: FINDINGS

Overview

This study examined the ability of the LASSI scale and component scores to accurately predict cpGPA in a sample of PT and OT students engaged in an online curriculum. This study used a predictive correlational design to examine the research questions and a standard multiple linear regression analysis to test each hypothesis. The results from the statistical analyses are found in the following section and are described as they pertain to each hypothesis tested.

Research Questions

RQ1: How accurately are the ten scales of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

RQ2: How accurately are the three components of the LASSI able to predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum?

Null Hypotheses

$H_0$1: None of the ten scale scores of the LASSI (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum.

$H_0$2: None of the three components of the LASSI (Skill, Will, and Self-regulation) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum.

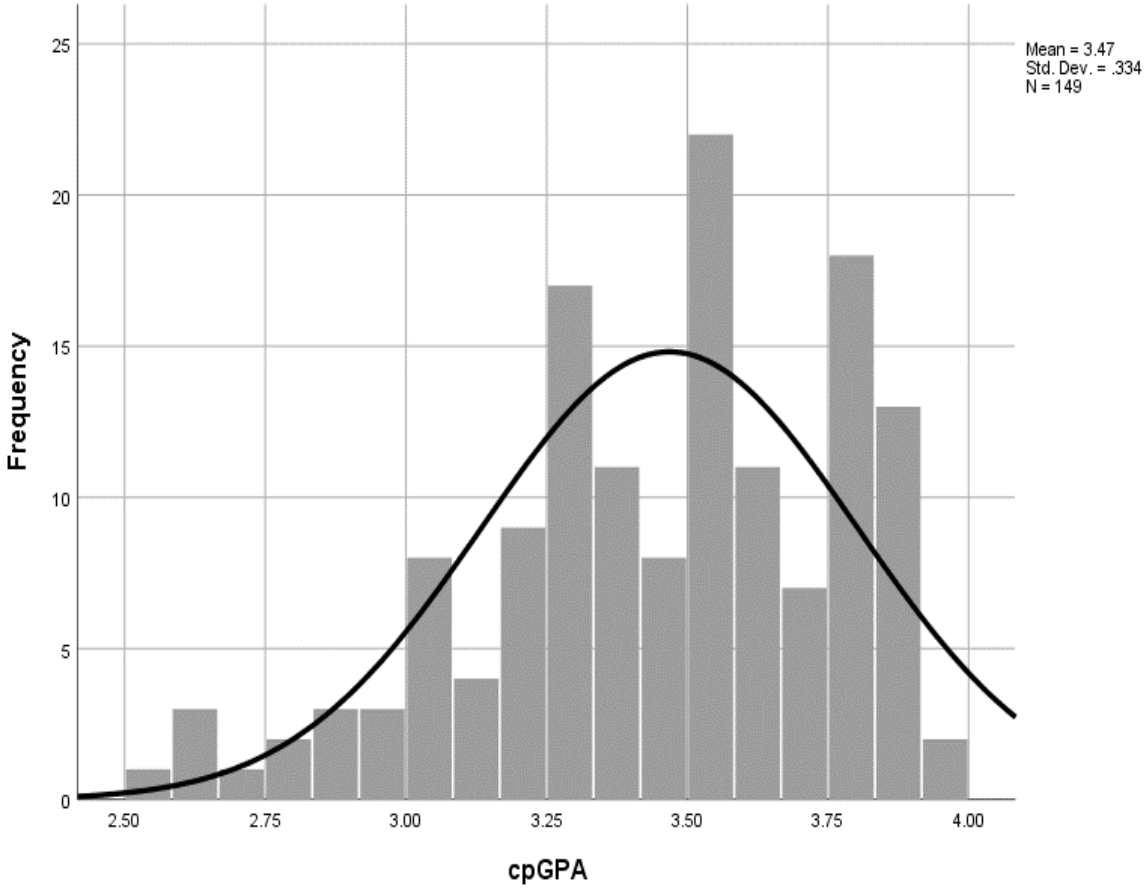
Descriptive Statistics

A total of 153 participants were enrolled and completed the LASSI measurement. However, at the conclusion of the Spring 2020 trimester a total of three records were removed for not meeting the inclusion criteria due to withdrawals or incomplete grades. Finally, after screening the data, one record was found to be an extreme outlier and removed prior to data analysis. There were no participants who voluntarily withdrew from the study. Therefore, a total of n = 149 (48 males; 101 females) participants met the inclusion criteria and were included for final analysis. The sample size included for analysis was greater than the n = 130 minimum sample needed to achieve statistical power for a standard multiple linear regression.

Descriptive statistics were calculated for the 10 scales and 3 components of the LASSI measurement and cpGPA. The results for the total sample population can be found in Table 4. The overall mean(SD) cpGPA for the n = 149 participants included in this study was 3.47(0.3) on a traditional 4.0 scale and can be viewed in Figure 1. The highest LASSI scale scores in this sample were noted in Information Processing 64.1(24.2), Attitude 62.3(24.6), Motivation 57.0(25.1), and Using Academic Resources 57.1(26.6). Contrastively, the lowest LASSI scale scores were noted in Anxiety 45.2(27.7) and Selecting Main Ideas 41.0(26.5). Notably, these two scales, Anxiety and Selecting Main Ideas, are below the 50^{th} percentile and would be considered relative weaknesses for this sample population (Weinstein et al., 2016). Of the three LASSI component scores, Self-regulation was the highest observed 56.9(20.0), while Skill was the lowest 53.1(19.8). Data screening included examining histograms for normality across levels of the predictor and outcome variables. Further assumptions and data screening procedures were conducted and are later described as they appear in testing each null hypothesis.

Figure 1

Histogram of the Dependent Criterion Variable of Cumulative Professional GPA (cpGPA).



Note. GPA is listed on a traditional 4.0 scale.

Table 4

Descriptive Statistics of the Criterion and Predictor Variables in the Sample Population

		n = 149
Type	Variable	Mean (SD)
Criterion	cpGPA	3.47 (0.3)
$H_0$1 Predictor	LASSI scale	
	Anxiety	45.2 (27.7)
	Attitude	62.3 (24.6)
	Concentration	51.1 (24.8
	Information Processing	64.1 (24.2)
	Motivation	57.0 (25.1)
	Selecting Main Ideas	41.0 (26.5)
	Self-testing	58.5 (26.3)
	Test Strategies	54.3 (23.7)
	Time Management	61.1 (26.1)
	Using Academic Resources	57.1 (26.6)
$H_0$2 Predictor	LASSI component	
	Skill	53.1 (19.8)
	Will	54.8 (19.3)
	Self-Regulation	56.9 (20.0)

Note. LASSI scale and component scores are represented out of 100 points; cpGPA is represented on a 4.0 scale. LASSI = Learning and Study Strategies Inventory; cpGPA = cumulative professional Grade Point Average.

Descriptive statistics were calculated by gender and academic program (PT/OT) and can be found in Tables 5 and 6, respectively. There were a total n(%) of 48(32.2%) male and 101 (67.8%) female participants included in the analysis. Overall, females demonstrated a slightly higher cpGPA, albeit insignificant. Females were also observed to have significantly lower mean(SD) scale scores of Anxiety 40.5(25.3) compared to male participants 55.0(30.1) (p = 0.003), indicating a difficulty managing anxiety. Contrastively, females were observed to have significantly higher mean (SD) scale scores of Time Management 64.5(23.8) and Attitude 65.2(23.2) (p = 0.02) compared to males 53.9(29.3) and 56.2(26.5) (p = 0.04), respectively.

Table 5

Descriptive Statistics of the Criterion and Predictor Variables by Gender

		Males	Females
		n = 48	*n = 101*
Type	Variable	Mean (SD)	Mean (SD)
Criterion	cpGPA	3.45 (0.3)	3.48 (0.3)
$H_0$1 Predictor	LASSI scale		
	Anxiety	55.0 (30.1)	40.5 (25.3)
	Attitude	56.2 (26.5)	65.2 (23.2)
	Concentration	48.5 (26.9)	52.2 (23.8)
	Information Processing	66.9 (22.6)	62.7 (25.0)
	Motivation	53.8 (25.5)	58.4 (24.8)
	Selecting Main Ideas	43.3 (29.0)	39.8 (25.4)
	Self-testing	59.5 (28.1)	58.1 (25.6)
	Test Strategies	55.7 (25.8)	53.6 (22.8)
	Time Management	53.9 (29.3)	64.5 (23.8)
	Using Academic Resources	54.1 (29.4)	58.5 (25.3)
$H_0$2 Predictor	LASSI component		
	Skill	55.3 (21.5)	52.1 (18.9)
	Will	55.0 (21.6)	54.7 (18.2)
	Self-Regulation	54.0 (23.4)	58.3 (18.2)

Note. LASSI = Learning and Study Strategies Inventory; cpGPA = cumulative professional Grade Point Average.

Descriptive statistics were calculated by academic program and there were a total n(%) of 89(59.7%) PT and 60(40.3%) OT students included for analysis (see Table 6). Overall, PT students demonstrated a slightly higher mean (SD) cpGPA of 3.48(0.3) compared to OT students 3.45(0.4). On average, there were no significant differences observed in the LASSI scale or component scores between PT and OT students, except for the LASSI scales of Anxiety. The mean (SD) Anxiety score for OT students 38.6(25.3) was significantly lower than PT students 49.6(28.5) (p = 0.02). The mean (SD) scale of Selecting Main Ideas was also lower in OT students 37.3(25.8) compared to PT students 43.4(26.9), approaching significance (p = 0.16).

Table 6

Descriptive Statistics of the Criterion and Predictor Variables by Academic Program

		PT	OT
		n = 89	*n = 60*
Type	Variable	*Mean (SD)*	*Mean (SD)*
Criterion	cpGPA	3.48 (0.3)	3.45 (0.4)
$H_0$1 Predictor	LASSI scale		
	Anxiety	49.6 (28.5)	38.6 (25.3)
	Attitude	62.8 (24.4)	61.5 (25.0)
	Concentration	51.9 (25.6)	49.8 (23.6)
	Information Processing	64.9 (24.1)	62.9 (24.6)
	Motivation	57.9 (22.6)	55.5 (28.5)
	Selecting Main Ideas	43.4 (26.9)	37.3 (25.8)
	Self-testing	60.1 (27.1)	56.2 (25.1)
	Test strategies	55.2 (23.8)	52.9 (23.8)
	Time management	61.2 (26.8)	61.0 (25.2)
	Using Academic Resources	56.4 (27.0)	58.1 (26.3)
$H_0$2 Predictor	LASSI component		
	Skill	54.5 (19.6)	51.0 (20.0)
	Will	56.8 (18.8)	51.9 (19.7)
	Self-Regulation	57.4 (20.8)	56.3 (18.9)

Note. LASSI = Learning and Study Strategies Inventory; cpGPA = cumulative professional Grade Point Average; PT = Physical Therapy; OT = Occupational Therapy.

Results

Null Hypothesis One

$H_0$1: None of the ten scale scores of the LASSI (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources) are able to accurately predict cumulative professional GPA for PT and OT students enrolled in an online curriculum.

To test $H_0$1, a standard multiple linear regression analysis was used. Alpha significance levels were set at 0.05. The total sample included in this analysis was n = 149. A standard

multiple regression analysis was conducted where all predictor variables, the 10 LASSI scale scores, were entered into the regression model simultaneously with the outcome variable.

Assumptions Tested

Assumptions were tested for $H_0$1. According to Warner (2008), these include testing for outliers, homoscedasticity, and linearity. Histograms were created to test the distribution of the data set across the outcome variable for cpGPA and the 10 scales of the LASSI. All variables were found to have a normal distribution. Next, homogeneity of variances was tested using partial regression plots and no violations were detected. Scatter plots were created to assess the linearity of the data set across all variables. There were no violations observed across any variable. A scatter plot matrix of all variables required to test $H_0$1 can be found in Figure 2. To test the assumption of independence of observations the Durbin-Watson statistic was calculated. In this regression model the Durbin-Watson statistic was 1.97, indicating acceptable levels. A summary of the regression model can be found in Table 7. Finally, non-multicollinearity was tested using the VIF and values across all ten scales of the LASSI were within acceptable levels, ranging from 1.45-2.78.

Figure 2

Scatter plot Matrix of the Scales of the LASSI and cpGPA for H_01

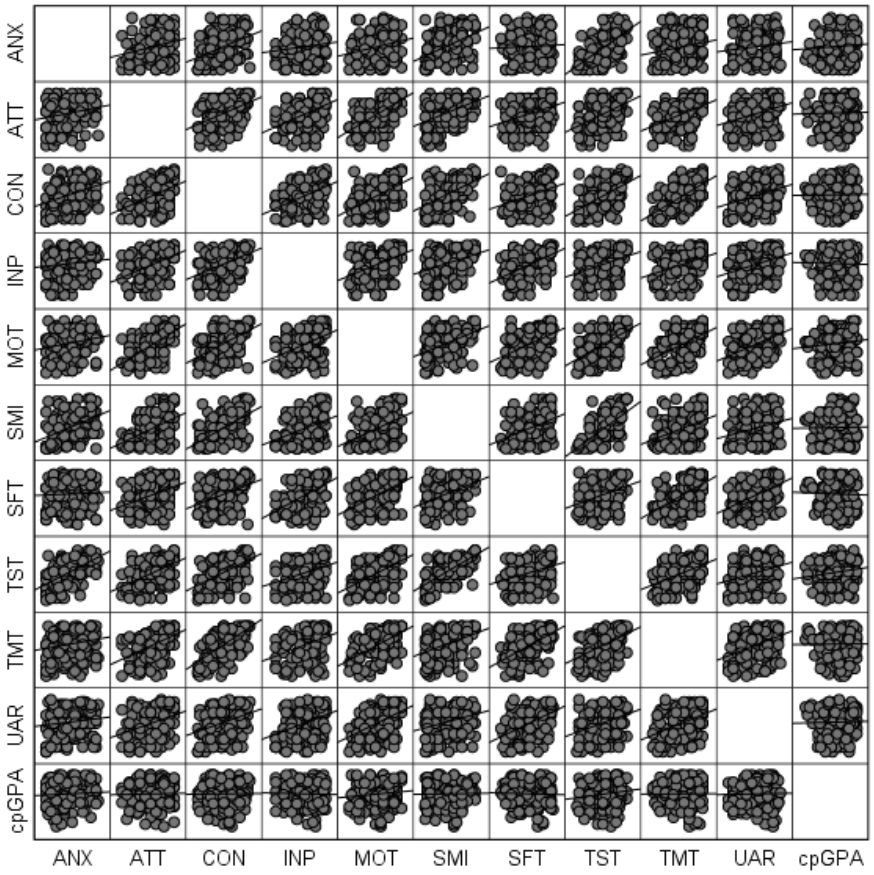


Table 7

Standard Regression Model Summary for H_01

Variables	R	R^2	Adj. R^2	SEE	Durbin-Watson
ANX, ATT, CON, INP, MOT, SMI, SFT, TST, TMT, UAR	0.22	0.05	-0.02	0.34	1.97

Note. Multiple correlation coefficients represented include R = correlation coefficient; R^2 = amount of explained variance; and Adjusted R^2; SEE = Standard error of the estimate. ANX = Anxiety; ATT = Attitude; CON = Concentration; INP = Information Processing; MOT = Motivation; SMI = Selecting Main Ideas; SFT = Self-testing; TMT = Time Management; UAR = Using Academic Resources.

Table 8

Contribution of the Predictor Variables to cpGPA for the Sample Population

						Correlation	
Variable	*B*	*SE*	*ß*	*t*	*Sig.*	*Zero-order*	*Partial*
Anxiety	0.00	0.10	-0.04	-0.34	0.74	0.06	. -0.03
Attitude	-0.001	0.001	-0.06	-0.53	0.60	0.02	-0.05
Concentration	-0.001	0.002	-0.04	-0.34	0.73	0.01	-0.03
Information Processing	-0.001	0.002	-0.04	-0.41	0.70	-0.03	-0.03
Motivation	0.002	0.001	0.15	1.19	0.24	0.11	0.10
Selecting Main Ideas	-0.001	0.002	-0.09	-0.73	0.47	0.02	-0.06
Self-testing	-0.001	0.002	-0.07	-0.61	0.54	-0.03	-0.05
Test Strategies	0.003	0.002	0.25	1.79	0.08	0.15	0.15
Time Management	0.00	0.002	-0.22	-0.22	0.83	0.01	-0.02
Using Academic Resources	-0.0003	0.001	-0.03	-0.31	0.98	0.02	-0.003

Note. Statistics represented are unstandardized regression coefficient (B), standard error (SE), standardized regression coefficient beta (β), significant test (t), p value (Sig.), and zero-order and partial correlation. cpGPA = cumulative professional GPA.

Based on the regression model summary from Table 7, the $H_0 1$ failed to be rejected, $F(10, 138) = 0.71$, $p = 0.71$. The multiple correlation coefficients were $R = 0.22$, $R^2 = 0.05$, and adjusted $R^2 = -0.02$. These results indicate an unstable model and demonstrate that none of the independent predictor variables, the 10 LASSI scale scores, only explains 5% of the variance noted in the outcome variable of cpGPA. No significant predictive correlations were identified. Furthermore, there were no significant predictive relationships identified across any individual scale of the LASSI, as represented in Table 8. Each individual predictor variable can be

evaluated on the degree to which it contributes to the prediction of cpGPA. The LASSI scales of Test Strategies and Motivation had the highest *ß coefficients* and t-ratios and only contributed 25% and 15% of the explained variation in this regression model, respectively. Neither of these scales achieved significance. However, Test Strategies approached a significance threshold (p = 0.08). Therefore, the null hypothesis cannot be rejected for RQ1. The LASSI scales of Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources are not able to accurately predict cpGPA in this sample of PT and OT students.

Null Hypothesis Two

$H_0$2: None of the three components of the LASSI (Skill, Will, and Self-regulation) are able to accurately predict cumulative professional GPA for PT and OT students enrolled in an online curriculum.

To test $H_0$2 a standard multiple linear regression analysis was used. Alpha significance levels were set at 0.05. The total sample included in this analysis was n = 149. To test $H_0$2, a multiple linear regression analysis was conducted where all predictor variables, the three LASSI components, were entered simultaneously into the regression model with the outcome variable.

Assumptions Tested

Assumptions were tested for $H_0$2. The same assumptions tested for $H_0$1, as outlined by Warner (2008), were repeated in testing $H_0$2. Histograms were created to test the distribution of the data set across the dependent outcome variable for cpGPA and the three components of the LASSI. All variables were found to have a normal distribution. Next, homogeneity of variances was tested using partial regression plots and no violations were detected. Scatter plots were created to assess the linearity of the data set across all variables. A scatter plot matrix of all

variables required to test $H_0$2 can be found in Figure 3. There were no violations observed across any variable. To test the assumption of independence of observations the Durbin-Watson statistic was calculated. In this regression model, the Durbin-Watson statistic was 2.03, indicating acceptable levels. A summary of the regression model can be found in Table 9. Finally, non-multicollinearity was tested using the VIF and values across the three components of the LASSI were within acceptable levels, ranging from 1.86-2.48.

Figure 3

Scatter plot Matrix of Components of the LASSI and cpGPA for $H_0$2

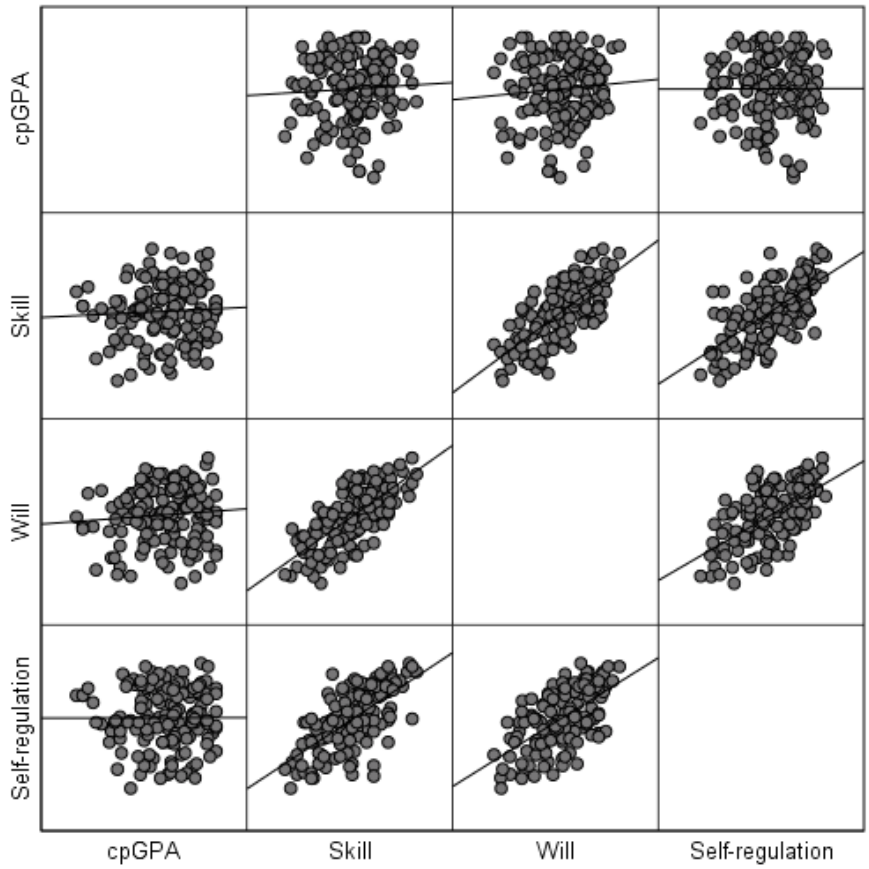


Table 9

Standard Regression Model Summary for $H_0 2$

Variables	R	R^2	Adj. R^2	SEE	Durbin-Watson
Skill, Will, Self-Regulation	0.11	0.011	-0.01	0.34	2.03

Note. Multiple correlation coefficients represented include R = correlation coefficient; R^2 = amount of explained variance; and Adjusted R^2; SEE = Standard error of the estimate.

Table 10

Contribution of the Predictor Variables to cpGPA for the Sample Population

						Correlation	
Variable	*B*	*SE*	*ß*	*t*	*Sig.*	*Zero-order*	*Partial*
Skill	0.000	0.002	0.03	0.19	0.85	0.06	0.02
Will	0.002	0.002	0.12	0.96	0.38	0.09	0.08
Self-Regulation	-0.001	0.002	-0.09	-0.76	0.45	0.003	-0.06

Note. Statistics represented are unstandardized regression coefficient (B), standard error (SE), standardized regression coefficient beta (β), significant test (t), p value (Sig.), and zero-order and partial correlation.

Based on the regression model summary from Table 9, the $H_0 2$ failed to be rejected, $F(3, 145) = 0.56$, $p = 0.64$. The multiple correlation coefficients in this model were R = 0.11, R^2 = 0.01, and adjusted R^2 = -0.01. These results indicate an unstable model. The predictor variable, LASSI component scores of Skill, Will, and Self-regulation, only explain 1% of the variance noted in the outcome variable of cpGPA. No significant predictive correlations were identified. Furthermore, the LASSI component of Will, with the greatest *ß coefficient* and t-ratio, only contributed 12% to the explanation of cpGPA for this regression model, nor did the Will

component achieve significance ($p = 0.38$). Therefore, the null hypothesis cannot be rejected for RQ2. The LASSI components of Skill, Will, and Self-regulation are not able to accurately predict cpGPA in this sample.

CHAPTER FIVE: CONCLUSIONS

Overview

The following chapter provides a comprehensive discussion on the findings of this study in light of the prior literature. Then, the implications and limitations to this study are outlined and discussed. Next, guidance for future inquiries is outlined and discussed as it emerges from the remaining gaps in the knowledge of this phenomenon. Finally, this chapter concludes with practical applications for this area of health professional education.

Discussion

The purpose of this study was to examine the ability of the LASSI scale and component scores to accurately predict cpGPA for PT and OT students enrolled in an online curriculum. This study was conducted in response to direction from previous inquiries to expand upon the understanding of the predictive nature of the LASSI measurement from leaders in professional education (Bernier, 2009; Carson, 2011; Crede & Kuncel, 2008; Donaldson, 2018; Griffin et al., 2012; Khalil et al., 2018a, 2018b, 2019; Mathes, 2003; Primus, 2003; Rosenbaum, 2015; Schutz et al., 2011; Slaybaugh, 2012; Waite et al., 2019; West et al., 2011; West & Sadoski, 2011; Zhou et al., 2016). As such, the results of this study are discussed in relation to the prior research conducted in this field.

For $H_0$1: None of the ten scale scores of the LASSI (Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test Strategies, Time Management, and Using Academic Resources) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum. The null hypothesis failed to be rejected.

In testing $H_0$1, none of the 10 LASSI scale scores were able to accurately predict cpGPA in PT or OT students. These findings are in support of studies conducted by Bernier (2009) and Lobb (2006) involving pharmacy education, Donaldson (2018) involving a large sample of chiropractic students, and that of Rosenbaum (2015) involving adult vocational students. However, in large part, the results from this study are contradictory to those from prior studies conducted across a variety of health professional learners.

Particularly, the results of this study are incongruent with prior findings in medical, nursing, physiotherapy, and chiropractic education (Jouhari et al., 2016; Khalil et al. 2018a, 2018b, 2019; Kuo, 2015; Schutz et al., 2011; 2013; West & Sadoski, 2011; West et al., 2014). The LASSI scales of attitude, motivation, concentration, and attention have continually emerged as significant strategies in medical students (Norouzinia et al., 2016; Sleight & Mavis, 2006). Similarly, Jouhari et al. (2015), Jouhari et al. (2016), and Khalil et al. (2018a, 2018b, 2019) identified significance among these LASSI scales in medical education outcomes. Furthermore, Zhou et al. (2016), West and Sadoski (2011), and West et al. (2014) reported the LASSI scales of attitude, concentration, motivation, test strategies, and time management as strongly linked to performance in medical education. On the other hand, Schutz et al. (2011) and Schutz et al. (2013) identified the LASSI scales of anxiety, concentration, selecting main ideas, and test strategies as significant predictors in chiropractic students and were able to differentiate between high and low performing students. Overall, Anxiety, Attitude, Concentration, Motivation, Time Management, and Test Strategies are the LASSI scales with the most significant relationships in prior studies. However, none of these relationships were evident with PT and OT students in this study.

One possible explanation for the discrepancy between findings is the inherent differences in the curriculum and instruction between health professional education programs. There may be fundamental differences between how medical and PT and OT students are instructed. Much of PT and OT professional education depends on the acquisition of psychomotor skill and technique-sensitive therapeutic treatments (Plack & Driscoll, 2011). As such, these educational programs typically rely heavily upon hands-on laboratory instruction where students practice therapeutic and rehabilitation techniques (CAPTE, 2019; USAHS, 2019a). Comparatively, laboratory instruction may be underrepresented in medical education and is one possible explanation for notable differences in the study outcomes. On the other hand, chiropractic education may share many similarities to PT and OT education given the degree of hands-on psychomotor components of laboratory learning compared to medicine or pharmacy (Donaldson, 2018). However, previous findings on the predictive nature of the LASSI in chiropractic students from Pringle and Lee (1998), Schutz et al. (2011), and Schutz et al. (2013) are more consistent with those from the medical profession than that of this study.

This study focused solely on an online PT and OT education program. As such, the LASSI may not have contextual applications for this population of adult online learners. Perhaps the LASSI is more relevant to traditional face-to-face education programs or in programs where psychomotor hands-on laboratory skills are not a defining characteristic. In this study, PT and OT students engaged in online education were considered a single group given the shared characteristics between programmatic learning outcomes as rehabilitation professionals. Under the assumptions of ALT, these groups were believed to share the characteristics of adult learners and millennials (Bennett et al., 2012; Bierema, 2018; Desy et al., 2017). Even still, differences between groups were noted and OT students performed significantly lower on the LASSI scales

of Anxiety and Selecting Main Ideas when compared to PT students. This could potentially be explained by a smaller sample size of OT students, or that females were over represented in both samples of students in this study. However, there is the possibility that adult PT and OT learners do not share enough similarities with respect to their learning and study strategies and should potentially be treated as mutually exclusive entities.

Furthermore, there were subtle differences noted in key LASSI scales between gender and were in agreement with previous findings from Crede and Kuncel (2008), Griffin et al. (2012), and West and Sadoski (2011); mainly, the scales of anxiety and time management. Females demonstrated significantly lower scores in Anxiety when compared to males, yet significantly higher scores in Time Management. This may suggest an interesting relationship exists among females' ability to manage time and anxiety. As a result, studies examining PT and OT students should consider monitoring each group individually and select larger and more equal numbers of males and females.

For $H_0 2$: None of the three components of the LASSI (Skill, Will, and Self-regulation) are able to accurately predict cumulative professional GPA for physical and occupational therapy students enrolled in an online curriculum. The null hypotheses failed to be rejected. In this study, none of the three components of the LASSI measurement were able to accurately predict cpGPA for this sample of PT and OT learners. These findings contradict much of the prior work that has been conducted on the three main components of learning and study strategies.

In testing $H_0 2$, the findings of this study disagree with many prior inquiries on the LASSI, especially the hallmark study by Crede and Kuncel (2008). The majority of prior studies have demonstrated strong relationships between the LASSI components of Will and Self-regulation (Jouhari et al., 2015, 2016; Khalil et al., 2018b, 2019; Kuo, 2015; Sleight & Mavis,

2006; Zhou et al., 2016). Particularly, the scales of Anxiety, Attitude, Motivation, Concentration, Self-testing, and Time Management that comprise the Will and Self-regulation components have repeatedly surfaced as significant predictors among these professions (Khalil et al., 2018a; Kuo, 2015). In this study, some of the elements of the Will component (anxiety, attitude, and motivation) of the LASSI appeared to be slightly more developed in this sample of learners when compared to elements of the Skill component (information processing, selecting main ideas, and test strategies). However, even the highest observed mean LASSI component scores of the Will and Self-regulation were only narrowly above those of the Skill component. Collectively, the sample failed to display the relationships that have been previously uncovered.

By far, the majority of prior evidence on the predictive nature of the LASSI measurement has been derived from studies of medical, nursing, pharmacy, and chiropractic students. It had been assumed that health professional learners possessed a set of shared characteristics given their generation, age, and prior academic backgrounds. Indeed, the assumptions on which this study was founded may have been inappropriate. Health professional students may be unique in their learning and study characteristics (Lee, 2018; Waite et al., 2019). Suffice to say, the sets of learning and study strategies that make one group of health professionals successful in an educational program may not necessarily work well for another, and vice versa. For example, there may be fundamental differences in characteristics and learning phenotypes between medical students and those in the rehabilitation professions, such as PT and OT. As such, medical students may be distinct sets of learners that are mutually exclusive from PT and OT students. Therefore, these groups of health professional students may not be as similar as presumed and should analyzed separately.

Implications

In a post-COVID-19 era that has witnessed dramatic shift toward online education, there has never been a more important time to possess a deeper understanding of the learning and study strategies that are predictive of academic success in online learning. Prior evidence suggests that the LASSI scales of Anxiety, Attitude, Concentration, Motivation, Test Strategies, and Time Management are significantly related to, and may be predictive of, academic outcomes (Crede & Kuncel, 2008; Khalil et al., 2018a, 2018b; Zhou et al., 2016). The LASSI components of Will and Self-regulation have also demonstrated significant relationships to academic outcomes. It is possible that the LASSI scales and components are predictive of academic success in this population of learners. However, the findings from this inquiry do not suggest such a relationship exists in this sample population given the conditions of this study.

This study represents a singular inquiry amid an emerging body of evidence and, to date, is the first of its kind in this set of health professional learners. The data collection for this research study straddled an extraordinary period of time in global history. Unfortunately, the early months of 2020 were unprecedented times for many as the COVID-19 pandemic challenged almost all aspects of education, and students in these PT and OT programs were no exception. Therefore, it is entirely possible that the findings from this study were impacted by global events that threatened internal validity. However, it is still plausible that the LASSI measurement is not an appropriate measure by which to predict outcomes in this population.

This study did not identify any significant predictive relationships for either of the hypotheses tested. Although the results of this study contradict much of the prior work in this field, they should be interpreted cautiously. Nevertheless, the results are beneficial to health professional educators at large. For example, prior to this study there had been no scientific

inquiries examining the predictive ability of the LASSI with this scope and breadth. Therefore, this study has provided a contemporaneous platform by which to construct new inquiries on this important topic of educational research, especially as health professional programs boom.

The administration of the LASSI to participants in this study may be value-laden and not readily perceived by the outcomes of this study design. The participants of this study were given an opportunity to self-assess their learning and study strategies and move forward in their education with this knowledge. Perhaps, exposing PT and OT learners to the LASSI measurement provided an individual awareness of learning strategies. This could have downstream implications yet to materialize. Students enrolled in this study may not have been previously aware of this measurement, or their strengths and weaknesses in each scale and component of the LASSI. As a result, it is possible that some of these participants may use this information to improve upon their learning and study habits. Thus, improving academic performance at a later point in time. As such, the timeframe of study would have been too narrow to capture or realize any of these potential gains, either latent or apparent. Therefore, future studies should consider longer enrollment and data collection periods to identify any relationships that may exist between the LASSI measurement and future academic performance that could not be readily ascertained due to the limited scope of this study.

Furthermore, this study occurred across two academic programs and three separate campuses at a single institution. As such, a notable amount of variation could be described across the settings. Each program enrolls students in six or seven courses each trimester. As a result, many different instructors teaching multiple classes, each at different campuses, introduces the likelihood that variation in teaching style, campus resources, geography, course assessment, and academic rigor could have impacted the outcome variable of cpGPA. There is also the possibility

that grade inflation occurred in some courses and could have skewed the cpGPA data collected. Understanding the extent to which any of these occurred is outside the scope of this study.

Limitations

Consistent with all forms of research there are certain limitations to this study. This study was grounded in the framework of ALT. As such, there may be potential limitations to the application of the theoretical assumptions underpinning this framework. The adult learning framework chosen as a reference for this study may be incongruent with the population and phenomenon of interest. Similarly, the same may be true for the theoretical application of strategic learning. The scales and components of the LASSI measurement are built upon the framework of Weinstein's SLT. Indeed, there exists a great deal of overlap with ALT. However, the predictive nature of the LASSI in adult learners rests upon the validity and accuracy of the tool. Therefore, it is possible that the LASSI is not an appropriate measure in this population or setting of education. These limitations should be considered in designing future studies.

There are undeniable threats to the internal and external validity of this study. Perhaps, the largest threat to the internal validity of this study involves the recent COVID-19 pandemic. This study was conducted over the course of the 15-week Spring 2020 trimester, spanning from January to late April. At week 10 of the term, the COVID-19 outbreak greatly impacted normal campus operations and disrupted many facets of instructional delivery and assessment. Thus, hybrid-online PT and OT curricula were forced to transition to fully online for the remaining five weeks (33%) of the trimester. As such, student stress, anxiety, and many other learning and study strategies could have been dramatically altered in the final weeks of the study. This single event could have had a tremendous impact on the observed study outcomes.

It is important to note that this extraordinary event took place after participants had completed the LASSI self-assessment and would have impacted participants just prior to final examinations. This significant event may have interfered with participants' learning and study strategies for a portion of the term; thus, altering the study outcomes. It is unclear the degree to which the COVID-19 had an impact on final grades. Therefore, the outcome variable of cpGPA could have been greatly influenced by time and maturation. The extent to which these exceptional conditions may have influenced the cpGPA of students participating in this study is unknown and could not have been anticipated prior to the commencement of the study.

There are other limitations to this study. Chief among them, the LASSI is a self-reported measurement and naturally introduces an unknown degree of bias into the predictor variable for this study. As the LASSI is self-reported in nature, it is also possible that participants experienced the Hawthorne effect, which may have interacted with the observed scores in cpGPA (Gall et al., 2015). That is, participants may have behaved differently as a result of their knowledge of being included in a research study, and thereby, impacting their academic performance to an unknown degree. One cannot dismiss the likelihood that the conditions under which a participant self-assessed their learning strategies impacted the results collected. Similarly, the LASSI is a commonly used assessment among undergraduate institutions and previous exposure with this measurement may have influenced reporting. Although this study sought to minimize these influences, the level and degree to which bias may have influenced the observed outcomes is not fully known and difficult to control for in educational research.

Secondly, the sample population for this study included graduate-level PT and OT learners enrolled in a hybrid-online curriculum and may not be representative of the broader population. As such, the results of this study may not be generalized to other institutions that

embrace more traditional PT and OT curricula or face-to-face methods of instruction. Third, time and maturation may have played a role in influencing the outcomes of this study. For example, to establish a predictive relationship temporal precedence was a prerequisite of the study design and the LASSI measurement had to be administered in the first three weeks of the academic term. By doing so, this study allowed 12 weeks to elapse prior to collecting the outcome variable of cpGPA. It is possible that the learning and study strategies of student participants in this study may have evolved throughout that period of time. Moreover, exposure to the LASSI measurement and its items could have interacted with a participant's awareness of the learning and study strategies used throughout the academic term. However, understanding of the degree to which these may have influenced the results lay outside the scope of this study.

Similarly, these results may not be directly applicable to professional education programs in nations outside the United States that deploy undergraduate preparation for health professionals. For example, many institutions in Australia, Europe, and parts of Asia still require entry-level PT and OT programs at the baccalaureate or masters levels. To address such deficiencies in the knowledge, more focused and specific inquiries would be required among broader samples. Furthermore, the results from this study may be limited by the degree of inter-correlation between levels of the independent variable. That is, there are intrinsic relationships that exist between the 10 scales and 3 components of the LASSI measurement and may impact the degree of accuracy in the predictive regression models. Lastly, although this sample achieved statistical power, there were significant differences noted between the number of males/females and PT/OTs. This study included significantly more females and PT students and may inadvertently underrepresent males and OT students. It is possible that participants may respond differently on the LASSI items based on key demographics such as gender and ethnicity.

However, the numbers included in this study were not disproportionately representative of the typical enrollment of these programs from prior admissions data (USAHS, 2019a).

Lastly, although there is a large body of evidence to support the use of GPA as a valid instrument by which to measure academic performance, there are threats to the validity of this method (Kosmahl, 2005; Riddle et al., 2009; Wolden, 2018). For example, GPA is traditionally measured on a 0.0 to 4.0 scale and the majority of scores collected from a sample in the higher education setting often lay within a reduced range by virtue of the academic performance required of students at this level (Wolden et al., 2020). For example, students who do not maintain GPA above 3.0 are typically placed on academic probation in professional programs and are at risk for failing to matriculate. This reduced range of GPA may result in an overrepresentation of scores between 3.0 and 4.0 (Wolden, 2018). Thus, potentially skewing the distribution of GPA. In future studies, it may be worthwhile to examine GPA by quartiles or range in order to more deeply understand any hidden relationships that may exist within a reduced range of scores. In this study, a total n(%) of 136(91.3%) of participants had an observed cpGPA of 3.0 or greater. As a result, it may have been more difficult to detect significant differences or meaningful relationships in a sample population within a reduced range. This presents academicians with a challenge as student GPA may not necessarily be the best illustration of downstream outcomes, nor might it be an accurate indicator outside of the classroom in future clinical performance.

Recommendations for Future Research

Future research should seek to replicate this study in larger and more diverse samples of online PT and OT education. This study should be repeated in an academic term that is unaffected by such a large-scale extraordinary event, such as a global pandemic. Along those

lines, it may also be beneficial to examine if students vary by the cohort in which they matriculate. For example, students that enter PT or OT programs during the Spring, Summer, and Fall could potentially display significant differences in learning strategies or academic performance by cohort. There may be relationships between when students complete their undergraduate coursework and future academic success or difficulty in health professional programs based upon the timing of matriculation and have yet to be explored.

Similarly, a suitable direction for this line of inquiry would involve testing the ability of the LASSI to detect changes in response to intervention. For example, some prior studies have examined the LASSI before and after exposing students to interventional coursework on learning and study strategies with mixed results (Haghani & Sadeghizadeh, 2011; Renzulli, 2013). Given the nature of educational research it may be difficult to design and recruit subjects for large prospective trials. To date, there have been no published studies performing such methods in PT and OT students and should be considered in future trials. As a result, it is not yet known the degree to which the LASSI can accurately monitor a change in learning and study strategies through time in this population. Therefore, future inquiries should further examine psychometric properties and responsiveness of the LASSI. However, larger studies with more robust prospective designs would be required to interrogate the diagnostic accuracy of the LASSI in this population.

Future studies should also consider alternative outcome variables to study in relation to the LASSI scales and components. For example, clinical performance or national licensure examination scores. In addition to academic performance, the LASSI has yet to be examined more thoroughly in relation to future clinical performance in the education of PT and OT students. There are many non-academic factors that exist in successful PT and OT clinicians.

Perhaps, the LASSI can detect which learning strategies are commonly deployed by effective adult learners in the continuing education setting. The learning and study strategies of successful clinicians may be more dynamic when compared to those of students in a classroom. For example, PT and OT clinicians are evidence-based practitioners and life-long learners. Adult learning occurs across the lifespan and cannot be contained by the walls of a classroom. Therefore, PT and OT clinicians are constantly consuming new information throughout their careers and learning how to integrate concepts into practice. It may be useful to examine the utility of the LASSI measurement in relation to more practical health care learning environments.

Conclusion

In conclusion, it is vital to continue to understand the influence of learning strategies in the online education of adult learners, especially in health professional education. This understanding has never been more important in the wake of the COVID-19 pandemic. A clear and undeniable trend exists in PT and OT education toward the widespread implementation of online learning. Even prior to the COVID-19 outbreak, many health professional education programs were already widely adopting online instruction. However, since the occurrence of this extraordinary event, many more institutions were forced to rapidly adopt online education. As such, some institutions were operating under unfamiliar circumstances. Should the previous trends in online education continue after the resolution of this global crisis, a deeper understanding of the learning and study strategies most accurately able to predict academic success in online would prove highly valuable to health professional educators.

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Appendix A: The LASSI third edition

Removed to comply with copyright. A copy of the LASSI third edition can be found at H&H Publishing:

https://www.hhpublishing.com/ap/_assessments/LASSI-3rd-Edition.html

Appendix B: Sample LASSI Score Report

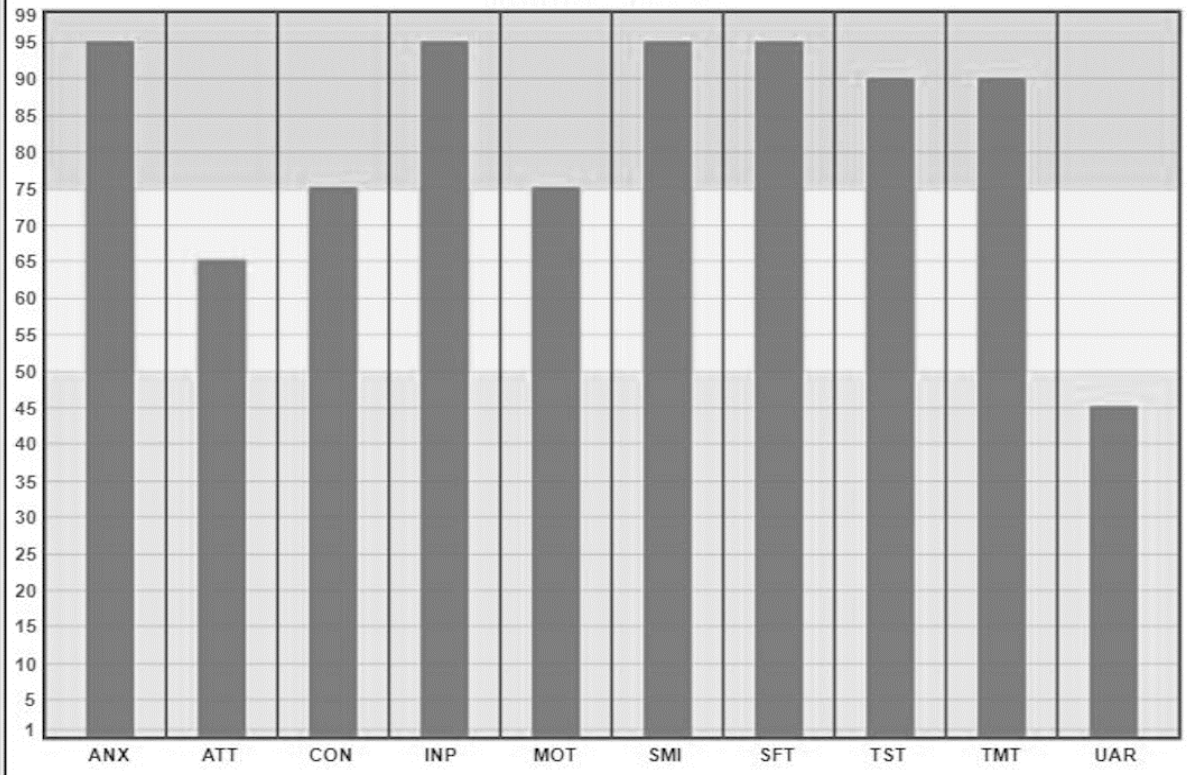
Learning and Study Strategies Inventory (LASSI)
Student Report

Evan Pucillo	School #: 81494
11/13/2018	Student Key: Pu87KG8E
ID Number: 001	epucillo@usa.edu

The graph below interprets your responses to the LASSI. The numbers on the left-hand side of the chart show percentile ranks. You can use these percentile ranks to compare your scores to other individuals' scores. For example, if you scored in the 80th percentile in Attitude (ATT), you scored higher than 80 percent of other individuals answering the same questions.

As you work to improve your scores, your advisor/instructor may want you to take this assessment again. If you do take it a second time, you will need your student key. Your student key is Pu87KG8E.

LASSI Scores



75 - 100	If you scored **above the 75th percentile** on any of the ten LASSI scales, you probably do not have to give a high priority to improving your strategies in those areas.
50 - 75	If you scored **between the 75th and the 50th percentiles** on any of the ten scales, you should consider improving your strategies for those scales.
0 - 50	If you scored **below the 50th percentile** on any of the ten scales, you need to improve your skills to avoid serious problems succeeding in college.

Appendix C: Host Institution – IRB Informed Consent

CONSENT FOR RESEARCH PARTICIPATION

Title: The predictive nature of the Learning and Study Strategies Inventory (LASSI) in the online education of physical and occupational therapy students.

IRB Number: UR-1001-336

Principal Investigator:
Evan M. Pucillo, PT, DPT
epucillo@XXXX.edu
XXXXXXX
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXXX

You are being asked to participate in a research study. The box below highlights key information about this research for you to consider when making a decision whether or not to participate. Carefully consider this information and the more detailed information provided below the box. Please ask questions about any of the information you do not understand before you decide whether to participate.

Key Information for You to Consider
• **Voluntary Consent**. You are being asked to volunteer for a research study. It is up to you whether you choose to participate or not. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate or discontinue participation. • **Purpose**. The purpose of this research is to describe the results of the Learning and Study Strategies Inventory 3rd edition (LASSI) in a sample of Physical and Occupational Therapy students enrolled in an online entry-level professional curriculum, and to determine if the scale or component scores of the LASSI can accurately predict academic performance in cumulative professional GPA. • **Duration.** It is expected that your participation will take about 15-20 minutes. • **Procedures and Activities.** You will be asked to complete the online LASSI-3 measurement by February 2nd, 2020. Score reports across the ten scales of strategic learning will be released to the researchers for analysis at the conclusion of the term. The LASSI measure will be analyzed with cumulative professional GPA. Participants will be able to retain their LASSI score reports for their own use and record. • **Risks.** Participation in this study involves no more than minimal risk, including potential breach in confidentiality. Some of the foreseeable risks or discomforts of your participation include: temporary postural discomfort and eye strain as part of the computerized assessment, but the likelihood of this will be minimized as the assessment is typically completed in under 15 minutes.

- **Benefits**. There are small financial benefits associated with this study. The first 150 participants may receive a $10 Amazon.com electronic gift card for successful completion of the study procedures. There are no health benefits associated with participating in this study. You may follow the instructions to claim this reward after the LASSI measurement is completed.
- **Alternatives.** Participation is voluntary and the only alternative is to not participate.

Why is this research being done?

The purpose of this research study is to describe the results of the Learning and Study Strategies Inventory 3rd edition (LASSI) in a sample of Physical and Occupational Therapy students enrolled in an online entry-level professional curriculum, and to determine if the scale or component scores of the LASSI can accurately predict academic performance in cumulative professional GPA. The information provided from the results of the LASSI measurement can be beneficial to both educators and students. This information includes a student's aptitude in various scales of learning strategies. The LASSI measures ten scales of learning strategies, including: Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test strategies, Time Management, and Using Academic Resources. Students and educators may benefit from a deeper understanding of which scales and components of the LASSI can accurately predict academic performance to improve learning outcomes. The results of this study may greatly help professional PT and OT programs across the nation.

What Will Happen in This Research Study

This research study will utilize a predictive correlational design to test the research questions and hypotheses.

- First-term MOT, OTD, and DPT students from the resident programs of the Miami, San Marcos, and Austin campuses will be recruited for participation in this study.
- Once informed consent is obtained a participant may use the LASSI access code provided to self-administer the LASSI measurement online.
- Instructions are included on how to complete the survey online. Each participant must omit their first and last names and will only enter their student ID number.
- The LASSI is a 60-item questionnaire that takes less than 15 minutes to complete. It generates percentile rank scores across ten scales of strategic learning, including: Anxiety, Attitude, Concentration, Information Processing, Motivation, Selecting Main Ideas, Self-testing, Test strategies, Time Management, and Using Academic Resources.
- Students will receive an individual score report and results will be stored in a secure online database for the investigator. This will conclude the participation required.
- At the conclusion of the term, all LASSI score reports from participants that met the inclusion criteria will be compared to GPA will be retrieved from the USAHS registrar.

The ways we will protect your privacy and confidentiality are described in a separate section later in this form.

Risks and Discomforts

Health: One may experience some brief postural discomfort and eye strain as part of the assessment, but the likelihood of this will be minimized as the assessment is typically completed in under 15 minutes taken on a computer.

Financial: There are no financial risks associated with participating in this research study. There are no costs associated with participation in this study.

Potential Benefits

There are no health benefits associated with participating in this study. The first 150 participants may receive a $10 gift card for their participation and completion of the study and is contingent upon successful completion of the LASSI online survey prior to end of week three of the term, or February 2nd, 2020.

Payment

You may receive one (1) $10 Amazon.com electronic gift card upon successful completion of the LASSI measurement. The LASSI must be completed prior to end of week three of the Spring 2020 term. You may collect the payment by following the link provided after you complete the LASSI measurement online. There are no other payments associated with participation in this study.

Confidentiality

We will not record your name or any information that shows your identity, instead you will use your student ID number when completing the LASSI. You will not be signing this form. Demographic information, including, but not limited to age, gender, ethnicity, campus and program affiliation, may be collected for this study. Information already collected about you will remain in the study record even if you later withdraw. *All information obtained in this study is strictly confidential unless disclosure is required by law.*

We will store your information in ways we think are secure. We will store paper files in locked filing cabinets. We will store electronic files in computer systems with password protection and encryption. However, we cannot guarantee complete confidentiality.

If you agree to be in the study and sign this form, we will share information that may show your identity with the following groups of people:

- People who do the research or help oversee the research, including safety monitoring.
- People from Federal and state agencies who audit or review the research, as required by law. Such agencies may include the U.S. Department of Health and Human Services, the Food and Drug Administration, the National Institutes of Health, and the Massachusetts Department of Public Health.
- Any people who you give us separate permission to share your information.

We will share research data where we have removed anything that we think would show your identity. There still may be a small chance that someone could figure out that the information is about you. Such sharing includes:

- Publishing results in a professional book or journal.
- Adding results to a Federal government database.
- Using research data in future studies, done by us or by other scientists.

Compensation for Injury

If you think that you have been injured by being in this study, please let the investigator know right away. Use the phone number on the first page of this form. There is no program to provide compensation for the cost of care for research related injury or for other expenses. Other expenses might be lost wages, disability, pain, or discomfort. You or your insurance will be billed for the medical care you receive for a research injury. You are not giving up any of your legal rights by signing this form.

Subject's Rights

By consenting to be in this study you do not waive any of your legal rights. Consenting means that you have been given information about this study and that you agree to participate in the study. You may keep a copy of this form for your records.

If you do not agree to be in this study or if at any time you withdraw from this study you will not suffer any penalty or lose any benefits to which you are entitled. Your participation is completely up to you. Your decision will not affect your ability to get health care or payment for your health care. It will not affect your enrollment in any health plan or benefits you can get.

We may decide to have you stop being in the study even if you want to stay. Some reasons this could happen are if staying in the study may be bad for you, or if the study is stopped.

Questions

The investigator or a member of the research team will try to answer all of your questions. If you have questions or concerns at any time, contact Evan M. Pucillo, PT, DPT at XXXXXXXXXX.

You may also call XXXXXXXXXXXX or email XXXXXXX.edu. You will be talking to Dr. XXXXX, the chairperson of the IRB. The IRB is a group that helps monitor research. You should call or email the IRB if you want to find out about your rights as a research subject. You should also call or email if you want to talk to someone who is not part of the study about your questions, concerns, or problems.

By agreeing to be in this research, you are indicating that you have read this form (or it has been read to you), that your questions have been answered to your satisfaction, and that you voluntarily agree to participate in this research study. By clicking the link below to complete the LASSI you agree to the elements of the informed consent as outlined above in this document.

Follow the instructions listed on the website and complete all 60 items. DO NOT list your first and last name, instead list your student ID number. Be sure to answer them honestly. This process should not take more than 15 minutes. A score report will be immediately generated and emailed to you for your records. You may save the report to your computer. The LASSI website offers explanations on how to interpret your scores and suggestions for improvement.

Appendix D: Host Institution – Letter of Approval to Conduct Study

24 May 2019

Dr. Evan M. Pucillo

Re: Research Permission

Dear Dr. Pucillo,

At your request, you are given permissions to complete the research project entitled, "The predictive nature of the Learning and Study Strategies Inventory in online physical and occupational therapy education".

To complete this project, you are requesting access to the following resources:

- The use of a University owned laptop computer to collect and store data
- The use of University printers
- The use of the University's SPSS subscription to analyze data
- The use of the University's Adobe suite subscription to generate tables and figures of results
- The use of the University's registrar professional GPA data of student record

You are granted permission to utilize these resources.

I wish you much success in your upcoming research project, and hope to learn of your results in the near future.

Sincerely,

Cindy Mathena, PhD, OTR/L
Dean of Post Professional Studies
Campus Director

Appendix E: Liberty University Informed Consent

CONSENT FORM

The predictive nature of learning and study strategies in online physical and occupational therapy education

Evan M. Pucillo
Liberty University
School of Education

You are invited to be in a research study on the predictive ability of learning and study strategies. You were selected as a possible participant because you are an occupational therapy or physical therapy student on the Austin, Miami, or San Marcos campuses. Please read this form and ask any questions you may have before agreeing to be in the study.

Evan M. Pucillo, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to examine the ability of the Learning and Study Strategies Inventory (LASSI) to accurately predict first-term GPA.

RQ1: How accurately are the ten scales of the LASSI able to predict first-term professional GPA for physical and occupational therapy students enrolled in an online curriculum?

RQ2: How accurately are the three components of the LASSI able to predict first-term professional GPA for physical and occupational therapy students enrolled in an online curriculum?

Procedures: If you agree to be in this study, I would ask you to do the following things:

1. Follow the log-on instructions to navigate to the LASSI measurement.
2. Complete the 60-item LASSI measurement online. (~12 minutes)
3. Navigate to the website to "claim your reward" for completing the procedures.

Risks: The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

Benefits: Participants should not expect to receive a direct benefit from taking part in this study. Benefits to society include a better understanding of the learning and study strategies that are related to academic outcomes in physical and occupational therapy students.

Compensation: Participants will be compensated for participating in this study. The first 150 participants to complete the study procedures may be eligible to collect a $10 gift card. Email addresses will be requested for compensation purposes, however they will be pulled and separated from your responses https://www.surveymonkey.com/r/NFYQLHR to maintain anonymity.

Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.

- Participants will be assigned instructed to use their student ID number instead of first and last names when completing the LASSI. Student ID numbers will be used to link LASSI records to GPA at the conclusion of the first term.
- Data will be stored on a password locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
- I understand that my name and email address may be provided to the business office of XXXXXX for the purpose of facilitating payment to me for participating in this study.

Conflicts of Interest Disclosure: The researcher serves as professor at the resident doctor of physical therapy program FL campus. To limit potential conflicts the study will be anonymous, so the researcher will not know who participated and a research assistant will ensure that all data is stripped of identifiers before the researcher receives it. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

The researcher has a financial interest in the outcome of this study. This study is funded by the internal scholarship award for 2020 and is providing funds for the study operations. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

Contacts and Questions: The researcher conducting this study is Evan M. Pucillo. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at or XXX. You may also contact the researcher's faculty chair, Dr. Ellen L. Black, at XXX.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature of Participant	Date
Signature of Investigator	Date

Appendix F: Host Institution Recruitment Letter

January 10th, 2020

You are receiving this letter because you are a Master of Occupational Therapy, Doctor of Occupational Therapy, or Doctor of Physical Therapy student on the Austin, Texas, Miami, Florida, or San Marcos, California campus and are eligible to complete a voluntary research study. You will be asked to complete the Learning and Study Strategies Inventory (LASSI), a quick ~10 minute online self-assessment that can help you understand more about how you approach learning. You will receive a score report that displays your proficiency on ten scales of learning. This information may help you plan your approach to maximize learning potential. Please refer to the informed consent document for information regarding this study and how to participate. A separate document describes how to log into the LASSI measurement and take the assessment at your earliest convenience.

The first 150 participants to enroll and successfully complete the LASSI measurement will be eligible to claim a $10 gift card. Participation is strictly voluntary, you may withdraw at any time, and will not impact your academic standing whatsoever at USAHS.

Thank you for considering being a participant in this study!

Principal Investigator:
Evan M. Pucillo, PT, DPT

Appendix G: Liberty University Recruitment Letter

January 10th, 2020

Dear student:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a Doctor of Education degree. The purpose of my research is to examine the predictive nature of the learning and study strategies inventory, and I am writing to invite you to participate in my study.

If you are 18 years of age or older, currently enrolled in first-term courses in the Master of Occupational Therapy, Doctor of Occupational Therapy, or Doctor of Physical Therapy on the Austin, TX, Miami, FL, or San Marcos, CA campuses, and are willing to participate you will be asked to complete a survey online called the Learning and Study Strategies Inventory (LASSI). It should take approximately 10-15 minutes to complete the procedures listed. Your student ID number will be requested as part of your participation, but the information will remain confidential.

To participate, go to:

https://www.surveymonkey.com/r/NFYQLHR

A consent document is provided as the first page you will see after you click on the survey link. The consent document contains additional information about my research. Please click on the survey link at the end of the consent information to indicate that you have read the consent information and would like to take part in the survey.

If you choose to participate, the **first 150 participants to enroll and successfully complete the LASSI measurement will be eligible to claim a $10 gift card.** Refer to the informed consent document and LASSI instructions to get started and participate in this study.

Sincerely,

Evan M. Pucillo, PT, DPT
Assistant Professor of Physical Therapy

Appendix H: LASSI Log-on Instructions

The predictive nature of the Learning and Study Strategies Inventory (LASSI) in the online education of physical and occupational therapy students

https://www.surveymonkey.com/r/NFYQLHR

INSTRUCTIONS FOR PARTICIPANTS

In a new webpage, please go to:

https://www.collegelassi.com/lassi/index.html

Read the instructions on how to answer the LASSI question items

Scroll down to → **First Administration**
Enter school #: **81494**
User name: **mxgk**
User password: **g53w**
Click → Submit

Enter your Student ID number in the First and Last name boxes
Enter your email if you wish to receive a copy of your score report
Click → Continue
Complete all 60 LASSI items and submit your response

Follow the instructions and complete all 60 items. DO NOT list your first and last name, instead use your student ID number. This process should not take more than 15 minutes. A score report will be generated and emailed to you. You may save the report to your computer. The LASSI website offers explanations on how to interpret your scores and suggestions for improvement to help you learn in your courses at the XXXXXXX

That's it, you're done! Good luck in your courses!

CLAIM YOUR REWARD

The first 150 participants to enroll and successfully complete the LASSI measurement online will be eligible to claim a $10 gift card. Follow the link below after self-administering the LASSI measurement. You will be asked to verify your completion.

http://amazon.com/giftcardbalance_LASSI2020surveyUSAHS

Appendix I: Host Institution – IRB approval letter

To: Dr. Evan Pucillo– Principal Investigator

From: Jeffrey A. Rot, PT, DHSc

Date: October 10, 2019, – Exempt Review

Re: IRB EXEMPT Protocol Application

Your IRB application submitted entitled, "*The Predictive Nature of Learning and Study Strategies in Online Physical and Occupational Therapy Education"* falls under the Exempt Review category as listed in 45 CFR §46.

- This application was reviewed as exempt as written on October 10, 2019.
  - Exempt Category 45 CFR §46.104
- The protocol number is UR-1001-336.

Please note that any changes to the exempt protocol must be re-reviewed by the IRB committee.

As Chair of the Florida IRB, I have reviewed this protocol and determined that it qualifies as exempt per 45 CFR §46.104.

Appendix J: Liberty University IRB Approval Signature Page

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

December 11, 2019

Dr. Evan M. Pucillo
IRB Exemption 4042.121119: The Predictive Nature of Learning and Study Strategies in Online Physical and Occupational Therapy Education

Dear Dr. Evan M. Pucillo,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
>
> > (iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

LIBERTY
UNIVERSITY.
Liberty University | Training Champions for Christ since 1971