



The Use of Learning and Study Strategies Inventory (LASSI) to Investigate Differences Between Low vs High Academically Performing Medical Students

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Abstract

Objectives This study examines differences in the Learning and Study Strategies Inventory (LASSI) 10-subscale scores between low and high academically performing medical students relative to internal and external examinations.

Methods The LASSI instrument was administered to 180 medical students from three classes (2016, 2017, and 2018). To measure the strength of association between LASSI 10-subscale scores and performance on overall biomedical sciences and the United States Medical Licensing Examination (USMLE) Step 1, Pearson product-moment correlation analyses were performed. One-way ANOVA and Bonferroni post-hoc analyses were performed to identify statistically significant differences on LASSI scores between students grouped by quartiles according to their performance on USMLE Step 1 examination (external performance measure) and by their average letter grade in the overall biomedical sciences (internal performance measure).

Results Significant associations were observed between Anxiety, Motivation, and Test Strategies and students' performance on both overall biomedical sciences and USMLE Step 1 examinations. Anxiety, Motivation, and Test Strategies were different between "A" and "C" students in the overall biomedical sciences. Anxiety, Information Processing, Motivation, Selecting Main Idea, and Test Strategies were significantly different between the upper and lower quartiles in USMLE Step 1 student performance.

Conclusions Anxiety, Motivation and Test Strategies are the main LASSI subscales that were significantly different between high-performing and low-performing students for internal and external examinations. Interestingly, the same LASSI subscales Anxiety, Motivation, and Test Strategies were correlated with students' performance in internal and external examinations.

Keywords Study strategies · LASSI · Academic performance · USMLE step 1 examination

Introduction

In the increasingly competitive realm of higher education, student academic success is of paramount importance for all institutions, and poor academic outcomes can negatively impact the reputation of an institution [1]. Many studies have investigated the relationship between learning and study strategies to academic achievement [2–6]. Deficiencies in the areas of learning and study strategies contribute to academic difficulties in their preclinical years. It has been shown

that the Learning and Study Strategies Inventory (LASSI) subscales are correlated with academic performance for medical students [6–9]. However, little is known about the differences in learning and study strategies between low and high academically performing medical students.

The LASSI is a 10-subscale, 80-item survey instrument that assesses students' awareness and implementation of learning and study strategies [10–12]. LASSI is designed to collect noncognitive information for diagnostic purposes and to inform appropriate interventions in improving students' academic outcomes, evaluating of learning strategies interventions, and predicting of students' success. The LASSI 10-scale instrument includes three major components of strategic learning: skill, will, and self-regulation. Information Processing, Selecting Main Ideas, and Test Strategies are encompassed in the skill component of strategic learning. The will component of strategic learning includes Attitude, Motivation, and

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Anxiety, whereas the self-regulation component encompasses Concentration, Time Management, Self-Testing, and Study Aids [11].

Several studies have shown that the 10 LASSI subscales are associated with academic performance [4, 6–9, 13, 14]. However, few studies have examined the relationship between study strategies and medical students' performance in internal and external examinations [4, 7–9]. The subscale concentration was found to be the only study strategy to predict success in Step 1 performance [7]. The LASSI subscales Concentration, Anxiety, Selecting Main Idea, and Test Strategies were found to be significant predictors of performance in National Board of Chiropractic Examiners (NBCE) [14]. Time Management and Self-Testing were observed to be strong predictors of medical students' performance in their first semester [6]. Schutz and colleagues [13] found significantly higher performances on the LASSI subscales Anxiety, Attitude, Motivation, Concentration, Selection Main Ideas, and Test Strategies in students with high GPAs compared to students with a low GPA. Despite these findings, little is known about the differences in learning and study strategies between low and high academically performing medical students relative to internal and external examinations.

The overall research goal of this study is to investigate the optimal use of LASSI for identifying the characteristics of medical students and their support needs and for the planning and implementation of learner-specific interventions. Specifically, the study examines the strength of association between the 10 LASSI subscales and performance on overall preclinical biomedical science and USMLE Step 1. Furthermore, the difference in LASSI subscale scores between students of different academic performance levels in internal and external examinations is examined. The study was guided by following research questions:

1. Is there a relationship between the 10 LASSI subscale scores and student performance on overall preclinical biomedical sciences and USMLE Step 1 examinations?

Hypothesis 1: There is an association between the scores of the 10 LASSI subscales and students' performance on overall preclinical biomedical sciences and USMLE Step 1 examinations

2. Is there a difference in LASSI subscale scores between students of different academic performance levels?

Hypothesis 2a: There is a difference in LASSI subscale scores between higher and lower academically performing students (earned letter grade of A versus C) in the overall biomedical sciences (i.e., internal performance measure).

Hypothesis 2b: There is a difference in LASSI subscale scores between students in the upper and lower quartile of academic performance on the USMLE Step 1 examination (i.e., external performance measure).

Methods

Participants

The sample consisted of a total number of 180 medical students (class of 2016 = 52 students; class of 2017 = 53 students; and class of 2018 = 75 students) in their preclinical years at the University of South Carolina School of Medicine Greenville. Participants were 56% female and 44% males. Their ages ranged from 21 to 34 years with an average age of 23 years. Students' pre-matriculation characteristics included an average MCAT of 67th percentile and an average undergraduate GPA of 3.65. The national average GPA for enrolled medical students in 2017–2018 academic year was 3.71 [15]. Collection of this data was approved by the Institutional Review Board of the University of South Carolina.

Educational Context

The curriculum at the University of South Carolina School of Medicine Greenville is an integrated curriculum, which blends basic and clinical sciences. The first year of medical school (M1) begins with Emergency Medical Technician (EMT) training followed by interdisciplinary foundational principles, which includes the following basic science modules: Foundations of Medicine, Structure and Function of the Human Body Part 1 & 2, Neuroscience, and Defenses & Responses. In addition to these modules, running throughout M1 year is the Integrated Practice of Medicine (IPM) module, which fosters clinical reasoning skills. The organ systems modules of the second year of medical school (M2) year teach the mechanisms and management of disease. These basic science modules are Biomedical Principles of Disease Therapy, Hematology/Oncology, Mind, Brain & Behavior, Cardiovascular/Pulmonary/Renal, GI/Hepatic, Endocrine & Reproductive, and Musculoskeletal/Dermatology/Rheumatology. Similar to M1 year, IPM module is delivered across the entire M2 year. However, as IPM in the M1 and M2 years does not access basic science content, scores associated with these modules are not included in this analysis.

Instrument

The Learning and Study Strategies Inventory (LASSI) is an 80-item inventory that contains 8 items for each of the 10 LASSI subscales. Description of the LASSI 10-subscale by Weinstein and Palmer [11] is summarized in Table 1. Participants answer each item on a 5-point Likert scale wherein 1 = not at all like me, 2 = not very much like me, 3 = somewhat like me, 4 = fairly much like me, and 5 = very much like me. The reliability of LASSI subscales is

Table 1 The scale and its description for the LASSI (Weinstein, Palmer, and Schulte, 2002)

Scale	Description
ANX	Anxiety and worry about school performance
ATT	Attitude and interest
CON	Concentration and attention to academic tasks
INP	Information processing, acquiring knowledge, and reasoning
MOT	Motivation, diligence, self-discipline, and willingness to work hard
SFT	Self-testing, reviewing, and preparing for classes
SMI	Selecting main ideas and recognizing important information
STA	Use of support techniques and materials
TMT	Use of time management principles for academic tasks
TST	Test strategies and preparing for tests

Note: *ANX* anxiety; *ATT* attitude; *CON* concentration; *INP* information processing; *MOT* motivation; *SFT* self-testing; *SMI* selecting main ideas; *STA* study aids; *TMT* time management; *TST* test strategies

measured by Cronbach's alpha of 0.73–0.89 and demonstrates good validity [2, 11].

Data Collection

The LASSI instrument was administered to the 180 medical students during orientation at the beginning of M2 year for the three classes. Biomedical sciences performance during the preclinical years (M1 and M2), which includes all basic science content delivered during the first 2 years of medical school, was extracted for these students. Because the preclinical curriculum is organized into modules of varying lengths, students' performances in each module were weighted based on the module duration relative to the duration of the academic year. All the weighted values were then averaged for each student. USMLE Step 1 examination scores were also collected for all three classes.

Data Analysis

Data were analyzed using IBM Statistical Package for the Social Sciences (SPSS) software (IBM Corporation, Armonk, NY, USA). To measure the strength of association between the LASSI 10-subscale scores and performance on overall biomedical sciences and USMLE Step 1, Pearson product-moment correlation analyses were performed. One-way ANOVA and Bonferroni post-hoc analyses were performed to identify statistically significant differences on LASSI 10-subscale scores between students grouped by A, B, and C letter grades according to their performance on overall biomedical sciences and grouped by quartiles according to their performance on USMLE Step 1 examination.

Results

There were significant associations between Anxiety, Motivation, and Test Strategies and students' performance in both internal preclinical (overall biomedical science at the end of M2 year) and external (USMLE Step 1) examinations (Table 2). In addition to these subscales, significant associations were also found between Concentration, Self-Testing, and Time Management and biomedical sciences performance and between Information Processing and Selecting Main Ideas and USMLE Step 1 performance.

When comparing study and learning strategies between high and low academically performing students (A vs. C and upper vs. lower quartiles) in the overall biomedical sciences, the LASSI subscales Anxiety, Motivation, and Test Strategies were significantly different between students earning a letter grade of an "A" versus students earning a letter grade of a "C" (Table 3). Meanwhile, the LASSI subscales Anxiety, Information Processing, Motivation, Selecting Main Idea, and Test Strategies were significantly different between the upper and lower quartiles in USMLE Step 1 performance (Table 4). Therefore, Anxiety, Motivation, and Test Strategies were significantly different between high- and low-performing students for both internal (overall biomedical sciences) and external academic performance measures (USMLE Step 1 examination). Interestingly, these LASSI subscales (Anxiety, Motivation, and Test Strategies) were correlated with students' performance for internal and external examinations, and they are the same subscales that were

Table 2 Strength of association between the 10 LASSI subscales and performance on overall preclinical biomedical sciences and USMLE Step 1 examinations

Scale	Biomedical sciences		USMLE step 1	
	<i>(N</i> = 173)		<i>(N</i> = 172)	
	<i>r</i> value	<i>p</i> value	<i>r</i> value	<i>p</i> value
ANX	0.19	0.014*	0.31	< 0.001**
ATT	0.10	0.187	0.07	0.351
CON	0.21	0.007**	0.14	0.065
INP	0.08	0.319	0.21	0.005**
MOT	0.35	< 0.001**	0.18	0.020*
SFT	0.15	0.045*	0.12	0.118
SMI	0.13	0.080	0.23	0.002**
STA	−0.08	0.270	−0.08	0.276
TMT	0.17	0.022*	0.12	0.109
TST	0.37	< 0.001**	0.38	< 0.001**

Note: *ANX* anxiety; *ATT* attitude; *CON* concentration; *INP* information processing; *MOT* motivation; *SFT* self-testing; *SMI* selecting main ideas; *STA* study aids; *TMT* time management; *TST* test strategies. **p* < 0.05; ***p* < 0.01 (2-tailed)

Table 3 Comparison of LASSI 10-subscale scores based on overall biomedical sciences performance letter grades A, B, and C

Scale	“A” students mean scores (<i>N</i> = 61)	“B” students mean scores (<i>N</i> = 98)	“C” students mean scores (<i>N</i> = 14)	<i>F</i>	<i>P</i>	Bonferroni test
ANX	69.57	64.25	46.57	4.68	0.011	(A,C)**;(B,C)*
ATT	55.59	44.53	48.29	3.40	0.036	(A,B)*
CON	54.03	40.43	42.86	4.89	0.009	(A,B)**
INP	73.36	62.49	67.86	4.19	0.017	(A,B)*
MOT	74.30	59.33	46.07	10.49	<0.001	(A,C)**; (A,B)**
SFT	61.16	49.83	56.43	3.46	0.034	(A,B)*
SMI	58.52	49.41	52.21	2.43	0.091	
STA	50.95	43.36	56.43	2.01	0.138	
TMT	66.25	52.96	57.93	3.88	0.023	(A,B)*
TST	70.74	57.05	42.57	12.33	<0.001	(A,C)**;(A,B)**

Note: *ANX* anxiety; *ATT* attitude; *CON* concentration; *INP* information processing; *MOT* motivation; *SFT* self-testing; *SMI* selecting main ideas; *STA* study aids; *TMT* time management; *TST* test strategies. **p* < 0.05 (2-tailed), ***p* < 0.01 (2-tailed)

significantly different between low- and high-performing students in terms of A and C grades and upper and lower quartiles.

Discussion

The results of this study support the research hypotheses outlined herein. Significant differences exist in the LASSI 10-subscale scores relative to the levels of academic performance. Several LASSI subscales are significantly correlated with the level of students' success when examined relative to internal (overall biomedical sciences performance) and external (USMLE Step 1 examination performance) examinations. Significant associations were observed between Anxiety, Motivation, and Test Strategies and students' performance in both internal and external examinations. In terms of

distinguishing high and low academically performing students, for internal examinations, Anxiety, Motivation, and Test Strategies significantly differed between students receiving an “A” and students receiving a “C,” while Anxiety, Information Processing, Motivation, Selecting Main Idea, and Test Strategies significantly differed between the upper and lower quartiles in external examination (USMLE Step 1).

Interestingly, when the LASSI 10-subscale scores were correlated with students' performance in both examinations, and in terms of distinguishing academically high- and low-performing students, the LASSI subscales Anxiety, Motivation, and Test Strategies repeatedly exhibited significance. Previous studies indicated that Anxiety and Test Strategies were also found to be significant predictors of academic achievement [8, 14, 16, 17]. A study by Sleight and Mavis [4] found that students who scored higher in Medical College Admission Test (MCAT) also scored higher on

Table 4 Comparison of LASSI 10-subscale scores based on USMLE Step 1 performance quartiles: 1 = 0–25%; 2 = 26–50%; 3 = 51–75%; 4 = 76–100%

Scale	“0–25%” mean (<i>N</i> = 45)	“26–50%” mean (<i>N</i> = 45)	“51–75%” mean (<i>N</i> = 41)	“76–100%” mean (<i>N</i> = 43)	<i>F</i>	<i>P</i>	Bonferroni test
ANX	52.69	65.93	72.02	69.44	5.16	.002	(1,3)**; (1,4)*
ATT	47.67	43.09	50.63	54.21	1.42	.239	
CON	42.04	43.27	42.88	54.44	2.01	.115	
INP	62.44	59.87	67.44	77.91	5.45	.001	(1,4)**; (2,4)**
MOT	58.09	59.20	64.41	73.07	3.07	.029	(1,4)*
SFT	50.47	50.69	55.66	60.58	1.40	.245	
SMI	44.04	52.67	53.34	61.95	3.79	.012	(1,4)**
STA	51.36	44.84	45.71	46.49	0.43	.733	
TMT	56.27	53.20	57.20	66.42	1.62	.187	
TST	46.69	63.36	63.17	70.58	9.43	.000	(1,2)**; (1,3)**; (1,4)**

Note: *ANX* anxiety; *ATT* attitude; *CON* concentration; *INP* information processing; *MOT* motivation; *SFT* self-testing; *SMI* selecting main ideas; *STA* study aids; *TMT* time management; *TST* test strategies. **p* < 0.05 (2-tailed), ***p* < 0.01 (2-tailed)

Motivation and Concentration when compared to those with low and medium MCAT scores. The LASSI subscale Motivation is grouped with effort-related activities (Motivation, Attitude, Time Management, and Concentration [18, 19]) and affective strategies (Attitude, Concentration, Motivation, and Time Management [16]), which were both found to be linked to academic performance.

Medical education is inherently stressful, and academic stress is associated with academic performance [20]. The competitive environment of higher professional education can also leave medical students vulnerable to anxiety and lack of motivation. Park and colleagues [21] have developed a path analysis model, which indicated that motivation, academic performance, and stress form a feedback loop (i.e., they are associated with one another). Additional studies also showed a relationship between academic stress and motivation [22, 23]. While learning can be enhanced by optimal stress levels, excess stress level can negatively affect academic achievement, and stress management increases motivation in students [21]. Indeed, Green et al. [24] reported that anxiety is negatively correlated with performance in Step 1 examination. A review by Dyrbye et al. [25] on medical students' psychological distress (depression, anxiety, burnout) found that medical students' anxiety is greater than their age-matched peers in the general population. Ahmed et al. [26], meanwhile, noted that student anxiety was experienced greatest during the second year of medical school.

In terms of addressing anxiety, Sohail [27] found that students use a combination of coping strategies to cope with stress. These strategies can be categorized into problem-solving (e.g., discussion with peers) and emotion focused (e.g., walking, exercising, etc.). However, higher levels of academic success were achieved via the problem-solving strategy [28]. Supplements may also offer some benefits to anxiety symptoms experienced in medical students. A randomized controlled trial utilizing first and second year medical students found supplementation of omega-3 to be associated with a reduction in anxiety symptoms, suggesting that such simple dietary interventions may have anxiolytic benefits for individuals without an anxiety disorder diagnosis [29].

The volume and pace of content delivery in medical school may serve to unmask insufficiencies, such as test strategies, which in turn result in poor academic performance. The Test Strategies scale in LASSI assesses knowing about test-taking and test preparation strategies (e.g., the characteristics of different types of tests, reasoning process to reach an answer). Unsurprisingly, at the undergraduate level, students having academic difficulty (i.e., grade point average (GPA) < 2.5) also had weaknesses in Test Strategies, as well as Anxiety compared to higher academically performing students [30]. Haghani and Sadeghizadeh [31] found that interventional approaches such as 20-h workshops focusing on such factors as theories of learning, metacognition, study planning techniques, and information processing theory produced significantly improved post-

workshop LASSI test strategy scores. Teaching students self-regulation strategies and having them practice in-class have also been found to help students manage their learning [32].

Limitations of the Study

The main limitation of this study is that it is based on self-reported data, which may not accurately reflect the learning and study strategies utilized by the medical students. However, comparing internal and external results in conjunction with correlating LASSI subscales with students' performance would enhance the validity of the results. Although this study attempted to enhance the self-reported nature of LASSI instrument, all data was derived from a single institution, which could potentially influence the generalization of the study findings. In order to improve the external validity of the study findings, similar studies should be conducted in other medical institutions.

Conclusion

This study utilizes LASSI subscales to investigate the relationship between learning and study strategies and the academic performance of medical students in internal and external examinations. A significant relationship was found between Anxiety, Motivation, and Test Strategies and the academic performance of high and low academically performing medical students during their preclinical years. This indicates that high anxiety, lack of motivation, and the lack of testing strategies' skills are associated with poor academic performance. Identifying these deficiencies and developing appropriate coping strategies tailored to the individual needs of the student are necessary to improve student learning outcomes.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The study was approved by University of South Carolina Institutional Review Board.

Informed Consent NA, only retrospective data were analyzed.

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