Creation and Validation of the Multi-Stakeholder Survey of Learning Environments (MSSLE) for Medical Schools

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Degree
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Dedication

This is dedicated to my parents, Teresa and Kevin, who have always been my rock of support. Also, to Papaw for supporting me through my writing process and providing me with the two most important things: a physical space to write and snacks.

Acknowledgement

I would like to thank my entire dissertation committee for the generosity and support they provided throughout this process: Gary Skolits, James McIntyre, Louis Rocconi, and Mitsunori Misawa. I would also like to thank those who provided guidance and expertise in this research endeavor: Charles Waller, Sondra LoRe, Robin Taylor, Cayla Teal, Michael Dewsnap, Amy Waer, Stacey Rose, Anne Christian, Astha Mittal, and Sam Lyons. Finally, I would like to thank the University of Tennessee – Knoxville Graduate School for their flexibility during a global pandemic, which allowed me to complete my dissertation and defend, regardless of the extraneous circumstances.

Abstract

Instruments have been designed to measure medical students' perspectives of various aspects of the learning environment (Roff, 2005; Rusticus, Worthington, Wilson, & Joughin, 2014) and to measure junior faculty perspectives (Roff, Mcaleer, & Skinner, 2005). However, there is not currently a validated instrument that measures these attributes across various stakeholder groups. The accrediting body for medical schools in the United States, LCME (March 2018), requires that the medical school learning environment promote appropriate professional behaviors for not only medical students, but for faculty and staff as well. This clarifies the need to assess the learning environment for medical students, faculty, and staff. While previous studies focused primarily on the perspectives of medical students, faculty and staff are also consumers of the learning environment. It is imperative that we ensure equitable environments among these constituency groups (Philibert, Elsey, Fleming, & Razack, 2019) and ongoing assessment should be part of an institution's best practices (Soemantri, Herrera, & Riquelme, 2010).

This quantitative research study is aimed at gaining a deeper understanding of the learning environment of medical schools, across a holistic group of constituents. First, a 27-item Likert scale instrument was formulated and assessed by an expert panel to establish evidence of content validity. Data were collected utilizing the Qualtrics survey software program from medical students, faculty, and staff at a public medical school in the southcentral region of the United States. Psychometric analyses of the data included a review of individual item descriptive statistics, as well as an examination of the

instrument's validity using factor analysis procedures. Results indicated that a parsimonious, two-factor model measuring: i) the general learning environment and ii) knowledge of policies and procedures showed evidence of being valid and reliable for measuring concurrent, multi-stakeholder perceptions of the learning environment at the medical school.

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Chapter 1

Introduction

While medical education serves as a catalyst for training future physicians, the learning environment in which these students are educated is acknowledged to have a critical role in developing their future identities as physicians (Shochet et al., 2015). This study will focus on the perceptions of the medical school learning environment from medical students, faculty, and staff in a medical school. For the purpose of this study, the learning environment for students was defined by Shochet et al. (2015) as "the physical, social, and psychological contexts in which medical students learn and grow professionally, and it influences how students develop behaviors and form identities as future physicians" (p. 810).

The average cost for a medical education in the United States at a public university is approximately $240,351 (Marcu, et al., 2017). This averages out to be over $60,000 per year for medical school. While the literature indicates that achievement in higher education is associated with the learning environment (Lizzio, Wilson, & Simons, 2002) if students leave medical school without finishing their education, it will be extremely costly to them, and yet they will lack a medical degree. It is imperative to recognize that the learning environment in which students learn can have a significant impact on students' wellbeing (Dyrbye, et al., 2009; Pai, 2014; Stanton, Zandvliet, Dhaliwal, & Black, 2016). Conversely, a learning environment also can have negative effects on the wellbeing of medical students (Slavin, Schindler, & Chibnall (2014). This is further highlighted by research pointing to the relationship between a subpar learning

environment and increased student burnout and stress (Karani, 2015). Moreover, due to the known relationship between medical student's resilience levels and their perception of the learning environment, it is imperative to ensure a positive learning environment to prevent students from accruing a financial burden only to withdraw from medical school before graduating (Tempski, et al., 2015). Dyrbye, et al. (2010) echoes this assertion, stating: "Burnout was associated with self-reported unprofessional conduct and less altruistic professional values among medical students" (p. 1173).

Another main focus in medical education, specifically around the learning environment in which physicians are being trained, is professionalism (LCME, 2019). Cruess, Cruess, Boudreau, Snell, & Steinert (2014) highlight this concern not only for medical students, but the medical profession in general by stating: "The assessment of the professionalism of medical students, residents, and faculty remains a major issue for both the educational establishment and for the profession" (p. 1449), giving credence to the creation of the instrument being addressed in this study which will include multiple constituencies. This is especially relevant given the great impact that the learning environment has on the success of medical students (Nagraj, Wall, & Jones, 2006). Additionally, professionalism can also be seen as a reflection on the culture of the institution (Smith, Saavedra, Raeke, & O'Donell, 2007).

Statement of the Problem

While there currently are instruments to measure various aspects of the educational and learning environments for medical students (Roff, 2005; Rusticus, Worthington, Wilson, & Joughin, 2014) and for junior faculty (Roff, Mcaleer, & Skinner,

2005), there is not currently a validated instrument that does this across various stakeholder groups. The Liaison Committee on Medical Education (LCME), an accrediting body for medical schools in the United States, emphasizes the importance of examining and evaluating the educational environment. Traditionally, this has been a focus for collecting data from the perspectives of medical students; however, there are also other consumers of the medical school learning environment such as faculty and staff, and it is imperative that we ensure assessing the environments from the perspective of these constituency groups (Philibert, Elsey, Fleming, & Razack, 2019). Assessing perspectives of the learning environment from these constituency groups should also become part of an institutions best practices to measure the learning environment regularly (Soemantri, Herrera, & Riquelme, 2010).

Purpose of the Study

The purpose of this study was to develop an instrument capable of offering a genuine understanding of the medical school learning environment from the unique perspectives of students, faculty, and staff at a public medical school in the Southcentral region of the United States. Additionally, the creation and validation of an instrument that measures the perception of the learning environment from medical students, faculty, and staff would help institutions meet current accreditation requirements by the LCME.

Research Question

In order to further understand the learning environment in a holistic way, this study focused on answering one main research question:

1. To what extent is the proposed instrument valid and reliable for measuring the learning environment at a medical school?

Hypothesis

1. The Multi-Stakeholder Survey of Learning Environments will be a valid and reliable instrument to measure perceptions of the learning environment from medical students, faculty, and staff at medical schools.

Significance of the Study

This study had significance to the medical education community by filling a substantial gap in the literature. In assisting to help fill this gap in the literature, intuitions will be provided with a reliable instrument to systematically collect data regarding the perceptions of the learning environment from the multiple constituency group. While this is most notably helpful in meeting accreditation requirements, this significance of this instrument also allows medical schools the ability to track learning environment perceptions longitudinally. Thus, allowing stakeholders and administration the ability to make data informed decisions based on perceptions of the medical students, faculty, and staff at the institution.

Assumptions

There are several assumptions that were considered in this research study. It was assumed that all participants that were sent the survey to complete were either currently enrolled as medical students at the institution, were employed or affiliate staff at the medical school, or were employed or affiliated faculty at the medical school. It is also

assumed that the participants answered the survey honestly and truthfully, as well as were reflective of only their experiences in the medical school context.

Limitations

There were several limitations that were encountered during this research study. First, participants were all enrolled at, employed at, or associated with one institution in the Southcentral region of the United States. Therefore, while the goal of this instrument is to be a valid and reliable measure of the perceptions of the learning environment, generalizability should be considered due to the sample being from one institution. Additionally, sample size is another limitation in this study. While the sample size was acceptable to conduct Confirmatory Factor Analysis (CFA) (Kline, 2011), the sample was not large enough to randomly split and conduct both Exploratory Factor Analysis (EFA) and a CFA. Another limitation is the power differential that exists between physician educators (faculty) and medical students and staff. While participants were informed that their responses would be anonymous, it is still often difficult for students to report sensitive topics, especially around breaches in professionalism and if they've been mistreated when the students will be relying on the faculty for grades and possibly for placement into a residency after medical school. The final limitation that should be mentioned is the possibility of measurement invariance due to the various populations included in the study (students, faculty, and staff), and the inability to test for this due to sample size constraints. Measurement invariance is defined as whether items are measuring the same construct, even among different groups (Kline, 2011).

Conceptual and Operational Definitions

The following definitions were used throughout this research study and are provided to help guide the reader accordingly:

AAMC GQ

"The GQ was first administered in 1978 and is an important tool for medical schools to use in program evaluation and to improve the medical student experience. The GQ includes questions related to:

- Pre-clinical, clinical, and elective experiences
- General medical education and readiness for residency
- Student services
- Experiences of negative behaviors
- Financial aid and indebtedness
- Career intentions
- Strengths of the medical school and areas that need improvement" ("Graduation Questionnaire (GQ)", 2019)

Learning Environment (students)

"The medical school learning environment (LE) comprises the physical, social, and psychological contexts in which medical students learn and grow professionally, and it influences how students develop behaviors and form identities as future physicians." (Shochet et al., 2015, p. 810)

Learning Environment (faculty)

"The environment for faculty consists of physical, social, and psychological contexts in which faculty work that oftentimes includes teaching, research, and administration that contributes to the education of medical and graduate students." (Dewsnap, 2019)

Learning Environment (staff)

"The environment for staff consists of physical, social, and psychological contexts in which staff work that can include teaching and research which contributes to the education of medical and graduate students." (Dewsnap, 2019)

Mistreatment

"Mistreatment, either intentional or unintentional, occurs when behavior shows disrespect for the dignity of others and unreasonably interferes with the learning process. Examples of mistreatment include sexual harassment; discrimination or harassment based on race, religion, ethnicity, gender, or sexual orientation; humiliation, psychological or physical punishment and the use of grading and other forms of assessment in a punitive manner." (Fleit, Iuli, Fischel, Lu, & Chandran, 2017)

Professionalism

"Professionalism is demonstrated through a foundation of clinical competence, communication skills, and ethical and legal understanding, upon which is built the aspiration to and wise application of the principles of professionalism: excellence, humanism, accountability, and altruism." (Stern, 2006, p. 19)

Chapter Summary

Medical education is a multifaceted and complex educational endeavor (Woodruff, 2019). While the goal of medical education is to produce physicians for entry into the healthcare system, they "must possess the attributes that are necessary to meet their individual and collective responsibilities to society" ("Learning Objectives for Medical Student Education", 1999). Jorm & Roberts (2018) emphasize the importance of competent and prepared physicians, stating: "Health care systems require a workforce of competent doctors who are well prepared to provide high-quality care" (p. 399). As described throughout chapter one, several factors lead to accomplishing this goal, specifically as it relates to the learning environment of medical schools and helping students develop their professional identities (Schocket et al., 2015), such as well wellbeing (Dyrbye, 2009) and burnout and stress (Karani, 2015). Therefore, the goal of this research was to help institutions in assessing the learning environment to ensure its adequacy across three essential constituency groups: medical students, faculty, and staff.

Chapter 2

Literature Review

The literature review will be guided by four overarching areas: i) discussing the theoretical frameworks for this study, Schlossberg's Transition theory and Learning Organization theory; ii) validity of an instrument and a description of content and construct validity; iii) description of the medical education context; and iv) various aspects of a learning environment in medical schools and the curricular elements in which it entails, including a review of currently existing learning environment instruments.

Theoretical Framework

Schlossberg's Transition Theory

Killam & Degges-White (2017) define transition as "an event that creates a disruption of roles, routine, and relationships for the individual experiencing the transition" (p. 24). Medical school is constantly evolving and shifting daily for students, faculty, and staff who are always in transition. Medical students are on rotations and can spend as little as a few hours with a faculty member in a clinic. They will be shifted through clinical rotations, encountering many different faculty, residents, staff, other medical students, nurses, medical assistants, etc. This is also true from the perspective of faculty and staff, they will be encountering an endless rotation of different medical students, and patients, throughout their rotations and careers in academic medicine.

The first lens to guide this work, and to better help understand the learning environment of the fast-paced landscape of medical school is Schlossberg's Transition

theory. Schlossberg's theory (Figure 1) will guide this work by utilizing the Four S's: situation, self, support, and strategies.

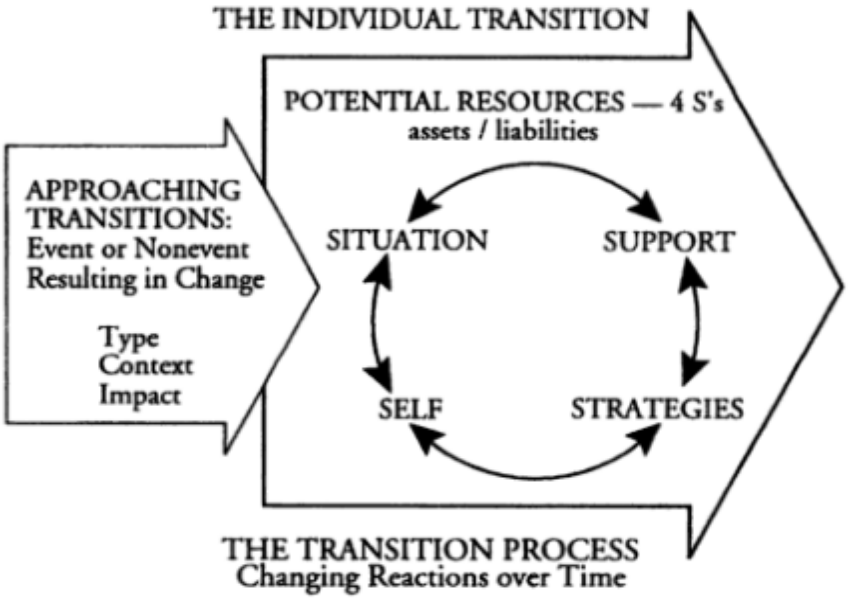


Figure 1: The Transition Framework: The Individual Transition by Schlossberg, Waters, & Goodman (1995).

The Four S's of Schlossberg's transition theory are easily adapted to the medical school environment and the experiences of medical students, faculty, and the staff that work with these medical students.

1. **Situation** – In this context, the situation is the multifaceted and numerous transition periods that are experienced in medical schools. Students will move through their clinical rotations every 4-8 weeks, working with various different faculty, residents, and staff. The same is true from the perception of the faculty and staff, as they will see an indefinite rotation and transition of medical students.
2. **Support** – In this context, support is the faculty and staff that work with the students tirelessly to help them throughout the educational process and encouraging the students.
3. **Self** – Part of medical education and the learning environment that they train in is helping the students develop their future identities as physicians (Shochet et al, 2015). Additionally, students are developing their identities as physicians, as well as faculty developing their identities as physician educators.
4. **Strategies** – In the context of medical education, students will face many different experiences working in breadth of healthcare systems (Villiers, et al., 2017). This can include the classroom, various different hospitals, Veterans Affairs (VA) hospitals, and community-based clinics. Therefore, the strategies students, faculty, and staff utilize to navigate these experiences will be critical for student success. The different strategies used could include: i) modifying the

> situation; ii) changing meaning of the situation; iii) controlling and managing the situation; or iv) taking deliberate inaction (Schlossberg, 2008).]

Shochet et al. (2015) states that "The medical school learning environment (LE) comprises the physical, social, and psychological contexts in which medical students learn and grow professionally, and it influences how students develop behaviors and form identities as future physicians (p. 810). While this definition would incorporate the physical spaces that are encountered in the medical school environment, it also includes the social aspect of the students, faculty, and staff's interaction amongst one another. Lastly, it encompasses the psychological aspect as well, which Caverzagie, Goldenberg, & Hall (2019) describe as "psychological safety is defined as individuals' perceptions that they can speak out in the learning or working context without consequences for their professional standing or risks to their status on work teams or groups" (p. 1). These ideas of the physical and social aspects of the learning environment are reflective of transition theory, and allows the research and understand transition theory to guide further understanding of the learning environment at medical schools.

Learning Organization Theory

The second lens guiding this research was Senge's learning organization theory. In the book *The Fifth Discipline,* the originator of the learning organization theory states the following:

> "The tools and ideas presented in this book are for destroying the illusion that the world is created of separate, unrelated forces. When we give up this illusion – we can then build "learning organizations," organizations where people continually

> expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together" (Senge, 1994, p. 3).

In the above passage, Senge discusses the importance of a system of people coming together for a shared meaning and work together. Healthcare has a major focus on teamwork (Lerner, Magrane, & Friedman, 2009) and can be easily guided by Senge's learning environment theory and framework. Senge describes five disciplines that have emerged amongst organizations that will allow them to achieve their goals and aspirations.

1. **Systems Thinking –** The idea of systems thinking according to Senge, focuses on the idea of concentrating on the larger picture and not necessarily on individuals within the system. Healthcare, which includes medical education, is "provided within – and interacts with – a complex network of systems at the macro- and microlevel" (Colbert, Ogden, Ownby, & Bowe, 2011, p. 179), therefore is it vital to not only understand the complexities of the interactions at the micro level, but also at that macro, systems level as well (Senge, 1994).
2. **Personal Mastery –** Senge describes personal mastery as "a special level of proficiency" (Senge, 1994, p. 7). In medical education, the training and mastery of the content is what drives the curriculum, including learning objectives, required clinical experiences, self-directed learning, and lifelong learning (LCME, 2019). Additionally, the mastery of this content is not only expected, but it is also

required and mandated by the LCME (2019), who state “Medical education program objectives are statements of the knowledge, skills, behaviors, and attitudes that medical students are expected to exhibit as evidence of their achievement by completion of the program” (p. 8).

3. **Mental Models –** Mental models can also be thought of as schemas, which are “major knowledge structures influencing the way people acquire and store information” (Marshall, 1995, p.1). A large part of the medical education, and the medical profession in general, is to ensure that patients are treated equally (Chapman, Kaatz, & Carnes, 2013). Society as a whole is susceptible to negative schemas such as implicit biases, including medical students, faculty, and staff, however if gone unchecked long term, these can contribute to healthcare disparities (Chapman, Kaatz, & Carnes, 2013).
4. **Building Shared Vision –** Senge (1994) discusses the idea of building a shared vision stating the following: “When there is a genuine vision (as opposed to the all-too-familiar ‘vision statement’), people excel and learn, not because they are told to, but because they want to” (p. 9). This statement highlights the importance of ensuring that the entire medical school, including all of the stakeholders and constituency groups, are aligned in their vision for excellence in medical education.
5. **Team Learning -** In medical school, team based learning has become a popular approach to delivering the curriculum to medical students (Burgess, et al., 2017). The idea of the team learning starts with dialogue between the stakeholders and

also incorporates the ability to recognize the patterns of the interactions in the team (Senge, 1994).

Using a holistic interpretation of the learning environment, combined with Senge's learning organization theory, is echoed in a study Genn (2001), where the author states: "curriculum's most significant manifestation and conceptualization will be as the environment, educational and organizational, which embraces 'everything that is happening' in the medical school" (p. 338). The aim of the study will be to better understand an institution's learning environment. This is important because traditionally the learning environment has gone unnoticed without particular attention paid, unless problems arise, which in turn leads to an insufficient understanding of the learning environment (Gruppen, 2019). The learning environment is often incorporated into what is known as the hidden curriculum. (Hafferty, 1998) discusses the importance of the hidden curriculum in medical school, which he defines as "a set of influences that function at the level of organizational structure and culture" (p. 404). Essentially, this hidden curriculum encompasses the elements of the learning environment, such as culture, nomenclature, and slang that are neither formal nor informal curricular components, but hidden (Hafferty, 1998).

Karani (2015) emphasizes the importance and complexity of the learning environment by stating that "Despite the fact that the learning environment is a multifaceted and complex construct, a supportive environment promotes student wellness, facilitates professionalism and optimizes learning" (p. 1236).

Not only does the research emphasize the importance of the learning environment (Gruppen, 2019; Karani, 2015), the accreditation body for medical education in the United States, LCME standard 3.5 dictates the following in order to meet the accreditation requirements:

> "A medical school ensures that the learning environment of its medical education program is conducive to the ongoing development of explicit and appropriate professional behaviors in its medical students, faculty, and staff at all locations. The medical school and its clinical affiliates share the responsibility for periodic evaluation of the learning environment in order to identify positive and negative influences on the maintenance of professional standards, develop and conduct appropriate strategies to enhance positive and mitigate negative influences, and identify and promptly correct violations of professional standards" (p. 4).

Thus, it is not only imperative for institutions to explore there learning environment using the lens of learning organization theory, it is critical to the continued success and accreditation of that institution to continue awarding medical degrees.

By understanding the five disciplines and domains of the learning organization theory (Figure 2), it allows this research to be viewed in a more holistic approach, and see the interworking behaviors of the multi-stakeholder method. Thus, allowing a better understanding of how these various stakeholder groups' perceptions of their surroundings impact the underlying construct of the learning environment.

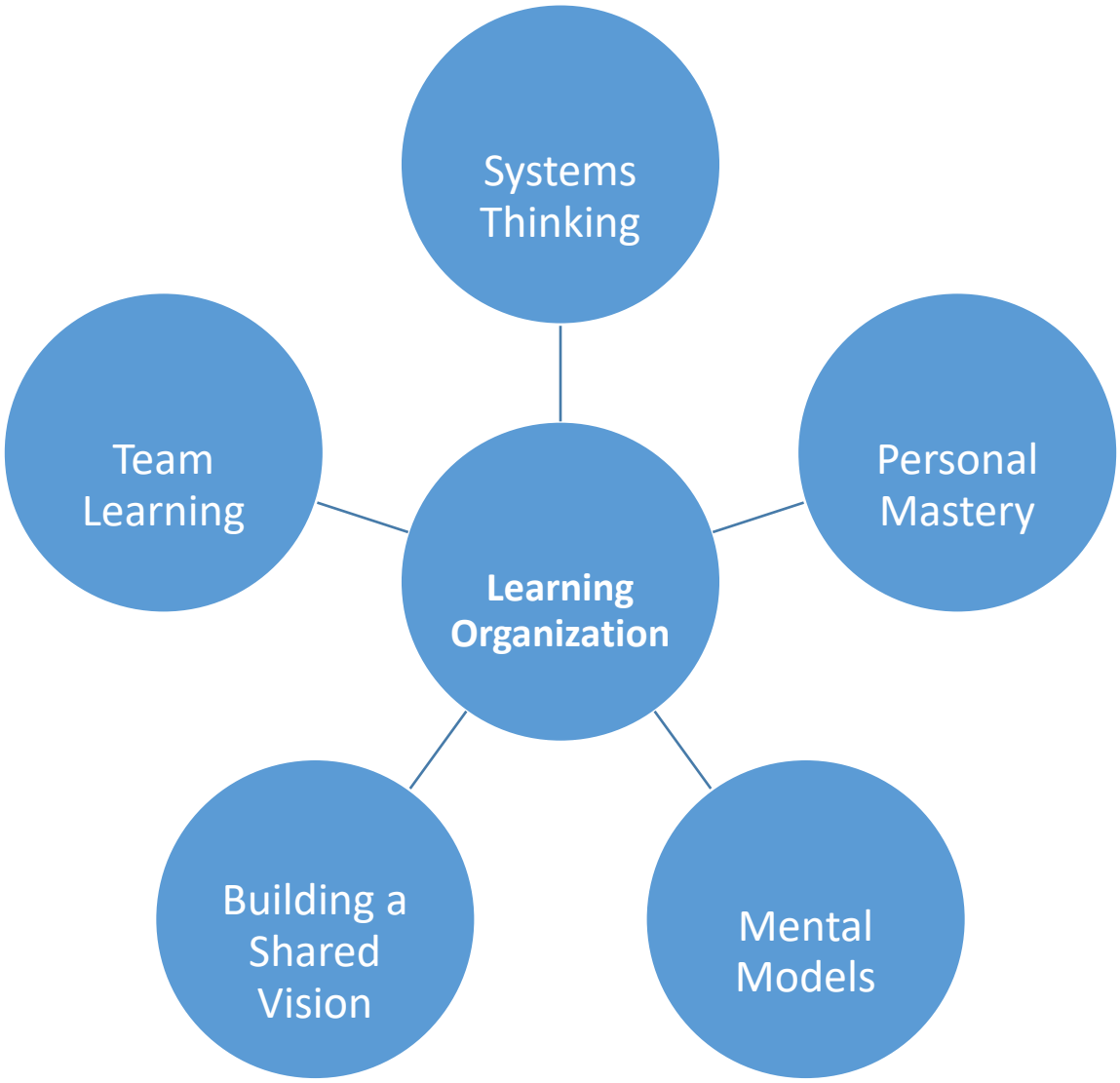


Figure 2: Five Disciplines of the Learning Organization

Validity Theory

This research study is focused on not only creating an instrument that measures the perceptions of the learning environment by medical students, faculty, and staff, but also providing evidence that the instrument is also valid. Validity is a term that is frequently described as nebulous, and its legitimacy is often heavily debated (St-Onge, Young, Eva, & Hodges, 2016). Leong & Austin (2006) state that "validity is unitary concept, which always refers to the degree to which empirical evidence and theoretical rationales support each other" (p. 139). Mostly simply, Banta, Palomba, & Kinzie (2015) pose the definition of validity with the following question "does an instrument measure what we intend it to measure?" (p. 76). In order for newly created instruments to be meaningfully interpreted in medical education, they must exhibit evidence of validity (Downing, 2003). Downing (2003) even goes as far as to state: "validity is the *sine qua non* of assessment, as without evidence of validity, assessments in medical education have little or no intrinsic meaning" (p. 830). It is imperative to understand that health professions education, including medical education, is made up of professionals from many different disciplines, whose work is informed by work in fields such as educational psychology and measurements (St-Onge, Young, Eva, & Hodges, 2016). However, what may be most important to remember is that validity is not a dichotomous "it is or is not valid" when creating an instrument (Cook & Beckman, 2006). This important realization is highlighted by (Cook & Beckman (2006) in the following passage from the American Journal of Medicine:

> "We often read about "validated instruments." This conceptualization implies a dichotomy—either the instrument is valid or it is not. This view is inaccurate. First, we must remember that validity is a property of the inference, not the instrument. Second, the validity of interpretations is always a matter of degree. An instrument's scores will reflect the underlying construct more accurately or less accurately but never perfectly" (p. 166.e10).

The two types of evidence of validity that were used to assist in validating the MSSLE are content validity and construct validity.

Content Validity

Content validity is defined as how well a construct is being reflected based on the content of the scale and how the responses could be representative of that construct (Leong & Austin, 2006). Additionally, evidence of content validity is not typically achieved through statistical analyses, but rather through the judgment of experts (Leong & Austin, 2006). While it is widely considered standard practice to engage experts in the field with expertise in the intended measured construct to assist in establishing evidence of content validity (Colton & Covert, 2007; Dinnesen, Olszewski, Breit-Smith, & Guo 2018; Leong & Austin, 2006), it is also important to include stakeholders aware of the context in which the data will be collected from as well (Connell, et al., 2018).

Connell, et al. (2018) describes the importance of including stakeholders in the process of establishing evidence of content validity, stating:

> "The content and face validity of many outcome measures currently in use are based on the judgements of researchers and health care professionals, with limited

> input from service users. However, what may be regarded as a good outcome by a clinician or researcher may differ from what is regarded as important to service users and only service users can determine whether the measure captures these outcomes favourably. Active input from service users in all the development stages of a measure can improve the acceptability, relevance, and the quality of the measure and related research" (p. 1894).

Therefore, the use of an expert panel in this study utilized both experts in the medical school learning environment context, but also medical students, a medical school faculty, and a medical school staff member in order to help achieve the desired evidence of content validity.

Construct Validity

In essence, newly created instruments are driven by theory, and construct validity tests to see if the instrument performs in the way the researchers expect it to (Colton & Covert, 2007; Leong & Austin, 2006). The theories proposed by Schlossberg and Senge drove the basis in considering the questions, and overall structure of the survey. Questions regarding the interactions amongst peers, especially given the transitions that medical students, faculty, and staff encounter were specifically influenced by Scholssberg's transition theory. Additionally, when considering the organizational structure, knowledge of policies and procedures, and satisfaction with upper administration were specifically influenced and driven by the learning organization proposed by Senge. While content validity in this study is assessed by experts observing and making content

judgements based on the instrument, construct validity is typically used to measure a construct or variable that is not typically observable (Bordens & Abbott, 2014).

For this study, evidence of construct validity will be completed through statistical analysis mechanisms including, Confirmatory Factor Analysis (CFA). Therefore, evidence of construct validity will be assessed by using the hypothesized theory, to see if the items load onto constructs in the manner in which they are expected to (Brown & Little, 2015). Brown & Little (2015) describe CFA as "an indispensable analytic tool for construct validation in the social and behavioral sciences" (p. 2).

Medical Education Context

The focus of this study will be on one portion of the medical education experience: undergraduate medical education (UME). UME is a typically a four year, program that prepares students to enter into patient care and to prepare you for the licensing exams to become a physician (Tom, 2020). Students applying to medical school will already have a bachelor's degree, and some students will have advanced degrees such as a masters or a PhD (AAMC, 2020). UME is typically broken down into two main phases: i) pre-clerkship; and ii) clinical training (Dublin, 2016). The pre-clerkship training and curriculum provides students with the base knowledge necessary to begin the clinical training they will receive (Tom, 2020). Pre-clerkship training is typically two years long and students take a variety of basic sciences courses (Dublin, 2016) (Figure 3).

The college of medicine that will be used to collect data for this study implements an 18-month pre-clerkship curriculum, followed by two and half years of clinical training. Pre-clinical training is a more "traditional" curriculum experience for students (Tom, 2020). They take courses, such as organ systems and basic sciences, in a classroom with lectures (Dublin, 2016). Students will then take assessments based on these lectures and then progress through the curriculum accordingly. Each year, students' progress and have a different year designation. First year students (M1), second year students (M2), third year students (M3), and fourth year students (M4). Halfway through a student's M2 year, they will shift from pre-clerkship training to clinical training. While all students in their M1 year are on the same campus and learn together, once they begin clinical training they will transition to their permanent home campus for the remainder of their training. The clinical curriculum is broken down into two main phases: i) core clerkships; and ii) electives. All students are required to take six core clerkships during their training: i) Family Medicine; ii) Internal Medicine; iii) Obstetrics & Gynecology; iv) Pediatrics; v) Psychiatry; and vi) Surgery. The elective time allows students to explore careers in medicine and to also conduct research (Figure 4).



Figure 3: Structure of Medical Education

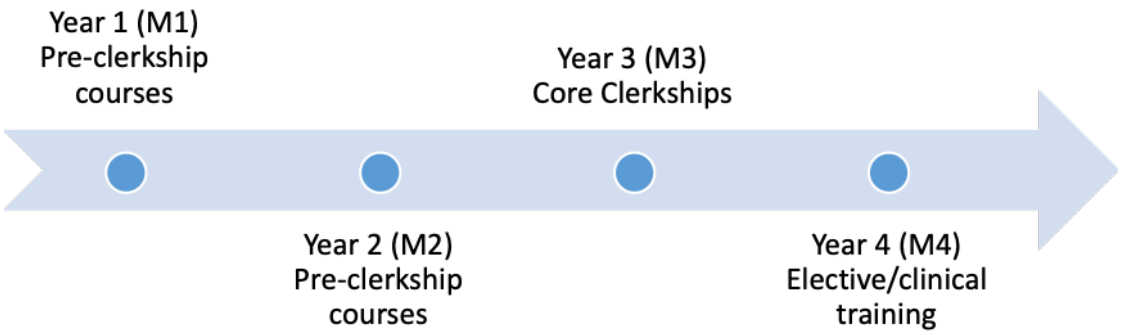


Figure 4: UME Typical Curricular Progression

Regional Campus Medical Schools

Every year, the LCME collects data from medical schools from the LCME Annual Medical School Questionnaire. During the 2017-2018 Academic Year, approximately 36% of responding medical schools (n=147) reported having a regional campus structure AAMC (2019). This determined in response to the survey question: "Does the medical school provide some or all of the curriculum for some students at a regional (geographically-separate) campus?" According to AAMC (2019), regional campus is defined as:

> "A geographically-separate campus or branch campus is defined as a site distinct from the main campus where at least one student spends at least six consecutive months (more typically at least one curriculum year). The campus may offer the preclerkship portion of the curriculum, the clinical portion of the curriculum, or both. Excluded are affiliated clinical sites at a distance from the main campus where a given student would only take one or two clerkships."

Affiliated Faculty

Vath (2001) "Community physician preceptors are often recruited to help teach basic physical examination and history-taking skills to medical students and to provide early exposure to clinical practice for students in their preclinical years" (p. 242).

Medical schools are increasingly becoming reliant on these affiliated, or volunteer, faculty (Vath, 2001). While relying on affiliated faculty helps intuitions provide training to more students, thus producing more physicians, it should also be

noted that this increases the affiliated faculty workload and can also place an increased burden on private practitioners (Vinson & Paden, 1994).

The context of this study consists of numerous different layers, which help define the uniqueness of medical education. This research study is focused on the UME portion of the medical school trajectory, and also includes the use of regional campuses, which allows for the delivery of the curriculum to occur at sites and campuses at a distance to the main campus AAMC (2019). Another aspect that this study accounts for is the use of affiliated faculty, which are community physicians who volunteer their time to teach and engage with medical students Vath (2001).

Existing Medical School Learning Environment Instruments

For medical schools interested in measuring perceptions of the learning, there are currently three widely used instruments in their field: i) The Medical School Learning Environment Survey (MSLES; Marshall, 1978); ii) The Johns Hopkins Learning Environment Scale (Shochet et al., 2015); and iii) The Dundee Ready Education Environment Measure (DREEM; Roff, 1997). While the aforementioned instruments have shown evidence of validity in the medical education context (Roff, 1997; Marshall, 1978; Shochet et al., 2015), they have not been validated among the holistic constituency groups (medical students, faculty, and staff) that the Multi-Stakeholder Survey of Learning Environment (MSSLE) intends to do.

The Medical School Learning Environment Survey

The Medical School Learning Environment Survey (MSLES) was originally created to measure the dimensions of the medical school environment due to the increase

in medical student's stress (Marshall, 1978). While it was originally created in 1978 by Robert Marshall, it was modified and additional evidence of construct validity was provided by Grahame Feletti in 1981 (Feletti & Clarke, 1981). Finally, in 2012, Shayna Rusticus further assessed the factor structure of the MSLES with a sample of 311 undergraduate medical students (Rusticus, Worthington, Wilson, & Joughin, 2014). The MSLES is comprised of 55 items and includes seven subscales according Rusticus, Worthington, Wilson, & Joughin (2014), which are:

1. **Breadth of Interest** – "Assesses the extent to which the environment fosters interest and activities outside of regular coursework" (p. 424).
2. **Emotional Climate** – "Assesses students' affective responses to the learning environment" (p. 424).
3. **Flexibility** – "Assesses the flexibility and control that students have within the learning the environment" (p. 425).
4. **Meaningful Learning Experience** – "Assesses the degree to which students' educational experience is meaningful and relevant to the practice of medicine" (p. 425).
5. **Organisation** – "Assesses the degree of perceived coherence and organisation of the educational experience" (p. 425).
6. **Nurturance** – "Assesses the degree to which students feel that they are supported by faculty and staff" (p. 425).
7. **Student-Student Interactions** – "Assesses the extent to which students mix socially and academically" (p. 425).

The MSLES uses a five-point Likert scale ranging from (1) Never to (5) Very Often. Rusticus, Worthington, Wilson, & Joughin (2014) found that the confirmatory factor analysis (CFA) that was conducted in 2014 with a sample of 311 undergraduate medical students further supported the evidence of construct validity of the seven subscales of the MSLES. However, the MSLES has only been validated with samples of medical students, and has not been used to show evidence of validity with a more holistic group of stakeholders such as faculty and staff.

The Johns Hopkins Learning Environment Scale

A more recently developed scale with intentions to measure perceptions of the learning environment in medical schools is the Johns Hopkins Learning Environment Scale (JHLES), which was created by Robert Shochet in 2015 (Shochet et al., 2015). The JHLES used exploratory factor analysis (EFA) and yielded a 28-item instrument with seven subscales: i) community of peers; ii) faculty relationships; iii) academic climate; iv) meaningful engagement; v) mentoring; vi) inclusion and safety; and vii) physical space (Shochet et al., 2015). Research using the JSLES has suggested that medical students that would recommend their medical school to others also showed an increase in higher personal growth (Shochet et al., 2015). While the JSLES showed initial evidence of validity through the EFA, this instrument was only validated using a sample of undergraduate medical students, and not with a larger constituency group that included faculty and staff (Shochet et al., 2015).

The Dundee Ready Education Environment Measure

The third instrument used for assisting medical education researchers for measuring the perceptions of the learning environment for medical school is the Dundee Ready Education Environment Measure (DREEM). The DREEM was created and validated with various data collection ventures between 1994 and 1997 by Sue Roff (Roff, et al., 1997). There was an initial 110-item instrument that was developed and then a Delphi panel paired the instrument down to 58-items and then eventually a 50-item version was then established (Roff, et al., 1997). The 50-item DREEM gives a total score out of 200 and has five subscales: i) students' perceptions of learning; ii) students perceptions of teachers; iii) students' academic self-perceptions; iv) students' perceptions of the atmosphere; and v) students' social self-perceptions (Roff, 2005). While the DREEM has been considered the "gold standard" for measuring the perceptions of the learning environment in medical schools (Damiano, et al., 2020), this very likely could be due to the name recognition of the instrument (Colbert-Getz, Kim, Goode, Shochet, & Wright, 2014).

While the three instruments presented in this chapter have been extremely useful to organizations to the assist them in assessing the learning environment, they have been designed to only measure perceptions from medical students. Therefore, they have failed to provide a holistic view of the perspectives of the learning environment, which also include stakeholders such as faculty and staff that help train the medical students and also contribute to the medical school learning environment. This lack of a holistic approach in currently used in instruments such as the DREEM, MSLES, and JHLES, fail to capture

these perspectives, which is the literature gap that helped drive the creation of the MSSLE.

Professionalism

While in medical school, students are expected to display the demeanor and temperament that is appropriate of an acting physician, the behaviors associated with this professional behavior need to be aligned with the culture of medical schools (Smith, Saavedra, Raeke, & O'Donell, 2007). Not only is this something that is critical for development of students in medical school; students are often graded on this behavior as well. Therefore, it is not only a critical aspect for building the necessary character that display a well-rounded physician, it is something that will be necessary to progress through the curriculum and obtain a residency position.

The learning environment can be closely associated with student's displays of professional behavior. This is evident as Dunham, et al. (2017) states that "Negatively perceived medical school LEs may adversely impact empathy, professionalism, academic success, and quality of life" (p. 384). Brazeau, Schroeder, Rovi, & Boyd (2010) also state "scores indicative of higher medical student burnout were associated with lower medical student empathy scores and with lower professionalism climate scores observed in medical students" (p. 533). Therefore, professionalism and the learning environment are closely associated and also factor into student's ability to persist in medical school and persistence.

Moreover, professionalism should not only be central through medical school, but also through ones medical career (Papadakis, et al., 2005). One of the current medical

education researchers who focus on professionalism in medical education is Maxine Papadakis. Papadkis' research has proven that unprofessional behavior in medical school is strongly associated with disciplinary action as a practicing physician by medical boards (Papadakis, et al., 2005). This is extremely alarming, and has led to a significant body of research surrounding mitigating these unprofessional behaviors in medical school (Hickson, Pichert, Webb, & Gabbe, 2007; Webb, et al., 2016). Wynia, Papadakis, Sullivan, & Hafferty (2014) encourage the various constituents involved in medical education and professions come together around professionalism, stating that "Believing in professionalism means accepting the premise that health professionals must come together to continually define, debate, declare, distribute, and enforce the shared competency standards and ethical values that govern their work" (p. 712).

Measuring professional behaviors in medical education can often times be very challenging (Hickson, Pichert, Webb, & Gabbe, 2007). However, institutions have begun to implement an alternative approach, based on the research of Vanderbilt University School of Medicine (VUSM), which is to identify, measure, and address the unprofessional behaviors (Hickson, Pichert, Webb, & Gabbe, 2007) (Figure 5). Using a system of peer reporting and non-punitive self-awareness discussions based on these reports at VUSM, 71% of individuals self-corrected their behavior and didn't receive a subsequent report (Clendening, 2016). The use of the peer reporting systems in medical education has become a direction in which institutions have found success in measuring professional behaviors, which can often times be very challenging

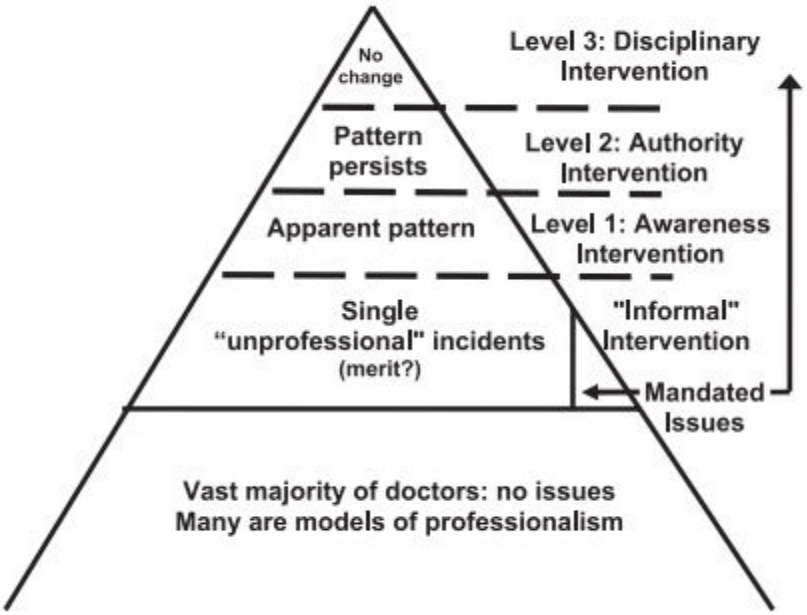


Figure 5: "The disruptive behavior pyramid for identifying, assessing, and dealing with unprofessional behavior" (Hickson, Pichert, Webb, & Gabbe, 2007, p. 1042)

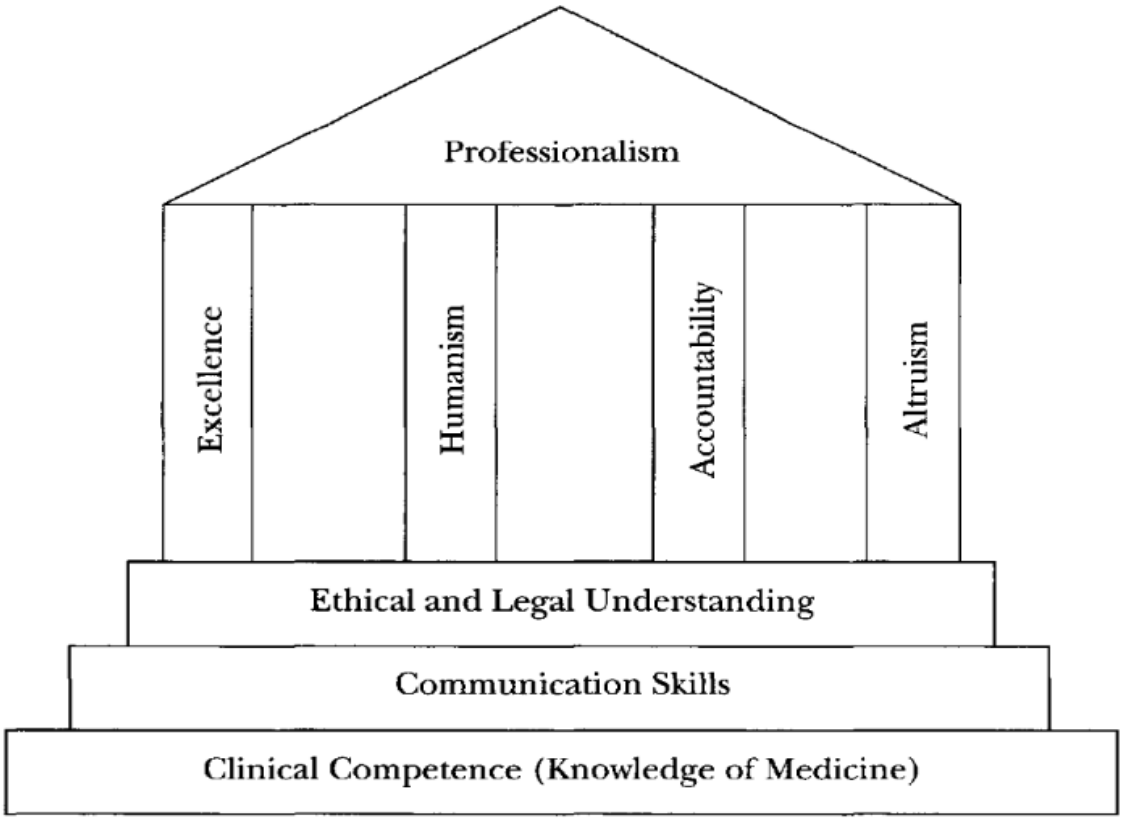


Figure 6: From Stern (2006) A Definition of Professionalism

Student Mistreatment

Mavis, Sousa, Lipscomb, & Rappley (2014) state that "students and residents must continue to document progress toward the goals of establishing a respectful learning environment, zero tolerance for abuse, and a greater understanding of what constitutes mistreatment." (p. 710). Therefore, the present study can assist in this desired goal of documenting progress towards a positive learning environment. The proposed instrument being created will not only show progress through elements of the survey that address mistreatment of students, but also with faculty and staff. Therefore, a more holistic picture of the extent and gravity of the learning environment, as it relates to mistreatment, can be addressed in real-time by the medical schools administration. This not only allows the intuitions to capture data regarding mistreatment, but allows them to make decisions to improve it for the future students.

Most institutions are currently only utilizing the AAMC GQ to assess areas of mistreatment (Cook, Arora, Rasinski, Curlin, & Yoon, 2014). While this is an important tool, it is only collected from exiting fourth year students who are graduating. Therefore, if a students experienced mistreatment and reports it in the AAMC GQ, it could have happened years prior, during their first or second year of the program. This strongly inhibits administration from being able to address concerns posed. Additionally, faculty and staff mistreatment data is rarely gathered, and if it is, doesn't occur on a regular basis, which poses the same type of issues for the administration in addressing concerns. Additionally, there is a lack of research regarding the perceptions of mistreatment relating to the learning environment (Gan & Snell, 2014).

Examples of mistreatment should not just be frowned upon, but also completely opposed, this is echoed by Antman (2018) when he states “Behaviors for which medical schools should have zero tolerance include sexual harassment as well as harassment based on ethnic or racial origin, gender identification, or personal beliefs” (p. 1760). Additionally, medical schools must equip students, faculty, and staff with tools to address abuse (Antman, 2018). While these are all good practices and recommended in the literature, addressing mistreatment in the learning environment is also required by the US accrediting body for institutions awarding medical degrees. LCME (2019) standard 3.6 clearly defines the requirements of a medical school regarding mistreatment by stating

> “A medical school develops effective written policies that define mistreatment, has effective mechanisms in place for a prompt response to any complaints, and supports educational activities aimed at preventing mistreatment. Mechanisms for reporting mistreatment are understood by medical students, including visiting medical students, and ensure that any violations can be registered and investigated without fear of retaliation” (p. 4).

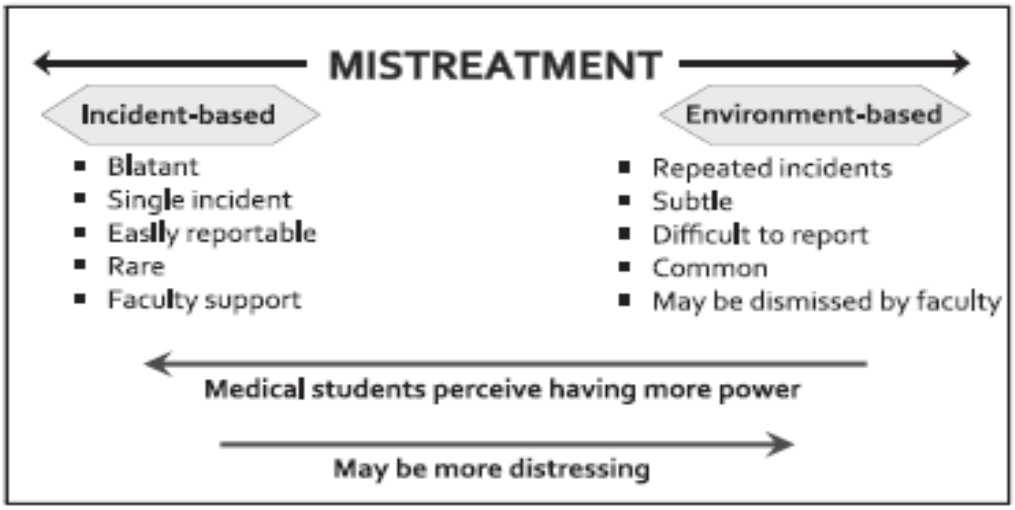


Figure 7: Mistreatment Spectrum (Gan & Snell, 2014).

Chapter Summary

While there has been extensive, and recent, research in the realm of medical education (Buery-Joyner, et al., 2019; Nordquist, et al., 2019), there is a currently a gap in the literature for a validated instrument that will allow medical schools to collect perceptions of the learning environment from multiple stakeholders. The literature in this chapter has described the vast work of medical educational researchers to create instruments to measure perceptions of the learning environment (MSLES, Marshall, 1978; JHLES, Shochet, et al., 2015; DREEM, Roff, 1997). However, these instruments has been focused on only perceptions of the students at the medical schools, and have only been validated with that population (Roff, 1997; Marshall, 1978; Shochet et al., 2015). The creation of this new instrument will allow future institutions and researchers to examine this from the perspectives of medical students, faculty, and staff. Furthermore, a crucial aspect of creating a new instrument is providing evidence of validity, which can will be done based on the results of this study (Bordens & Abbott, 2014), using both content and construct validity.

Additionally, using a dual lens of Schlossberg's transition theory and Senge's learning organization theory, will position the research in a unique space to further understand the perceptions of the learning environment from a multi-stakeholder perspective. Through conscientious efforts of the researcher, Schlossberg's transition theory will allow the exploration of the multifaceted, and complex learning environment in which students learn (Mennin, 2010). Utilizing the four S's of transition theory allows for the exploration of the perceptions of the learning environment from the various

stakeholders in several different ways. Exploring the idea of **self** and allows a lens for exploring the personal growth that not just the medical students with encounter, but also the faculty and staff, and how that personal growth contributes to their goals and success. The exploring the idea of **support** involves considering the peer interactions among all constituency groups as well as delving into how these groups perceive the medical school administration and how that contributes to the learning environment. Finally, the ideas of **situation** and **strategies** will allow institutions that utilize the MSSLE to take a longitudinal view of the different aspects of the learning environment and look for patterns across time.

The utilization of Senge's learning organization theory also heavily influenced the MSSLE, as well as how the results can be used to assist organization in better understanding their medical school learning environment. Senge outlined five disciplines of the learning organization theory: i) systems thinking; ii) personal mastery; iii) mental models; iv) building a shared vision; and v) team learning. These five disciplines incorporate both a personal viewpoint, but more importantly, a more complex view that observes the larger mechanisms of the organization (Senge, 1994). Using this model, allows institutions for better understanding of the learning environment from both viewpoints, as well as identifying and understand personal biases that could lead to a more pervasive, cultural problem at the institution.

Chapter 3

Method

This chapter will lay the foundation for the methodology used in this research study, which includes two overarching phases: i) Expert Panel for the purpose establishing evidence of content validity; and ii) Instrument data collection. A deeper discussion of the research design will be shared, followed by a thorough description of the following study elements: i) research setting; ii) development of the newly proposed instrument; iii) instrumentation reliability and validity; iv) data collection procedures; v) participants; and vi) summary of data analysis.

Research Procedure

This quantitative research study was aimed at gaining a deeper understanding of the perspectives of the learning environment of medical schools, from a holistic group of constituents (medical students, faculty, and staff). The learning environment was defined as the following for each group as follows:

Learning Environment (students)

"The medical school learning environment (LE) comprises the physical, social, and psychological contexts in which medical students learn and grow professionally, and it influences how students develop behaviors and form identities as future physicians." (Shochet et al., 2015, p. 810)

Learning Environment (faculty)

"The environment for faculty consists of physical, social, and psychological contexts in which faculty work that oftentimes includes teaching, research, and

administration that contributes to the education of medical and graduate students." (Dewsnap, 2019)

Learning Environment (staff)

"The environment for staff consists of physical, social, and psychological contexts in which staff work that can include teaching and research which contributes to the education of medical and graduate students." (Dewsnap, 2019)

First, a 27-item Likert scale instrument was created (Appendix B) in consultation with learning environment specialists and a medical education researcher and assessment specialist at the institution. After the initial creation of the instrument, an expert panel, consisting of six individuals with experience in medical education research and learning environments within the medical education context, reviewed and made suggested modifications to the instrument. After revisions and suggestions proposed by the expert panel were addressed, a 28-question Likert scale instrument was ultimately created and distributed to the three key medical school constituency groups. Next, data collection occurred through the Qualtrics survey software program and distributing the final version of the Multi-Stakeholder Survey of Learning Environments (MSSLE) to all medical students, faculty, and staff at a public medical school in the southcentral region of the United States. Finally, analysis of the data was performed by looking at the psychometric structure of the instrument and conducting Confirmatory Factor Analysis (CFA).

Developing the Multi-Stakeholder Survey of Learning Environments (MSSLE) Instrument

The MSSLE was originally inspired from an internal evaluation instrument created by a public medical school in the Southeastern region of the United States. This was an internal evaluation instrument shared directly with the researcher that has not been previously published or validated. The purpose of the instrument was to help the institution meet the accreditation requirements for LCME standard 3.5. That instrument consisted of 42 items and was designed to collect data from five different constituencies: i) pre-clerkship students; ii) clerkship students; iii) faculty, residents, and fellows; iv) administrative staff; and v) nurses. While this approach was appropriate for this particular institution for internal evaluative purposes, it was not designed to be generalizable to a larger context in a manner that could easily be adopted by other medical schools. Additionally, that instrument had five different versions, one for each constituency group; therefore, the data collected could not readily be compared between the various constituency groups. Moreover, each separate instrument would require validation.

In consideration of the original evaluation instrument, in this study the first iteration of a new instrument was created by reducing the internal evaluation instrument from 42 questions to 27 items that were deemed most relevant by the researcher. This was accomplished in consultation with a learning environment specialist and an evaluation and assessment specialist, both with expertise in the medical school context. The three individuals (researcher, learning environment specialist, and evaluation and

assessment specialist) met and went through each of the 42 questions. The initial pass of questions resulted in dropping 17 questions, which left 25 remaining questions. Many of the questions that were dropped were deemed to be too specific to the institutions specific programs and would not necessarily be generalizable to a broader medical school context.

Next, the wording of the 27 items were modified in order to create a single instrument that captures data across all stakeholder groups, rather than having specific questions for each constituency group. Additionally, further modifications were conducted based on feedback from the learning environment specialist, which resulted changing the wording to 11 of the original questions and adding two additional questions. Finally, the three stakeholders agreed on an operational definition of the "learning environment" for each of the stakeholder groups.

Phase I: Expert Panel.

The development of the MSSLE was initially conceived due to the need for the instrument to assist with LCME accreditation standard 3.5. The internal evaluation instrument, in which the MSSLE was originally inspired by, was initially discussed and described by that institution's dean during a webinar. Post webinar, the researcher emailed asking for this institution to share their created instrument, in which they willingly did. The instrument that was shared consisted of five different versions for the following stakeholder groups: i) pre-clerkship students; ii) clerkship students; iii) staff; iv) faculty/residents; and v) nurses. This instrument was also described as measuring the following factors: i) the general environment; ii) sensitivity to culture, diversity, and inclusion; iii) teamwork and peer support; iv) students, faculty, and learning resources;

and v) knowledge of policies and procedures. This factor structure was hypothesized and used in the original internal evaluation instrument that the MSSLE was inspired by. The four factors that the MSSLE is hypothesized to measure are:

1. **General Learning Environment (GLE)** – The GLE factor was designed to measure general perceptions of the learning environment for which the various stakeholders encounter. Example items include: “I feel valued in the learning environment” and “the learning environment is conducive to learning and growth”.
2. **Sensitivity to Culture, Diversity, and Inclusion (SCDI) –** The SCDI factor was designed to measure the stakeholder’s awareness of, and sensitivity to, issues surrounding culture, diversity, and/or inclusion. Example items include: “the learning environment fosters a culture that values diversity and inclusion” and “My peer’s exhibit awareness of cultural biases in themselves”.
3. **Teamwork and Peer Support (TPS) –** The TPS factor was designed to measure aspects of the learning environment that support collaboration. Example items include: “My peers create an atmosphere of trust and support” and "there are excellent role models within the learning environment”.
4. **Knowledge of Policies and Procedures (KPP) –** The KPP factor was to help identify whether stakeholders were aware of the institutions various policies and procedures regarding the learning environment. Example items include: “I am aware of how to report concerns or issues regarding the learning

environment" and "The procedures for reporting harassment (e.g., sexual and/or racial, etc.) and mistreatment are clear".

However, this was just a hypothesized factor structure since it had not been statistically tested to see if this factor structure was valid or showed evidence of construct validity. The newly created MSSLE was created and revised, intending to measure the following four constructs: i) the general learning environment; ii) knowledge of policies and procedures; iii) sensitivity to culture, diversity, and inclusion; and iv) teamwork and peer support.

The newly proposed MSSLE was modified to consist of 27 Likert scale questions on a five-point scale. The respondents were asked to rate the extent to which they agree with each statement (1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, 5 – strongly agree). The MSSLE has also been modified to collect data only from three targeted constituencies: i) medical students; ii) faculty; and iii) staff using one instrument. Additionally, there is one demographic question that was asked: "*Which campus are you primarily affiliated with*?" The demographic question was asked in order to help the institution with their internal evaluation of the learning environment among its different campus locations.

Content Validity

To address validity at the early stage, a panel of experts read and analyzed the survey prior to data collection, to help establish evidence of content validity. According to Leavy (2017) content validity is "a judgement call made by experts that the measure is tapping what it is intended to access" (p. 271). The main purpose of the use of the expert

panel in instrument creation to address content validity is extremely important, especially since content validity is considered a prerequisite for all other types of validity (Zamanzadeh, et al., 2015). Additionally, Zamanzadeh, et al. (2015) defines content validity "as the ability of the selected items to reflect the variables of the construct in the measure. This type of validity addresses the degree to which items of an instrument sufficiently represent the content domain" (p. 166).

The incorporation of qualitative methods to the expert panel, by providing panel members with the open ended feedback option, is also recommended by Dinnesen, Olszewski, Breit-Smith, & Guo (2018) who express the following sentiment: "Evidence of content validity can be captured using qualitative and/or quantitative methods and is typically based on the judgment of individuals deemed to be experts in the field of study being targeted" (p. 86). Therefore, based on the recommendations on establishing evidence of content validity by Zamanzadeh, et al. (2015) and Dinnesen, Olszewski, Breit-Smith, & Guo, (2018), the appropriate steps were taken through the meticulous use of the expert panel to solidly state that the MSSLE demonstrates the necessary evidence of content validity.

Expert Panel Participants

The expert panel consisted of six different individuals, with six different perspectives they were asked to provide in their assessment. The first was a learning environment specialist who has experience working at a medical school. This particular expert was to pay particular attention to the questions and if they would be appropriate and relevant to the learning environment overall. The second expert panel member was a

psychometrician who has worked in the context of medical education for over 16 years. This expert was charged with providing feedback on the instruments design and psychometric properties. The third member of the expert panel was a clinician educator who has been teaching in medical education for over five years and is a practicing physician. This expert was charged at examining the instrument from a faculty perspective. The fourth member of the expert panel was a current staff member who works at a medical school and has a distinct role in working alongside medical students and faculty, therefore this perspective helped to ensure that the questions were equally applicable to staff members. The final two members of the expert panel consisted of two current medical students. One medical student was in the pre-clerkship phase of the curriculum and the other was in the clinical or clerkship phase of the curriculum. They each represented those perspectives when assessing the instrument.

Phase 1 Data Collection Procedures for Instrument Validation

Data were collected from the six members of the expert panel using Qualtrics version 11.2019. The experts were given instructions (Appendix C) and used a rubric (Appendix D) that allowed them to assess each individual question with three possible options: i) acceptable as is; ii) requires revisions as follows; and iii) unacceptable/remove. If the second option, “requires revisions as follow”, was chosen, then the expert was to provide additional details in the revisions to the specific question. Additionally, there was an open-ended comment box for each question’s labeled “additional comments” where the expert could provide additional information on that item if they chose to. There was also a final open-ended comment box at the end of the

rubric that stated “please provide any additional feedback regarding the survey instrument or items that you believe should be added”, which was an optional question and not required.

Once all of the responses were collected from the six expert panel members, the data were examined for themes and consistency based on panel member’s ratings for each question. In response to the feedback from the expert panel, edits to wording were made to 26 of the 27 questions. The biggest change based on feedback, specifically from the learning environment specialist, and agreed upon by the others, was the change from using the term “educational environment” to “learning environment”. During the initial development of the MSSLE, much discussion focused on the use of “educational environment” vs “learning environment”. The original instrument from which the MSSLE was inspired, used the term “learning environment”, however the decision was made to transition this to “educational environment” in order try and encapsulate a wider perspective. However, after feedback from the expert panel and delving into the literature, the decision to revert back to “learning environment” was deemed most appropriate. In addition to the revisions to the 27 existing questions, a 28th question (“Medical school leadership promotes a positive learning environment”) was added to the survey based expert panel feedback. Individual question edits that were implemented can be found in Appendix E.

Phase II: MSSLE Instrument Data Collection

Study Participants

Participants were recruited from a public, non-profit medical school in the southcentral region of the United States. The MSSLE survey instrument was sent to all medical students, faculty, and staff who were employed, enrolled, or affiliated with the in medical school. For the purposes of this study, only students currently enrolled at the institution who were currently seeking the Doctor of Medicine (MD) degree were included in the study. Graduate students pursing other degrees (e.g., M.S. or Ph.D) and not also pursuing an MD degree were not included. A list of all currently employed staff was provided from human resources and were included in the study, as well as affiliated staff members who work directly with the medical students (e.g., clerkship coordinators). Additionally, a list of all employed and affiliated faculty was provided from the faculty affairs office and were included in the study.

A total of 3,509 medical students, faculty, and staff were invited to participate in the survey. Of those who were invited, 451 total participants responded to the survey, which is a total response rate of approximately 13%. This included 53 medical students, 311 faculty, and 87 staff members. However, due to an unknown error in the online software platform system 63 responses were not recorded and could not be included in the analyses. The software error appeared to be a glitch that did not display any of the questions to 63 respondents so they were not able to complete the survey. The glitch could not be identified by IT support and the glitch appeared to happen sporadically. The final sample size consisted of 67 staff members (response rate of 18%), 268 faculty members (response rate of 11%), and 53 medical students (response rate of 9%).

Samples were combined (n = 388) despite the differences in position, given the necessity of a larger sample size (Brown & Little, 2015).

Research Setting

The setting for this research is a public, non-profit medical school in the southcentral region of the United States. Data were collected from medical students, faculty, and staff who are employed, enrolled, or affiliated with the university's college of medicine. The survey instrument was distributed using email, where the survey link was sent to participant email addresses. This survey was conducted using Qualtrics version 11.2019. Additionally, survey participants were permitted to use any electronic device (e.g., phone, laptop, tablet, etc.) that allowed them to access their email and internet connection. Therefore, participants could participate in the survey from any location, and were not advised to complete at a specific location (i.e., participation did not require them to be on campus).

Reliability of New Instrument

To evaluate reliability, Green and Yang's reliability coefficient (2009), also referred to as "categorical omega" (Kelley & Pornprasertmanit, 2016), was conducted. This was used an alternative to Cronbach's alpha as it is more appropriate for ordinal, Likert scale data and does not assume tau-equivalence (Yang & Green, 2011; Furr & Bacherach, 2014). Literature and simulations of categorical omega have demonstrated that this method performs as well or better than Cronbach's alpha in various conditions (Green & Yang, 2009; Yang & Green, 2011; Yang & Green, 2015). In order to conduct categorical omega, the semTools package (Jorgensen, Pornprasertmanit, Schoemann, &

Rosseel, 2019) of R was used. While there is not a currently established guideline for categorical omega cutoff, the values of categorical omega coefficients range from zero to one, similar to Cronbach's alpha. Values that are closer to one indicate higher reliability. The two-factor model (General Learning Environment (GLE) and Knowledge of Policies and Procedures (KPP)) that was eventually established through CFA showed high categorical omegas: GLE = 0.89 and KPP = 0.95. Therefore, the MSSLE is a reliable measure of these two factors.

Data Collection Procedures

Permission to conduct this research was obtained from both the Interim Dean for the College of Medicine and the Associate Dean for Evaluation and Assessment (Appendix H).

Once full support was obtained by the medical school where data collection took place (Institution A), a full prospectus was submitted to the dissertation committee and presented in October 2019. Following approval of the prospectus by the committee, an Institutional Review Board (IRB) application was submitted Institution A. The IRB determined that the research was categorized as "exempt" due to the anonymous nature of the survey data. Due to the "exempt" classification of the research project, a reliance agreement between Institution A and the University of Tennessee – Knoxville would not be necessary. Once full approval was given by Institution A, the full IRB information was provided to the UTK IRB office. UTK agreed that research was fully covered by IRB and permitted data collection to proceed.

The expert panel was then commenced and provided revisions based on the rubric. After all revisions were made to the survey and agreed upon, an amendment to the original IRB was submitted to Institution A based on the newly revised instrument. This amendment was approved by Institution A and then provided to the UTK IRB office.

Next, a recruitment email (Appendix G) was sent to all enrolled medical students, employed and affiliated faculty, and staff of the medical school requesting their participation. It was approximated to take five to ten minutes to complete the currently proposed survey. Data collection remained open for approximately 18 days. After the initial invitation was sent out, a reminder was sent twice to participants who had not completed the survey. Emails were distributed directly from the Qualtrics platform. Data was de-identified and collected completely anonymously, providing anonymity to the participants.

Data Analysis

In order to accurately analyze the survey data, multiple data cleaning steps were done prior to conducting CFA. First, the 63 survey participants with no recorded data were deleted from the data set. This included removing 43 faculty responses and 20 staff responses. Next, two items were reverse scored in order to be able to accurately conduct the statistical analyses:

1. MSSLE7: I have witnessed mistreatment of others
2. MSSLE11: I have been a recipient of mistreatment

Data collected from the newly designed MSSLE was analyzed quantitatively using the R software package (Version 3.6.2, R Core Team, 2019). The data analyses were conducted by a statistical consultant/psychometrician familiar with factor analysis and also the medical school context. The writing of the results and interpretations of the data analyses were then conducted in consultation between the statistician and the principal investigator. To help ensure integrity of the instrument and to mitigate any conflicts of interest, the psychometrician who served on the expert panel was not consulted regarding data analyses or interpretations of the instrument. Confirmatory Factor Analysis (CFA) was used in order to accurately answer the research question:

1. To what extent is the proposed instrument valid and reliable for measuring the learning environment at a medical school?

Chapter Summary

The methods of this instrument development and validation study was conducted in two phases: i) Expert Panel for instrument validation; and ii) MSSLE Survey Data Collection. The participants included in the expert panel consisted of six experts, which included a learning environment specialist, a psychometrician, a clinical physician educator, a medical school staff member, and two students (one pre-clerkship and one clinical). Expert panel members made revisions recommendations to the 27 question Likert scale instrument, and ultimately a 28 item instrument was used. The final instrument was sent to medical students, faculty, and staff at a public, non-profit medical school in the southcentral region of the United States. Data collected was conducted in

both phases using the virtual survey platform, Qualtrics. Finally, survey data was cleaned and analyzed using CFA to answer the proposed research question.

Chapter 4

Results

This chapter will provide the results of this study, including a discussion of the normality of the data, results of the Confirmatory Factor Analysis (CFA), the models that stemmed from the results of the CFA, and also areas of localized strain for the retained two-factor model. It should also be noted, that due to sample size constraints, samples of medical students, faculty, and staff were combined and analyses were conducted on the three groups combined, and not separately.

Normality

In order to test the normality of the data, a Shapiro-Wilk test (Shapiro & Wilk, 1965) was used. The results of the Shapiro-Wilk test determined that there was a significant departure of normality for each item of the Multi-Stakeholder Survey of Learning Environments (MSSLE) at $p < .001$. The item level descriptive statistics are contained in Table 1 and Shapiro-Wilk results in Table 2. Additionally, to evaluate multivariate normality, a QQ plot (see Figure 8) and Mardia's multivariate skewness and kurtosis tests (Mardia, 1970) were conducted. The results of the QQ plot suggest a lack of multivariate normality. Likewise, Mardia's multivariate skewness and kurtosis test both indicated a significant departure from multivariate normality at $p < .001$. These results show a pattern of skewed data among the items of the MSSLE. Due to the non-normality of the data, this will need to be considered when choosing an estimator in conducting the CFA.

Table 1: Item Level Statistics

Item	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
MSSLE1	1	5	4.46	0.82	-1.87	3.91
MSSLE2	1	5	4.49	0.83	-1.98	4.33
MSSLE3	1	5	4.31	0.99	-1.66	2.40
MSSLE4	1	5	4.48	0.89	-1.90	3.21
MSSLE5	1	5	4.67	0.73	-2.78	8.72
MSSLE6	1	5	4.51	0.88	-2.08	4.22
MSSLE7	1	5	3.82	1.38	-0.72	-0.95
MSSLE8	1	5	3.89	1.05	-0.62	-0.31
MSSLE9	1	5	4.23	0.99	-1.30	1.22
MSSLE10	1	5	3.76	1.02	-0.54	-0.25
MSSLE11	1	5	4.09	1.29	-1.15	-0.09
MSSLE12	1	5	3.70	1.25	-0.72	-0.55
MSSLE13	1	5	4.25	0.97	-1.42	1.62
MSSLE14	1	5	4.31	0.90	-1.56	2.59
MSSLE15	1	5	4.26	0.89	-1.39	2.13
MSSLE16	1	5	4.27	0.87	-1.39	2.14
MSSLE17	1	5	4.28	0.90	-1.27	1.13
MSSLE18	1	5	4.44	0.93	-1.85	3.20
MSSLE19	1	5	4.37	0.88	-1.63	2.58
MSSLE20	1	5	4.37	0.89	-1.51	2.04
MSSLE21	1	5	4.33	0.91	-1.56	2.31
MSSLE22	1	5	4.32	1.01	-1.57	1.86
MSSLE23	1	5	4.02	1.13	-1.00	0.04
MSSLE24	1	5	4.18	1.14	-1.40	1.08
MSSLE25	1	5	4.26	1.07	-1.58	1.89
MSSLE26	1	5	4.00	1.14	-1.13	0.42
MSSLE27	1	5	4.18	1.00	-1.23	1.19
MSSLE28	1	5	4.16	1.07	-1.30	1.10

Table 2: Shapiro-Wilks Results

MSSLE Item	*Statistic*	*p* Value
MSSLE1	0.67	< .001
MSSLE2	0.65	< .001
MSSLE3	0.70	< .001
MSSLE4	0.63	< .001
MSSLE5	0.51	< .001
MSSLE6	0.61	< .001
MSSLE7	0.79	< .001
MSSLE8	0.85	< .001
MSSLE9	0.76	< .001
MSSLE10	0.88	< .001
MSSLE11	0.71	< .001
MSSLE12	0.85	< .001
MSSLE13	0.75	< .001
MSSLE14	0.73	< .001
MSSLE15	0.76	< .001
MSSLE16	0.76	< .001
MSSLE17	0.76	< .001
MSSLE18	0.65	< .001
MSSLE19	0.71	< .001
MSSLE20	0.72	< .001
MSSLE21	0.72	< .001
MSSLE22	0.70	< .001
MSSLE23	0.80	< .001
MSSLE24	0.73	< .001
MSSLE25	0.71	< .001
MSSLE26	0.79	< .001
MSSLE27	0.77	< .001
MSSLE28	0.76	< .001

Confirmatory Factor Analysis

To account for a relatively small sample size, the use of a five-point Likert scale, and due to the non-normality of the data, parameters were estimated using weighted least squares with mean and variance adjustment (WLSMV) in the lavaan package (Version 0.6-5, Rosseel, 2012) of R (Version 3.6.2, R Core Team, 2019), in which data are fitted to a polychoric correlation matrix. Additionally, this estimation method makes no distributional assumption about the observed variables (Flora & Curran, 2004; Li, 2015). This is especially important for this study due to the skewed (non-normal) nature of the data.

Robust variants were interpreted for all standard errors and indices of model fit, and the mean- and variance-adjusted variants were interpreted for all chi-squared test statistics. Goodness of model fit was evaluated using four different indices: i) the Tucker-Lewis incremental fit index (TLI; Tucker & Lewis, 1973); ii) the comparative fit index (CFI; Bentler, 1990); iii) the root-mean-square error of approximation (RMSEA; Steiger & Lind, 1980, as cited in Hu & Bentler, 1999); and iv) the standardized root-mean-square residual (SRMR; Jöreskog & Sörbom, 1981). The magnitudes for these indices were evaluated with the aid of recommendations by Hu & Bentler (1999), which suggest the CFI and TLI cutoffs be “close to .95”, SRMR “close to .08”, and RMSEA values “close to .06” (p. 27). There were no missing values present in the data set.

The metric of the factors in all models were defined by fixing the factor variances to 1.0. Factor loadings and error variances were freely estimated, and factors were allowed to covary as would be theoretically expected. Localized areas of strain were

evaluated with the aid of recommendations from Kline (2011) by evaluating residual correlations, values with an absolute value greater than .10 indicating local strain. There is no clear rule of thumb, however, for how many areas of strain are too many. Two reverse worded items were present in the survey, and there is substantial contention in the literature regarding the use of such items (DiStefano & Motl, 2006; Magnus, et al., 2012; Mirowsky & Ross, 1991; Schriesheim & Hill, 1981; Watson, 1992). There is evidence to support the use of reverse worded items for their potential to reduce or eliminate acquiescence bias, which is the tendency for respondents to agree with items regardless of its content (Mirowsky & Ross, 1991; Schriesheim & Hill, 1981; Watson, 1992).

Occasionally, a method effect can occur due to methods that were used to collect the data (Brown, 2015). In the case of the MSSLE, there were two items that were negatively worded and needed to be reversed scored prior to conducting the analyses, which can introduce the method effect or method factor, however the particular method factor was not an area in which the researchers were intending to measure (DiStefano & Motl, 2006; Magnus, et al., 2012). Since the items that were reversed scored contain important data regarding the survey, which is related to the mistreatment in the learning environment, the covariance of these error terms is acceptable (DiStefano & Motl, 2006; Magnus, et al., 2012). As error terms were allowed to covary, additional steps were taken to demonstrate the identification of the models (Kenny, Kashy, & Bolger, 1998, as cited in Kline, 2011). There are three conditions were are deemed necessary for nonstandard models to be identified, which were found: i) at least three items whose errors were uncorrelated; ii) for every pair of factors, there were at least two items, one from each

factor, whose error terms were uncorrelated; and iii) for every item, there was at least one other item with which its error term was not correlate.

Figure 9 and Figure 10 are path diagram models of the standardized solution for the four-factor and the two-factor model respectively. The large circles represent the factors, or the instruments underlying dimensions (Brown, 2015). For the four-factor model (Figure 9), the factors are: i) general learning environment (GLE); ii) sensitivity to culture, diversity, and inclusion (SCDI); iii) knowledge of policies and procedures (KPP); and iv) teamwork and peer support (TPS). For the parsimonious two-factor model (Figure 10), the factors are: i) the general learning environment (GLE) and ii) knowledge of policies and procedures (KPP). The arrows between the factors are representative of the factor correlations. The rectangular boxes labeled MSSLE1, MSSLE2, MSSLE3, etc. are the individual items from the instrument. The arrows pointing from the factor circles to each item are the factor loadings. Factor loadings are the "pattern of item-factor relationships" (Brown, 2015, p. 1). The numbers that are to the left of the items are the error variance and any arrows between these are the correlated errors. As seen in both Figure 9 and Figure 10, MSSLE7 and MSSLE11 have correlated errors, these items were allowed to correlated during the analyses as they were negatively worded, where all other items were positively worded, therefore these items had to be reverse scored.

Four-Factor Model

The original CFA was conducted to test the four-factor theorized hypothesis. The four factors were: i) the general learning environment (GLE); ii) sensitivity to culture, diversity, and inclusion (SCDI); iii) knowledge of policies and procedures (KPP); and iv)

teamwork and peer support (TPS). The chi-square test for the proposed four-factor model was significant, χ^2 (343) = 1,160.890, $p < 0.001$. Fit indices ranged from excellent (CFI = 0.967, TLI = 0.964, SRMR = 0.053) to good (RMSEA = 0.078). Factor correlations among three of the proposed factors were higher than 0.85 (GLE and SCDI = 0.95; GLE and TPS = 0.98; SCDI and TPS = 0.94), indicating that these factors do not measure distinct constructs. As these correlations were higher than 0.85 and did not indicate measuring distinct constructs, the four-factor model was respecified and a two factor model was then analyzed. Figure 9 displays the path diagram for the initial four-factor model.

Two-Factor Model

The chi-square test for the re-specified two-factor model was also significant, χ^2 (348) = 1,166.612, p < 0.001, and showed similar levels of fit among the fit indices (CFI = 0.967, TLI = 0.965, SRMR = 0.053, RMSEA = 0.078). A scaled chi-square difference test ($\Delta\chi^2$; Satorra, 2000) between the 4-factor and 2-factor models determined that the four-factor model did not display significantly better model fit than the two-factor model, $\Delta\chi^2$ (5) = 8.098, p = 0.151. Provided that the re-specified model was more parsimonious, and that the factor structure was theoretically justifiable, the two-factor model was retained. In addition, a scaled chi-square difference test between the two-factor model and a one-factor model determined that the two-factor model displayed significantly better model fit than the one-factor model, $\Delta\chi^2$ (1) = 107.85, $p < .001$, which supported the retention of knowledge of policies and procedures (KPP) as a separate factor. Figure 10 displays the path diagram for the retained two-factor model. Standardized factor

loadings (std.lv) of all items were greater than .60, and R^2 values were greater than .40 for all items, except for the reverse-scored items: items seven (std.lv = .34, R^2 = .12) and 11 (std.lv = .41, R^2 = .17); suggesting good item fit. Table 3 displays standardized factor loadings, *p* values, standard errors, and R^2 values for the two-factor model.

The correlation between the two factors was 0.78, which Cheung & Wang (2017) state should not be "significantly larger than 0.7" to demonstrate appropriate discriminant validity. The average variance explained of the general learning environment (GLE) and the KPP factors were .625 and .814 respectively, suggesting that both factors demonstrate high convergent validity. The GLE factor and the KPP factor showed high categorical omegas of 0.89 and 0.95 respectively, which suggests high reliability in both factors.

As the chi-square test was significant and the RMSEA value was higher than 0.60, localized areas of strain were determined by evaluating correlation residuals of the two-factor model with absolute values greater than .10, which indicated that the current model inadequately accounts for a relatively small proportion (25, or 6.6%) of the 378 correlation residuals. The largest correlation residual was .19 and the average absolute value of the correlation residuals was .04. In order to assess the areas of localized strain, correlation residuals are calculated. Correlation residuals are the "difference between the observed value and a predicted value (zero" (Kline, 2011, p. 240). There were 25 areas of localized strain in the two-factor model, which were identified by having a correlation residual over the absolute value of .10. The benchmark of .10 is the rule of thumb for determining the cutoff of acceptability between the observed and predicted value (Kline, 2011). This is out of a total of 378 correlation residuals, which is approximately 8% of

the correlation residuals. While there is no specific threshold for correlation residuals having an absolute value greater than .10, the more there are, the greater the possibility for specification error (Goodboy & Kline, 2017). The number of areas of localized strain for each MSSLE item is shown on Table 4.

Table 3: Factor Loadings for the Two-Factor Model

Item	Standardized Estimates	Standard Error	*p* Value
GLE			
MSSLE1	0.77		0.00
MSSLE2	0.80	0.04	0.00
MSSLE3	0.78	0.03	0.00
MSSLE4	0.83	0.04	0.00
MSSLE5	0.66	0.05	0.00
MSSLE6	0.87	0.04	0.00
MSSLE7	0.34	0.06	0.00
MSSLE8	0.75	0.04	0.00
MSSLE9	0.82	0.04	0.00
MSSLE10	0.60	0.04	0.00
MSSLE11	0.41	0.06	0.00
MSSLE12	0.71	0.04	0.00
MSSLE13	0.89	0.04	0.00
MSSLE14	0.93	0.04	0.00
MSSLE15	0.76	0.04	0.00
MSSLE16	0.84	0.04	0.00
MSSLE17	0.68	0.04	0.00
MSSLE18	0.93	0.05	0.00
MSSLE19	0.82	0.04	0.00
MSSLE20	0.92	0.04	0.00
MSSLE21	0.92	0.04	0.00
MSSLE26	0.92	0.04	0.00
MSSLE27	0.94	0.04	0.00
MSSLE28	0.85	0.04	0.00
KPP			
MSSLE22	0.86		0.00
MSSLE23	0.87	0.03	0.00
MSSLE24	0.91	0.03	0.00
MSSLE25	0.97	0.04	0.00

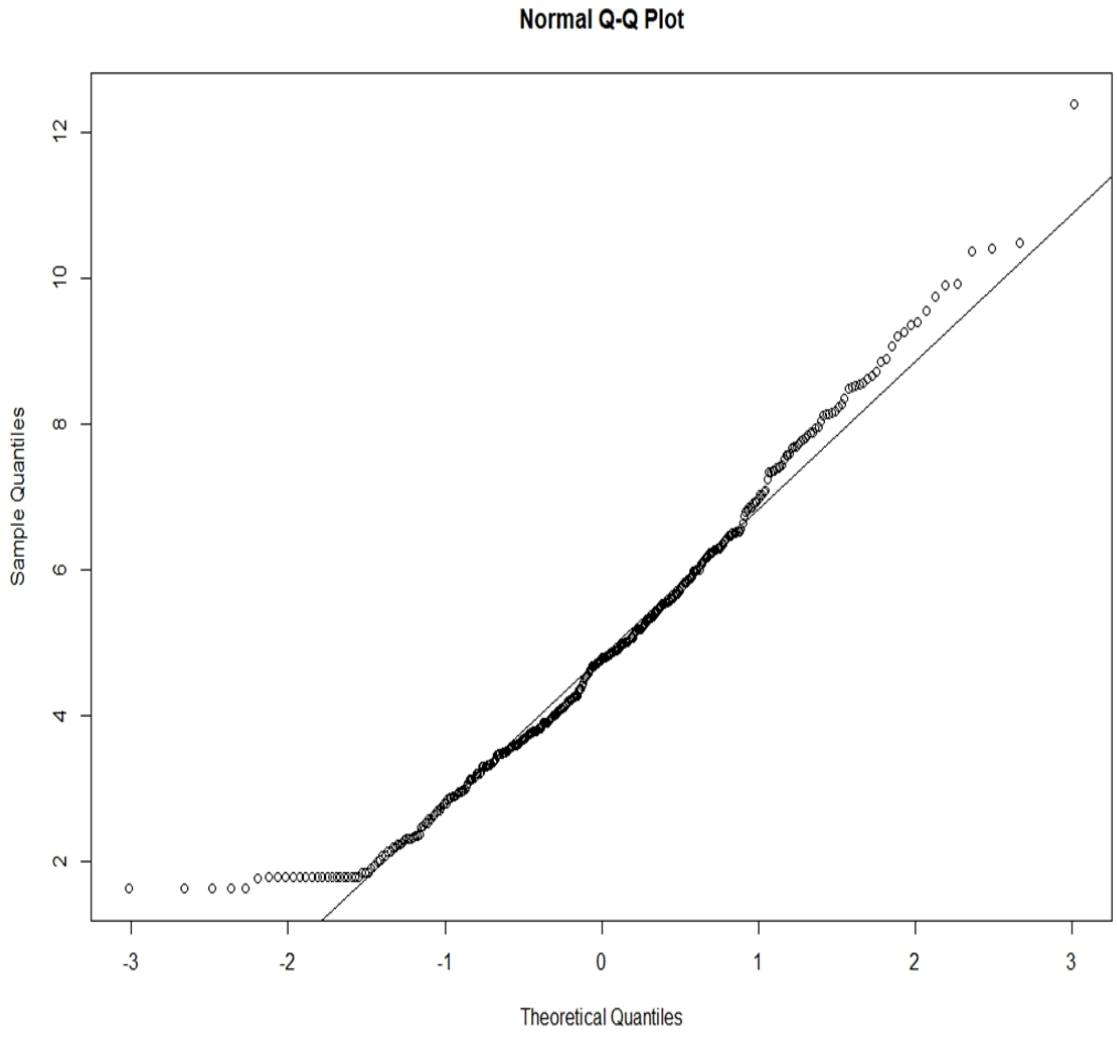


Figure 8: QQ Plot of the MSSLE

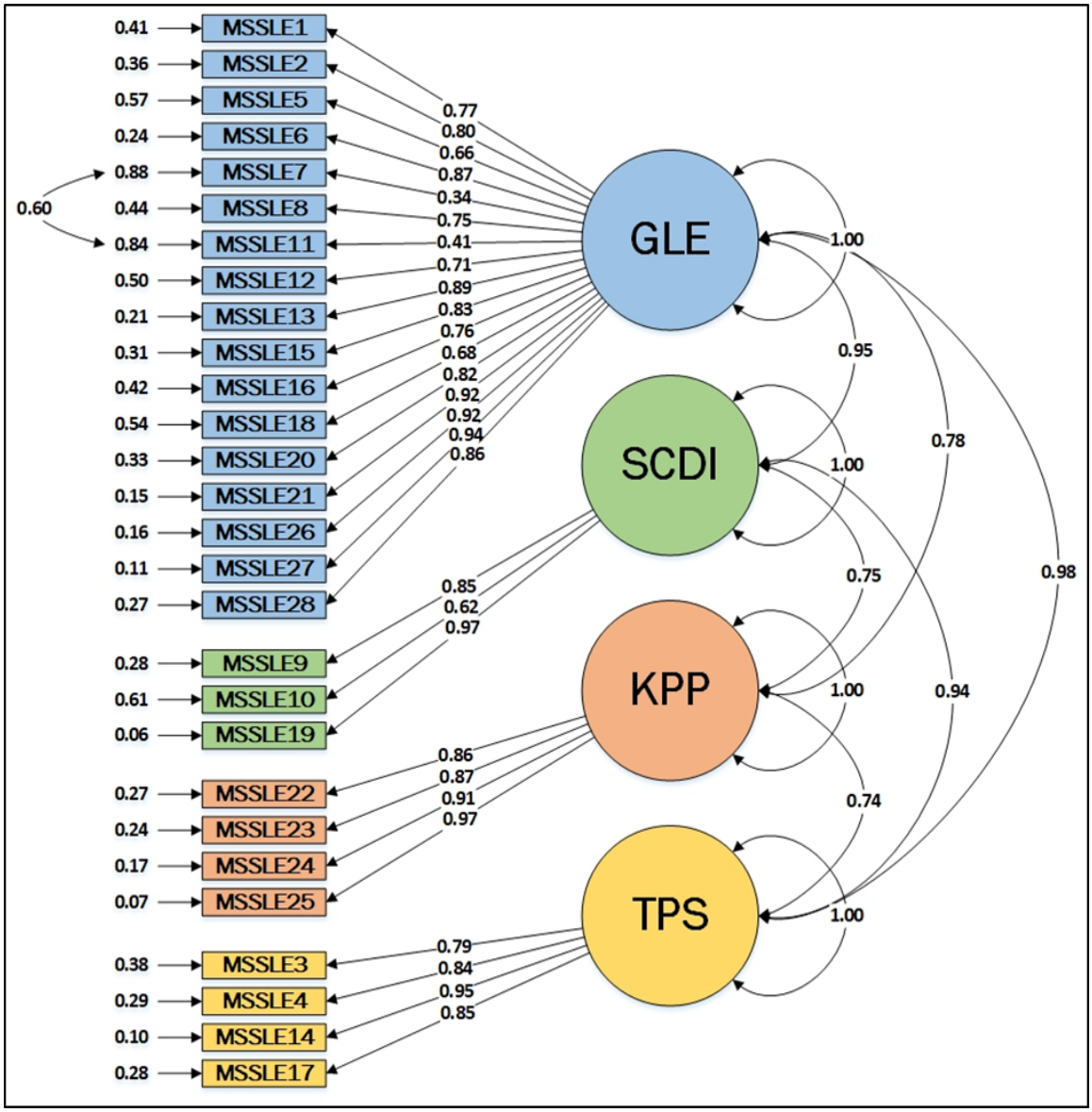


Figure 9: Path diagram of the standardized solution of the proposed four-factor model of the MSSLE

[1] GLE – General Learning Environment; SCDI – Sensitivity to Culture, Diversity, & Inclusion; KPP – Knowledge of Policies & Procedures; TPS – Teamwork & Peer Support.

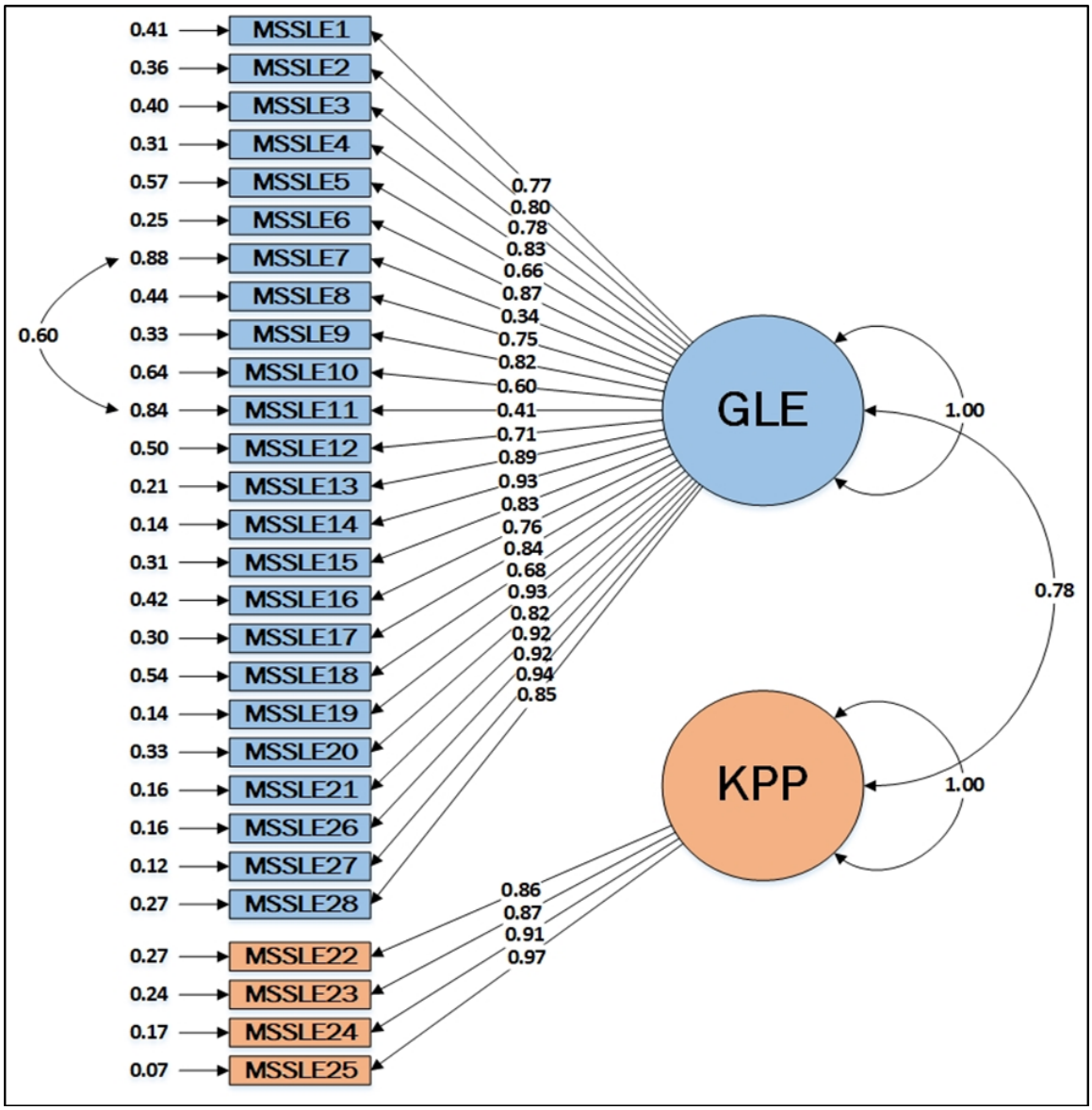


Figure 10: Path diagram of the standardized solution of the retained two-factor model of the MSSLE

[2] GLE – General Learning Environment; KPP – Knowledge of Policies & Procedures

Table 4: Two-Factor Model: Analysis of Correlation Residuals

MSSLE Item	***Number of Residual Correlations >|.1|***
MSSLE1	0
MSSLE2	0
MSSLE3	0
MSSLE4	1
MSSLE5	2
MSSLE6	0
MSSLE7	1
MSSLE8	0
MSSLE9	0
MSSLE10	1
MSSLE11	1
MSSLE12	1
MSSLE13	1
MSSLE14	1
MSSLE15	0
MSSLE16	2
MSSLE17	0
MSSLE18	1
MSSLE19	0
MSSLE20	1
MSSLE21	0
MSSLE22	0
MSSLE23	2
MSSLE24	2
MSSLE25	6
MSSLE26	1
MSSLE27	0
MSSLE28	1

Overall Summary of Results

The chi-square test for the proposed four-factor model was significant (χ^2 = 1,160.890, df = 343, $p < 0.001$). Fit indices ranged from excellent (CFI = 0.967, TLI = 0.964, SRMR = 0.053) to good (RMSEA = 0.078). Factor correlations among three of the proposed factors were higher than 0.85 (General Learning Environment (GLE) and Sensitivity to Culture, Diversity, and Inclusion (SCDI) = 0.95; GLE and Teamwork and Peer Support (TPS) = 0.98; SCDI and TPS = 0.94), indicating that these factors do not measure distinct constructs and were therefore re-specified. The chi-square test for the re-specified two-factor model was also significant (χ^2 = 1,166.612, df = 348, $p < 0.001$), and showed similar levels of fit among the fit indices (CFI = 0.967, TLI = 0.965, SRMR = 0.53, RMSEA = 0.078). The correlation between the two factors of the re-specified model was 0.78, indicating that the two factors display appropriate discriminant validity and measure distinct constructs. Provided that the re-specified model is more parsimonious, and that the factor structure was theoretically justifiable, the two-factor model was retained.

Figure 9 displays the path diagram for the initial four-factor model. Figure 10 displays the path diagram for the retain two-factor model. The two-factor model that was eventually retained showed the latent variables of the General Learning Environment (GLE) and Knowledge of Policies and Procedures (KPP). Table 3 displays the unstandardized estimates, p values, and standard errors for the two-factor model. The GLE factor and the KPP factor of the two-factor model showed high categorical omegas

of 0.89 and 0.95 respectively, which suggests high reliability in both factors (Green & Yang, 2009).

As the chi-square test was significant and the RMSEA value was higher than 0.60, localized areas of strain were determined by evaluating the correlation residuals of the two-factor model. Twenty-five of the 378 correlation residuals indicated localized strain with absolute values greater than .10, indicating that the current model inadequately accounts for 25 relationships among pairs of items within the MSSLE.

Chapter 5

Discussion

The purpose of this instrument development study was to provide a genuine understanding of the learning environment from the unique perspectives of students, faculty, and staff at a public medical school in the Southcentral region of the United States. This chapter includes a brief summary of the results, areas of interest for future research, and concluding remarks.

Summary of Results

In order to further understand the learning environment in a holistic way, this study focused on answering one main research question:

1. To what extent is the proposed instrument valid and reliable for measuring the learning environment at a medical school?

The proposed research question led to the following hypothesis by the researcher:

1. The Multi-Stakeholder Survey of Learning Environments will be a valid and reliable instrument to measure perceptions of the learning environment from medical students, faculty, and staff at medical schools.

The results of the Multi-Stakeholder Survey of Learning Environments (MSSLE) has demonstrated evidence of both validity and reliability as an instrument to measure the aggregate perceptions of the learning environments from students, faculty, and staff at a public medical school in the southcentral region of the United States. This includes demonstration of content validity through the use of a six member expert panel. Additionally, evidence of construct validity was established through the use of

confirmatory factor analysis (CFA), which resulted in a parsimonious two-factor model that measures: i) the general learning environment (GLE) and ii) knowledge of policies and procedures (KPP). Statistical analyses, including correlations, indicated appropriate discriminant and convergent validity, which is evidence of construct validity. Additionally, categorical omegas were conducted, which indicated high reliability in both the GLE and KPP factors.

The theoretical frameworks that guided this study, and that were presented in chapter two, were Schlossberg's transition theory and Senge's learning organization theory. The MSSLE reflects transition theory in two distinct ways: i) the design of the medical school curriculum; and ii) the expectations of the Liaison Committee on Medical Education (LCME) accreditation standards.

The first instance of the Schlossberg's transition theory reflecting this study is in the design of the medical school curriculum. As described extensively in chapter two, the curriculum is a transitional curriculum from all perspectives. Medical students will be transitioning through different phases of their education, including the pre-clerkship phase, clinical phase, elective phase, etc. However, even within these phases many transitions occur. This includes the clinical phases of the curriculum that requires students to have patient encounters and work in various different hospitals, community clinics, etc. and with many different faculty preceptors. Additionally, the medical school faculty and staff are also encountering many different transitions, similar to the medical students. This includes the faculty working with different students, sometimes on a daily basis. Additionally, staff are also encountering a seemingly endless barrage of different

medical students, from various different medical schools. Often times, this means the faculty must be familiar with the educational objectives of the various different institutions that will be transitioning their students through the hospitals and clinics. This concept is reflected in "**situation**" and "**support**", which are among Schlossberg's four S's, which are the framework and underpinnings of transition theory.

The second instance of transition theory that was reflected in this study was through the LCME accreditation requirements. The LCME Standard 3.5 (LCME, 2019) states the following:

> "A medical school ensures that the learning environment of its medical education program is conducive to the ongoing development of explicit and appropriate professional behaviors in its medical students, faculty, and staff at all locations. The medical school and its clinical affiliates share the responsibility for periodic evaluation of the learning environment in order to identify positive and negative influences on the maintenance of professional standards, develop and conduct appropriate strategies to enhance positive and mitigate negative influences, and identify and promptly correct violations of professional standards" (p. 4).

This accreditation standard that is laid out by the LCME is a requirement of all medical schools in the United States. The idea of medical schools evaluating the professional behaviors and influences on the environment is very much attached to the idea of "**self**". Part of medical education and the learning environment of the institution in which

medical students are trained is helping student develop their future identities as physicians (Shochet et al, 2015).

The second theoretical framework that was used as a lens for this study was Senge's learning organization theory, which was also reflected in this research study in the same two areas: i) the design of the medical school curriculum; and ii) the expectations of the Liaison Committee on Medical Education (LCME) accreditation standards.

The five disciplines of Senge's learning organization theory are: i) systems thinking; ii) personal mastery; iii) mental models; iv) building a shared visions; and v) team learning. These disciplines, are described in chapter two, were easily used to help guide this research. The first way in which learning organization theory is reflected in through the design and implementation of the medical school curriculum. One of the five disciplines, as laid out by Senge is "**team learning**". With regards to delivering the medical school curriculum, team based learning has become a popular approach (Burgess, et al, 2017). Additionally, medical schools rely on the expertise of physicians in the field to help mold the curriculum,

Through the lens of learning organization theory, and reflected in the area of LCME accreditation requirements is the discipline of "**personal mastery**". In medical education, the training and mastery of the content is what drives the curriculum, including learning objectives, required clinical experiences, self-directed learning, and lifelong learning (LCME, 2019). Additionally, the mastery of this content is not only expected, but it is also required and mandated by the LCME (2019), who state "Medical

education program objectives are statements of the knowledge, skills, behaviors, and attitudes that medical students are expected to exhibit as evidence of their achievement by completion of the program" (p. 8).

In addition to the two theoretical frameworks that were used as the lens for this research, the development and use of the MSSLE will also add to the literature regarding medical school professionalism and students mistreatment. These are two areas that are mandated to be assessed by the LCME (LCME, 2019). Medical schools can utilized the results of the MSSLE to both capture instances of professionalism breaches and claims of student mistreatment in real-time, as well as observe patterns overtime. This can be achieved by implementing the MSSLE on a bi-annual or annual basis at the institution, and tracking results longitudinally. This will also assist continuous quality improvement efforts to assess if initiatives by the medical school are being perceived as useful, or if the medical students, faculty, and staff even have awareness of such initiatives. In addition to capturing this data, collecting from the three stakeholder groups will allow institutions to also do direct training with specific groups if necessary, based on the results of the MSSLE. For instance, if faculty results are showing a significance in scores related to knowledge of policies and procedures, additional faculty development could be instituted. Likewise, if medical students are showing increased instances of mistreatment, targeted efforts to addresses or remove offenders could be implemented. Therefore, the creation of the MSSLE through this research endeavor will not only provide additional literature in the field of medical school learning environments, but will also provide a practical

solution for instructions to monitor and assess their personal learning environment while meeting the LCME accreditation requirements.

Implications for Future Research

While the MSSLE appears to be a valid instrument for measuring the perceptions of the learning environment from students, faculty, and staff in the aggregate within a medical school context, it should be noted that data was only collected from one medical school institution. Therefore, future validation of the MSSLE should include student, faculty, and staff samples from other medical school institutions. Additionally, geographic differences in the samples that are collected she be addressed. The institution where the data were collected was in the southcentral region of the United States; further data collection should study the extent to which MSSLE also shows evidence of validity in institutions in other parts of the country, as well as private institutions.

Further data collection should also address the concerns surrounding sample size. While the sample size for this study (n = 388) is appropriate for the analyses that were conducted (Kline, 2011), a more robust sample for each group would be preferential. Additionally, to address the limitation of measurement invariance, a more robust sample for each of the three stakeholder groups (students, faculty, and staff) would have allowed for these groups to be analyzed separately.

Another implication for research would be to further validate the instrument using convergent validity. In order to demonstrate evidence of convergent validity, Leong & Austin (2006) state: “a scale must correlate significantly and positively with other instruments designed to measure the same construct” (p. 109). Providing evidence of

convergent validity could be considered using multiple approaches and data collection instruments. Some of these options could include the three major instruments discussed in chapter two: i) the Medical School Learning Environment Survey (MSLES); ii) the Johns Hopkins Learning Environment Scale (JHLES); and iii) the Dundee Ready Education Environment Measure (DREEM). Data could be collected from the same sample using both the MSSLE and another learning environment measure (MSLES, JHLES, or DREEM) and then analyzed to see if results from the two data collections efforts resulted in a significant, positive correlation, thus providing evidence of convergent validity.

Another area for additional data collection to strengthen the validity and reliability of the MSSLE is to conduct cognitive interviews with participants. According to Knafl, et al. (2007) "cognitive interviews assess respondents' understanding of questionnaire items and are increasingly used to improve instrument design" (p. 224). The use of these cognitive interviews could be used with samples of all three stakeholder groups that the MSSLE is intending to capture perceptions of the learning environment from (medical students, faculty, and staff). This technique would provide further evidence of content validity (Knafl, et al., 2007) and would strengthen the overall validation of the MSSLE for future publication.

Finally, the MSSLE may provide a tool for assessing perspectives of the learning environment in other health profession education contexts. For example, nursing schools, dental schools, and pharmacy schools may also be able to benefit from the MSSLE. This

could help these schools not only assess the perceptions of the learning environment internally, but also meet accreditation requirements for their specific accrediting bodies.

Implications for Practice

The creation and validation of the MSSLE not only has implications for research by filling the gap in the literature, but also has implications for practice in the context of medical education where medical students are trained. The ability for the MSSLE to capture instances of mistreatment in more of a "real time" manner can help institutions at both a macro and micro level. At the macro level, it will allow institutions to look at patterns of mistreatment and see if these areas are improved overtime, and can allow administration to target certain areas or subsets of their environment where these instances have occurred. This can include reinforcing policies and also providing mentorship and faculty development opportunities for minor instances. On the micro level, it can pinpoint specific instances and allow administration to intervene and remove problematic faculty, students, or staff that have breach mistreatment policies that may have otherwise gone unnoticed without the MSSLE data.

Additionally, the MSSLE can also aid evaluation and assessment offices at medical schools by providing them with a tool by which they can collect the necessary data from the various constituents and stakeholders at one data collection time. Often times this data has been collected through anonymous reporting or through targeted focus groups to help reveal the perceptions of the learning environment. Unfortunately, focus groups with the different stakeholder groups take much more effort and time from both the evaluation and assessment office staff as well as the participants themselves. The

MSSLE can help streamline these data collection efforts by offering a simplified data collection procedure by utilizing the 28 Likert scale questions. This is also less burdensome to the participants as it will take only a few minutes to complete rather than having busy physicians and students block out much more time from their schedules to participate in a focus group.

Lastly, the ability for institutions to have a streamlined way to collect and analyze data for the LCME accreditation standard 3.5 will also be a much-welcomed addition. There has been much discussion amongst the medical education community around LCME standard 3.5 and how to provide data that demonstrates the competency of the institution in collecting learning environment data from medical students, faculty, and staff to meet this requirement. Not only will with help the institution by providing a tool by which they can continually monitor the environment, but as there are eight years between each LCME accreditation visit, it allows for longitudinal data collection to show areas in which improvements have been made since the institutions last accreditation site visit.

Conclusion

In conclusion, the development of the MSSLE was a substantive first step in creating a valid and reliable instrument to measure perceptions of the learning environment from a holistic group of stakeholders at medical schools. While there is considerable work that still needs to be done, including validating the MSSLE with additional groups of medical students, faculty, and staff at different medical institutions, this instrument has paved the way for that work to continue. Moreover, the validation of

the MSSLE will allow medical school institutions to provide both real-time and longitudinal data regarding the climate of the learning environments at their institutions. Equally important, this will allow for medical schools to provide data that they meet the accreditation requirements of the Liaison Committee on Medical Education (LCME) which states that they institution must provide a conducive learning environment for *all* constituencies, including medical students, faculty, and staff.

References

AAMC. (2020). Medical School Admissions Requirements. Retrieved from https://apps.aamc.org/msar-ui/#/landing

AAMC Regional Campuses at US Medical Schools. (2019). Retrieved from https://www.aamc.org/data-reports/curriculum-reports/interactive-data/regional-campuses-us-medical-schools

Antman, K. (2018). Building on #MeToo to Enhance the Learning Environment for US Medical Schools. *Jama, 319*(17), 1759. doi: 10.1001/jama.2018.3812

Arnold, E. L., Blank, L. L., Race, K. E. H., & Cipparrone, N. (1998). Can Professionalism Be Measured? The Development of a Scale for Use in the Medical Environment. *Academic Medicine, 73*(10), 1119–1121. doi: 10.1097/00001888-199810000-00025

Banta, T. W., Palomba, C. A., & Kinzie, J. L. (2015). *Assessment essentials planning, implementing, and improving assessment in higher education*. San Francisco, CA: Jossey-Bass & Pfeiffer Imprints.

Bentler, P. M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*, 238-246.

Bordens, K. S., & Abbott, B. B. (2014). *Research design and methods: a process approach*. New York: McGraw-Hill.

Brazeau, C. M., Schroeder, R., Rovi, S., & Boyd, L. (2010). Relationships between medical student burnout, empathy, and professionalism climate. *Academic Medicine, 85*. doi: 10.1097/acm.0b013e3181ed4c47

Brown, T. A., & Little, T. D. (2015). *Confirmatory factor analysis for applied research*. New York: Guilford Press.

Buery-Joyner, S. D., Ryan, M. S., Santen, S. A., Borda, A., Webb, T., & Cheifetz, C. (2019). Beyond mistreatment: Learner neglect in the clinical teaching environment. *Medical Teacher*, *41*(8), 949–955. doi: 10.1080/0142159x.2019.1602254

Burgess, A., Bleasel, J., Haq, I., Roberts, C., Garsia, R., Robertson, T., & Mellis, C. (2017). Team-based learning (TBL) in the medical curriculum: better than PBL? *BMC Medical Education*, *17*(1). doi: 10.1186/s12909-017-1068-z

Caverzagie, K. J., Goldenberg, M. G., & Hall, J. M. (2019). Psychology and learning: The role of the clinical learning environment. *Medical Teacher*, *41*(4), 375–379. doi: 10.1080/0142159x.2019.1567910

Chan, D. (2002). Development of the Clinical Learning Environment Inventory: Using the Theoretical Framework of Learning Environment Studies to Assess Nursing Students Perceptions of the Hospital as a Learning Environment. *Journal of Nursing Education*, *41*(2), 69–75. doi: 10.3928/0148-4834-20020201-06

Chapman, E. N., Kaatz, A., & Carnes, M. (2013). Physicians and Implicit Bias: How Doctors May Unwittingly Perpetuate Health Care Disparities. *Journal of General Internal Medicine*, *28*(11), 1504–1510. doi: 10.1007/s11606-013-2441-1

Cheung, G. W., & Wang, C. (2017). Current Approaches for Assessing Convergent and Discriminant Validity with SEM: Issues and Solutions. *Academy of Management Proceedings*, *2017*(1), 12706. doi: 10.5465/ambpp.2017.12706abstract

Clendening, J. (2016, April 21). Medical professionals can change their behavior: study. Retrieved March 30, 2020, from https://news.vumc.org/2016/04/21/medical-professionals-can-change-their-behavior/

Colbert, C. Y., Ogden, P. E., Ownby, A. R., & Bowe, C. (2011). Systems-Based Practice in Graduate Medical Education: Systems Thinking as the Missing Foundational Construct. *Teaching and Learning in Medicine*, *23*(2), 179–185. doi: 10.1080/10401334.2011.561758

Colbert-Getz, J. M., Kim, S., Goode, V. H., Shochet, R. B., & Wright, S. M. (2014). Assessing Medical Students' and Residents' Perceptions of the Learning Environment. *Academic Medicine*, *89*(12), 1687–1693. doi: 10.1097/acm.0000000000000433

Colton, D., & Covert, R. W. (2007). *Designing and constructing instruments for social research and evaluation*. San Francisco: Jossey-Bass.

Connell, J., Carlton, J., Grundy, A., Buck, E. T., Keetharuth, A. D., Ricketts, T., … Brazier, J. (2018). The importance of content and face validity in instrument development: lessons learnt from service users when developing the Recovering Quality of Life measure (ReQoL). *Quality of Life Research*, *27*(7), 1893–1902. doi: 10.1007/s11136-018-1847-y

Cook, A. F., Arora, V. M., Rasinski, K. A., Curlin, F. A., & Yoon, J. D. (2014). The Prevalence of Medical Student Mistreatment and Its Association With Burnout. *Academic Medicine*, *89*(5), 749–754. doi: 10.1097/acm.0000000000000204

Cook, D. A., & Beckman, T. J. (2006). Current Concepts in Validity and Reliability for Psychometric Instruments: Theory and Application. *The American Journal of Medicine*, *119*(2). doi: 10.1016/j.amjmed.2005.10.036

Cornelius, L. J., & Harrington, D. (2014). *A social justice approach to survey design and analysis*. New York: Oxford University Press.

Cruess, R. L., Cruess, S. R., Boudreau, J. D., Snell, L., & Steinert, Y. (2014). Reframing Medical Education to Support Professional Identity Formation. *Academic Medicine*, *89*(11), 1446–1451. doi: 10.1097/acm.0000000000000427

Damiano, R. F., Furtado, A. O., Silva, B. N. D., Ezequiel, O. D. S., Lucchetti, A. L., Dilalla, L. F., … Lucchetti, G. (2020). Measuring Students' Perceptions of the Medical School Learning Environment: Translation, Transcultural Adaptation, and Validation of 2 Instruments to the Brazilian Portuguese Language. *Journal of Medical Education and Curricular Development*, *7*, 238212052090218. doi: 10.1177/2382120520902186

Dewsnap, M. (2019). *Leep and Oea.*

Dinnesen, M. S., Olszewski, A., Breit-Smith, A., & Guo, Y. (2018). Collaborating With an Expert Panel to Establish the Content Validity of an Intervention for Preschoolers With Language Impairment. *Communication Disorders Quarterly*, *41*(2), 86–99. doi: 10.1177/1525740118795158

DiStefano, C., & Motl, R. W. (2006). Further Investigating Method Effects Associated With Negatively Worded Items on Self-Report Surveys. *Structural Equation Modeling; A Multidisciplinary Journal*, *13*(3), 440-464.

Downing, S. M. (2003). Validity: on the meaningful interpretation of assessment data. *Medical Education*, *37*(9), 830–837. doi: 10.1046/j.1365-2923.2003.01594.x

Dublin, B. (2016). Innovative Curriculum Prepares Medical Students for a Lifetime of Learning and Patient Care. *Kansas City University of Medicine and Biosciences Dean's Report*, *113*(3), 170–173.

Dunham, L., Dekhtyar, M., Gruener, G., Cichoskikelly, E., Deitz, J., Elliott, D., … Skochelak, S. E. (2017). Medical Student Perceptions of the Learning Environment in Medical School Change as Students Transition to Clinical Training in Undergraduate Medical School. *Teaching and Learning in Medicine*, *29*(4), 383–391. doi: 10.1080/10401334.2017.1297712

Dyrbye, L. N., Thomas, M. R., Harper, W., Massie, F. S., Power, D. V., Eacker, A., … Shanafelt, T. D. (2009). The learning environment and medical student burnout: a multicentre study. *Medical Education*, *43*(3), 274–282. doi: 10.1111/j.1365-2923.2008.03282.x

Dyrbye, L. N., Massie, F. S., Eacker, A., Harper, W., Power, D., Durning, S. J., … Shanafelt, T. D. (2010). Relationship Between Burnout and Professional Conduct and Attitudes Among US Medical Students. *Jama*, *304*(11), 1173. doi: 10.1001/jama.2010.1318

Feletti, G. I., & Clarke, R. M. (1981). Construct Validity of a Learning Environment Survey for Medical Schools. *Educational and Psychological Measurement*, *41*(3), 875–882. doi: 10.1177/001316448104100330

Fleit, H. B., Iuli, R. J., Fischel, J. E., Lu, W.-H., & Chandran, L. (2017). A model of influences on the clinical learning environment: the case for change at one U.S. medical school. *BMC Medical Education*, *17*(1), 63. https://doi-org.srv-proxy1.library.tamu.edu/10.1186/s12909-017-0900-9

Flora, D. B., & Curran, P. J. (2004). An Empirical Evaluation of Alternative Methods of Estimation for Confirmatory Factor Analysis With Ordinal Data. *Psychological Methods*, *9*(4), 466-491. doi:https://doi.org/10.1037/1082-989X.9.4.466

Furr, R. M., & Bacharach, V. R. (2014). *Psychometrics: An Introduction* (2 ed.). Edn Thousand Oaks, CA: SAGE Publications.

Gan, R., & Snell, L. (2014). When the Learning Environment Is Suboptimal. *Academic Medicine*, *89*(4), 608–617. doi: 10.1097/acm.0000000000000172

Genn, J. (2001). AMEE Medical Education Guide No. 23 (Part 1): Curriculum, environment, climate, quality and change in medical education–a unifying perspective. *Medical Teacher*, *23*(4), 337–344. doi: 10.1080/01421590120063330

Goodboy, A. K., & Kline, R. B. (2017). Statistical and Practical Concerns With Published Communication Research Featuring Structural Equation Modeling. *Communication Research Reports*, *34*(1), 68–77. doi: 10.1080/08824096.2016.1214121

Graduation Questionnaire (GQ). (2019). Retrieved from https://www.aamc.org/data-reports/students-residents/report/graduation-questionnaire-gq

Green, S. B., & Yang, Y. (2009). Reliability of summed item scores using structural equation modeling: an alternative to coefficient alpha. *Psychometrika, 74*, k155-167.

Gruppen, L. D. (2019). Context and complexity in the clinical learning environment. *Medical Teacher, 41*(4), 373–374. doi: 10.1080/0142159x.2019.1566599

Hafferty, F. W. (1998). Beyond curriculum reform. *Academic Medicine, 73*(4), 403–7. doi: 10.1097/00001888-199804000-00013

Hickson, G. B., Pichert, J. W., Webb, L. E., & Gabbe, S. G. (2007). A Complementary Approach to Promoting Professionalism: Identifying, Measuring, and Addressing Unprofessional Behaviors. *Academic Medicine*, *82*(11), 1040–1048. doi: 10.1097/acm.0b013e31815761ee

Holden, M., Buck, E., Clark, M., Szauter, K., & Trumble, J. (2012). Professional Identity Formation in Medical Education: The Convergence of Multiple Domains. *HEC Forum*, *24*(4), 245–255. doi: 10.1007/s10730-012-9197-6

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Jöreskog, K. G., & Sörbom, D. (1981). *LISREL V: Analysis of linear structural relationships by the method of maximum likelihood.* Chicago: National Educational Resources.

Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2019). semTools: Useful tools for structural equation modeling. Retrieved from https://CRAN.R-project.org/package=semTools

Jorm, C., & Roberts, C. (2018). Using Complexity Theory to Guide Medical School Evaluations. *Academic Medicine*, *93*(3), 399–405. doi: 10.1097/acm.0000000000001828

Karani, R. (2015). Enhancing the Medical School Learning Environment: A Complex Challenge. *Journal of General Internal Medicine*, *30*(9), 1235–1236. doi: 10.1007/s11606-015-3422-3

Kelley, K., & Pornprasertmanit, S. (2016). Confidence intervals for population reliability coefficients: Evaluation of methods, recommendations, and software for composite measures. *Psychological Methods*, *21*(1), 69–92. doi: 10.1037/a0040086

Killam, W. K., & Degges-White, S. (2017). *College student development: applying theory to practice on the diverse campus*. New York, NY: Springer Publishing Company, LLC.

Kline, R. B. (2011). *Principles and practice of structural equation modeling.* New York: Guilford Press.

Knafl, K., Deatrick, J., Gallo, A., Holcombe, G., Bakitas, M., Dixon, J., & Grey, M. (2007). The analysis and interpretation of cognitive interviews for instrument development. Research in Nursing & Health, 30(2), 224–234. doi: 10.1002/nur.20195

Kost, A., & Chen, F. M. (2015). Socrates Was Not a Pimp. *Academic Medicine*, *90*(1), 20–24. doi: 10.1097/acm.0000000000000446

LCME. (2019). *Functions and Structure of a Medical School Standards for Accreditation of Medical Education Programs Leading to the Md Degree*. Retrieved from https://lcme.org/publications/#Standards

Learning Objectives for Medical Student Education— Guidelines for Medical Schools: Report I of the Medical School Objectives Project. (1999). *Journal of the Association of American Medical Colleges*, *74*(1), 13–18. doi: 10.1097/00001888-199901000-00010

Leavy, P. (2017). *Research design: quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. New York: Guildord Press.

Leong, F. T. L., & Austin, J. T. (2006). *The psychology research handbook: a guide for graduate students and research assistants* (second). Thousand Oaks, CA: Sage.

Lerner, S., Magrane, D., & Friedman, E. (2009). Teaching Teamwork in Medical Education. *Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine*, *76*(4), 318–329. doi: 10.1002/msj.20129

LI, C. (2015). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods, 48*, 936-949. doi:https://doi.org/10.3758/s13428-015-0619-7

Litwin, M. S. (1995). *How to measure survey reliability and validity: The survey kit, volume 7*. Thousand Oaks, CA: Sage.

Lizzio, A., Wilson, K., & Simons, R. (2002). University Students Perceptions of the Learning Environment and Academic Outcomes: Implications for theory and practice. *Studies in Higher Education*, *27*(1), 27–52. doi: 10.1080/03075070120099359

Magnus, L., Vassilis, B., Grano, C., Lucidi, F., Raudsepp, L., Liukkonen, J., & Thøgersen-Ntoumani, C. (2012). Method Effects: The Problem With Negatively Versus Positively Keyed Items. *Journal of Perosnality Assessment*, *94*(2), 196-204.

Marcu, M. I., Kellermann, A. L., Hunter, C., Curtis, J., Rice, C., & Wilensky, G. R. (2017). Borrow or Serve? An Economic Analysis of Options for Financing a Medical School Education. *Academic Medicine*, *92*(7), 966–975. doi: 10.1097/acm.0000000000001572

Mardia, K. V. (1970). Measures of Multivariate Skewness and Kurtosis with Applications. *Biometrika*, *57*, 519-530. doi:https://doi.org/10.1093/biomet/57.3.519

Marshall, R. E. (1978). Measuring the medical school learning environment. *Academic Medicine*, *53*(2), 98–104. doi: 10.1097/00001888-197802000-00003

Marshall, S. P. (1995). *Schemas in problem solving*. Cambridge: Cambridge University Press.

Mavis, B., Sousa, A., Lipscomb, W., & Rappley, M. D. (2014). Learning About Medical Student Mistreatment From Responses to the Medical School Graduation Questionnaire. *Academic Medicine*, *89*(5), 705–711. doi: 10.1097/acm.0000000000000199

Mennin, S. (2010). Self-organisation, integration and curriculum in the complex world of medical education. *Medical Education*, *44*(1), 20–30. doi: 10.1111/j.1365-2923.2009.03548.x

Mirowsky, J., & Ross, C. (1991). Eliminating Defense and Agreement Bias from Measures of the Sense of Control: A 2 X 2 Index. *Social Psychology Quarterly, 54*(2), 127-145.

Morrow, J., & Skolits, G. (2013, October). *Twelve steps of data cleaning: Strategies for dealing with dirty evaluation data.* Workshop presented at the annual meeting of the American Evaluation Association, Washington, DC.

Nagraj, S., Wall, D., & Jones, E. (2006). Can STEEM be used to measure the educational environment within the operating theatre for undergraduate medical students? *Medical Teacher, 28*(7), 642–647. doi: 10.1080/01421590600922875

Nordquist, J., Hall, J., Caverzagie, K., Snell, L., Chan, M.-K., Thoma, B., … Philibert, I. (2019). The clinical learning environment. *Medical Teacher*, *41*(4), 366–372. doi: 10.1080/0142159x.2019.1566601

Nordquist, J., Chan, M.-K., Maniate, J., Cook, D., Kelly, C., & Mcdougall, A. (2019). Examining the clinical learning environment through the architectural avenue. *Medical Teacher, 41*(4), 403–407. doi: 10.1080/0142159x.2019.1566603

Orom, H., Semalulu, T., & Underwood, W. (2013). The Social and Learning Environments Experienced by Underrepresented Minority Medical Students. *Academic Medicine*, *88*(11), 1765–1777. doi: 10.1097/acm.0b013e3182a7a3af

Pai, P. G. (2014). Medical Students' Perception of Their Educational Environment. *Journal Of Clinical And Diagnostic Research*. doi: 10.7860/jcdr/2014/5559.3944

Papadakis, M. A., Loeser, H., & Healy, K. (2001). Early Detection and Evaluation of Professionalism Deficiencies in Medical Students. *Academic Medicine*, *76*(11), 1100–1106. doi: 10.1097/00001888-200111000-00010

Papadakis, M. A., Teherani, A., Banach, M. A., Knettler, T. R., Rattner, S. L., Stern, D. T., … Hodgson, C. S. (2005). Disciplinary Action by Medical Boards and Prior Behavior in Medical School. *New England Journal of Medicine*, *353*(25), 2673–2682. doi: 10.1056/nejmsa052596

Philibert, I., Elsey, E., Fleming, S., & Razack, S. (2019). Learning and professional acculturation through work: Examining the clinical learning environment through the sociocultural lens. *Medical Teacher*, *41*(4), 398–402. doi: 10.1080/0142159x.2019.1567912

R Core Team. (2019). R: A Language and Environment for Statistical Computing. Vienna, Austria. Retrieved from https://www.R-project.org

Roff, S., Mcaleer, S., Harden, R. M., Al-Qahtani, M., Ahmed, A. U., Deza, H., … Primparyon, P. (1997). Development and validation of the Dundee Ready Education Environment Measure (DREEM). *Medical Teacher*, *19*(4), 295–299. doi: 10.3109/01421599709034208

Roff, S., Mcaleer, S., & Skinner, A. (2005). Development and validation of an instrument to measure the postgraduate clinical learning and teaching educational environment for hospital-based junior doctors in the UK. *Medical Teacher, 27*(4), 326–331. doi: 10.1080/01421590500150874

Roff, S. (2005). The Dundee Ready Educational Environment Measure (DREEM)—a generic instrument for measuring students' perceptions of undergraduate health professions curricula. *Medical Teacher*, *27*(4), 322–325. doi: 10.1080/01421590500151054

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1-36. Retrieved from http://www.jstatsoft.org/v48/i02/

Rusticus, S., Worthington, A., Wilson, D., & Joughin, K. (2014). The Medical School Learning Environment Survey: an examination of its factor structure and relationship to student performance and satisfaction. *Learning Environments Research, 17*(3), 423–435. doi: 10.1007/s10984-014-9167-9

Satorra, A. (2000). Scaled and adjusted restricted tests in multi-sample analysis of moment structures. In R. D. Heijmans, D. S. Pollock, & A. Satorra (Eds.), *Innovations in multivariate statistical analysis. A Festschrift for Heinz Neudecker* (pp. 233-247). London, UK: Kluwer Academic Publishers.

Schlossberg, N. K., Waters, E. B., & Goodman, J. (1995). *Counseling adults in transition: linking practice with theory*. New York: Springer Pub. Co.

Schlossberg, N. K. (2008). *Overwhelmed: coping with lifes ups and downs*. Lanham, MD: Rowman & Littlefield Pub. Group.

Schriesheim, C. A., & Hill, K. D. (1981). Controlling Acquiescence Response Bias by Item Reversals: The Effect on Questionnaire Validity. *Educational and Psychological Measurement, 41*(4), 1101–1114. doi:https://doi.org/10.1177/001316448104100420

Senge, P. M. (1994). *The fifth discipline: the art and practice of the learning organization*. New York, NY: Currency Doubleday.

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika, 52*(3-4), 591-611. doi:doi:10.1093/biomet/52.3-4.591

Shrank, W. H., Reed, V. A., & Jernstedt, C. (2004). Fostering professionalism in medical education. *Journal of General Internal Medicine, 19*(8), 887–892. doi: 10.1111/j.1525-1497.2004.30635.x

Shochet, R. B., Colbert-Getz, J. M., & Wright, S. M. (2015). The Johns Hopkins Learning Environment Scale. *Academic Medicine, 90*(6), 810–818. doi: 10.1097/acm.0000000000000706

Slavin, S. J., Schindler, D. L., & Chibnall, J. T. (2014). Medical Student Mental Health 3.0. *Academic Medicine, 89*(4), 573–577. doi: 10.1097/acm.0000000000000166

Smith, K. L., Saavedra, R., Raeke, J. L., & O'Donell, A. A. (2007). The Journey to Creating a Campus-Wide Culture of Professionalism. *Academic Medicine*, *82*(11), 1015–1021. doi: 10.1097/acm.0b013e318157633e

Soemantri, D., Herrera, C., & Riquelme, A. (2010). Measuring the educational environment in health professions studies: A systematic review. *Medical Teacher*, *32*(12), 947–952. doi: 10.3109/01421591003686229

Stanton, A., Zandvliet, D., Dhaliwal, R., & Black, T. (2016). Understanding Students' Experiences of Well-Being in Learning Environments. *Higher Education Studies*, *6*(3), 90. doi: 10.5539/hes.v6n3p90

Stern, David. *Measuring Medical Professionalism*. New York, Oxford University Press, 2006.

St-Onge, C., Young, M., Eva, K. W., & Hodges, B. (2016). Validity: one word with a plurality of meanings. *Advances in Health Sciences Education*, *22*(4), 853–867. doi: 10.1007/s10459-016-9716-3

Tempski, P., Santos, I. S., Mayer, F. B., Enns, S. C., Perotta, B., Paro, H. B. M. S., … Martins, M. A. (2015). Relationship among Medical Student Resilience, Educational Environment and Quality of Life. *Plos One*, *10*(6). doi: 10.1371/journal.pone.0131535

Tom. (2020, February 27). A Brief Synopsis of Medical School - From First Year to Residency. Retrieved from https://www.petersons.com/blog/a-brief-synopsis-of-medical-school-medical-school-requirements/

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38*, 1–10.

Vath, B. E. (2001). Volunteer physician faculty and the changing face of medicine. *Western Journal of Medicine, 174*(4), 242–246. doi: 10.1136/ewjm.174.4.242

Villiers, M. D., Schalkwyk, S. V., Blitz, J., Couper, I., Moodley, K., Talib, Z., & Young, T. (2017). Decentralised training for medical students: a scoping review. *BMC Medical Education, 17*(1). doi: 10.1186/s12909-017-1050-9

Vinson, D. C., & Paden, C. (1994). The effect of teaching medical students on private practitioners' workloads. *Academic Medicine, 69*(3), 237–8. doi: 10.1097/00001888-199403000-00020

Wasson, L. T., Cusmano, A., Meli, L., Louh, I., Falzon, L., Hampsey, M., … Davidson, K. W. (2016). Association Between Learning Environment Interventions and Medical Student Well-being. *Jama*, *316*(21), 2237. doi: 10.1001/jama.2016.17573

Watson, D. (1992). Correcting for Acquiescent Response Bias in the Absence of a Balanced Scale: An Application to Class Consciousness. *Sociological Methods & Research, 21*(1), 52-88. doi: https://doi.org/10.1177/0049124192021001003

Webb, L. E., Dmochowski, R. R., Moore, I. N., Pichert, J. W., Catron, T. F., Troyer, M., … Hickson, G. B. (2016). Using Coworker Observations to Promote Accountability for Disrespectful and Unsafe Behaviors by Physicians and Advanced Practice Professionals. *The Joint Commission Journal on Quality and Patient Safety*, *42*(4). doi: 10.1016/s1553-7250(16)42019-2

Woodruff, J. N. (2019). Accounting for complexity in medical education: a model of adaptive behaviour in medicine. *Medical Education*, *53*(9), 861–873. doi: 10.1111/medu.13905

Wynia, M. K., Papadakis, M. A., Sullivan, W. M., & Hafferty, F. W. (2014). More Than a List of Values and Desired Behaviors. *Academic Medicine*, *89*(5), 712–714. doi: 10.1097/acm.0000000000000212

Yang, Y., & Green, S. B. (2011). Coefficient alpha: a reliability coefficient for the 21st century? *Journal of Psychoeducational Assessment*, *29*, 377-392.

Yang, Y., & Green, S. B. (2015). Evaluation of structural equation modeling estimates of reliability for scales with ordered categorical items. *Methodology*, *11*, 23-34.

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A.-R. (2015). Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. *Journal of Caring Sciences*, *4*(2), 165–178. doi: 10.15171/jcs.2015.017

Appendices

Appendix A – Informed Consent

INFORMED CONSENT STATEMENT:
Creation and Validation of the Learning Environment Survey

A. INTRODUCTION You are invited to take part in a research study designed to understand the learning environment at the medical school. The research is being conducted by the Office of Evaluation and Assessment at the College of Medicine.

B. INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY Your involvement in the study would include participating in an online survey for about 5-10 minutes.

C. RISKS There are no known risks associated with your participation in the project greater than those encountered in everyday life.

D. BENEFITS This research will help to understand and improve the learning environment at your institution. There is no direct benefit to you for participating in the research study.

E. CONFIDENTIALITY Confidentiality cannot be guaranteed, but no identifying information will be collected from participants. Participant data will not be attributed to specific individuals. Data will be stored securely and only made available to the research and evaluation team at the university.

F. CONTACT INFORMATION If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the Protocol Director, Kevin Kidder at kidder@tamu.edu and (713) 214-3691 or the Principal Investigator, Michael Dewsnap at dewsnap@tamu.edu. If you have questions about your rights as a participant, you may contact the [redacted] IRB Research Compliance Office at [redacted]

G. PARTICIPATION Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time.

H. CONSENT I have read the above information. By clicking OK, I agree to participate in this study and will be directed to the survey.

Appendix B – Proposed Instrument (prior to expert panel review)

Please rate the extent to which you agree with each statement using the following scale:
1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree

Question #	Question
1	I am able to contribute to the learning environment in a positive way.
2	The educational environment encourages me to treat others with empathy.
3	The educational environment provides opportunities for me to collaborate with others.
4	I have been or I have seen others be excellent role models to medical students.
5	I enjoy working with medical students.
6	Students, faculty, residents, and staff generally behave professionally.
7	I have never witnessed or been a recipient of mistreatment by students, residents, faculty, or staff.
8	Medical student complaints are responded to in an appropriate fashion.
9	The educational environment fosters a culture that values diversity and inclusion.
10	My colleagues exhibit awareness of cultural biases in themselves and in the health care system.
11	I have not been a witness or recipient of mistreatment based on gender, race, ethnicity, sexual orientation, etc.
12	I feel included as a member of the medical school.
13	The educational environment promotes an intellectually dynamic climate.
14	The educational environment fosters opportunities for positive professional relationships.
15	The faculty/residents are enthusiastic and motivating.
16	The medical students are enthusiastic and motivated.
17	My colleagues create an atmosphere of trust and support.
18	I am comfortable asking questions to my superiors.
19	The educational environment encourages me to treat everyone with respect and dignity.
20	The educational environment allows my colleagues to feel comfortable requesting feedback.
21	The medical school and clinical facilities are conducive to learning and growth.
22	The procedures for reporting harassment (e.g., sexual and/or racial, etc.) are clear.
23	I am aware of learning environment initiatives by the medical school.
24	I am aware of how to use at least one of the available mechanisms to report concerns or issues regarding the educational environment.
25	I feel comfortable using at least one of the available mechanisms to report concerns or issues regarding the educational environment.
26	I feel valued in the educational environment.
27	The educational environment promotes an appreciation of others.

Appendix C - Expert Panel Instructions

Below are a list of questions that are intended to measure the perceptions of the learning environment of a medical school from the perspective of (students; faculty; or staff member) of a medical school. Please use the rubric and rate each question in one of the following categories:

1. Acceptable as is
2. Requires revisions as follows (please provide feedback how to improve)
3. Unacceptable/remove

Please note that following each question you will be able to provide additional comments if you would like, but is not required.

Appendix D – Expert Panel Rating Guide

Question	Acceptable as is	Requires revisions as follows	Unacceptable /Remove	Additional Comments
I am able to contribute to the learning environment in a positive way.				
The educational environment encourages me to treat others with empathy.				
The educational environment provides opportunities for me to collaborate with others.				
I have been or I have seen others be excellent role models to medical students.				
I enjoy working with medical students.				
Students, faculty, residents, and staff generally behave professionally.				
I have never witnessed or been a recipient of mistreatment by students, residents, faculty, or staff.				
Medical student complaints are responded to in an appropriate fashion.				

The educational environment fosters a culture that values diversity and inclusion.				
My colleagues exhibit awareness of cultural biases in themselves and in the health care system.				
I have not been a witness or recipient of mistreatment based on gender, race, ethnicity, sexual orientation, etc.				
I feel included as a member of the medical school.				
The educational environment promotes an intellectually dynamic climate.				
The educational environment fosters opportunities for positive professional relationships.				
The faculty/residents are enthusiastic and motivating.				
The medical students are enthusiastic and motivated.				
My colleagues create an atmosphere of trust and support.				
I am comfortable asking questions to my superiors.				

The educational environment encourages me to treat everyone with respect and dignity.				
The educational environment allows my colleagues to feel comfortable requesting feedback.				
The medical school and clinical facilities are conducive to learning and growth.				
The procedures for reporting harassment (e.g., sexual and/or racial, etc.) are clear.				
I am aware of learning environment initiatives by the medical school.				
I am aware of how to use at least one of the available mechanisms to report concerns or issues regarding the educational environment.				
I feel comfortable using at least one of the available mechanisms to report concerns or issues regarding the educational environment.				
I feel valued in the educational environment.				

The educational environment promotes an appreciation of others.				

Final rubric question: Please provide any additional feedback regarding the survey instrument or items that you believe should be added (optional).

Appendix E – Changes in questions based on expert panel feedback

Question Number	Original Item	Revised Item
1	I am able to contribute to the learning environment in a positive way.	No changes.
2	The educational environment encourages me to treat others with empathy.	The learning environment encourages me to treat others with empathy.
3	The educational environment provides opportunities for me to collaborate with others.	The learning environment provides opportunities for me to collaborate with others.
4	I have been or I have seen others be excellent role models to medical students.	There are excellent role models within the learning environment.
5	I enjoy working with medical students.	I enjoy working with medical students.
6	Students, faculty, residents, and staff generally behave professionally.	The learning environment encourages professional behavior.
7	I have never witnessed or been a recipient of mistreatment by students, residents, faculty, or staff.	I have witnessed mistreatment of others.
8	Medical student complaints are responded to in an appropriate fashion.	Concerns/complaints are responded to in a timely matter.
9	The educational environment fosters a culture that values diversity and inclusion.	The learning environment fosters a culture that values diversity and inclusion.
10	My colleagues exhibit awareness of cultural biases in themselves and in the health care system.	My peers exhibit awareness of cultural biases in themselves.
11	I have not been a witness or recipient of mistreatment based on gender, race, ethnicity, sexual orientation, etc.	I have been a recipient of mistreatment.

12	I feel included as a member of the medical school.	I feel valued as a member of the medical school.
13	The educational environment promotes an intellectually dynamic climate.	The learning environment promotes an intellectually stimulating climate.
14	The educational environment fosters opportunities for positive professional relationships.	The learning environment fosters opportunities for positive, professional relationships.
15	The faculty/residents are enthusiastic and motivating.	The faculty are enthusiastic and motivating.
16	The medical students are enthusiastic and motivated.	The medical students are enthusiastic and motivated.
17	My colleagues create an atmosphere of trust and support.	My peers create an atmosphere of trust and support.
18	I am comfortable asking questions to my superiors.	I am comfortable asking my superior questions.
19	The educational environment encourages me to treat everyone with respect and dignity.	The learning environment fosters a culture of respect and dignity of others.
20	The educational environment allows my colleagues to feel comfortable requesting feedback.	I feel comfortable requesting feedback.
21	The medical school and clinical facilities are conducive to learning and growth.	The learning environment is conducive to learning and growth.
22	The procedures for reporting harassment (e.g., sexual and/or racial, etc.) are clear.	The procedures for reporting harassment (e.g., sexual and/or racial, etc.) and mistreatment are clear.
23	I am aware of learning environment initiatives by the medical school.	I am aware of initiatives to improve the learning environment.

24	I am aware of how to use at least one of the available mechanisms to report concerns or issues regarding the educational environment.	I am aware of how to report concerns or issues regarding the learning environment.
25	I feel comfortable using at least one of the available mechanisms to report concerns or issues regarding the educational environment.	I am comfortable reporting concerns or issues regarding the learning environment.
26	I feel valued in the educational environment.	I feel valued in the learning environment.
27	The educational environment promotes an appreciation of others.	The learning environment promotes appreciation of others.
28	No question 28.	Medical school leadership promotes a positive learning environment.

Appendix F – Final Instrument

Please rate the extent to which you agree with each statement using the following scale:
1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree

Question #	Question
1	I am able to contribute to the learning environment in a positive way.
2	The learning environment encourages me to treat others with empathy.
3	The learning environment provides opportunities for me to collaborate with others.
4	There are excellent role models within the learning environment.
5	I enjoy working with medical students.
6	The learning environment encourages professional behavior.
7	I have witnessed mistreatment of others.
8	Concerns/complaints are responded to in a timely matter.
9	The learning environment fosters a culture that values diversity and inclusion.
10	My peers exhibit awareness of cultural biases in themselves.
11	I have been a recipient of mistreatment.
12	I feel valued as a member of the medical school.
13	The learning environment promotes an intellectually stimulating climate.
14	The learning environment fosters opportunities for positive, professional relationships.
15	The faculty are enthusiastic and motivating.
16	The medical students are enthusiastic and motivated.
17	My peers create an atmosphere of trust and support.
18	I am comfortable asking my superior questions.
19	The learning environment fosters a culture of respect and dignity of others.
20	I feel comfortable requesting feedback.
21	The learning environment is conducive to learning and growth.
22	The procedures for reporting harassment (e.g., sexual and/or racial, etc.) and mistreatment are clear.
23	I am aware of initiatives to improve the learning environment.
24	I am aware of how to report concerns or issues regarding the learning environment.
25	I am comfortable reporting concerns or issues regarding the learning environment.
26	I feel valued in the learning environment.
27	The learning environment promotes appreciation of others.
28	Medical school leadership promotes a positive learning environment.

Appendix G – Recruitment Email

Greetings.

[redacted] is currently conducting a research study about the medical school learning environment for faculty, staff, and students. I am emailing to ask if you would take approximately 5-10 minutes to complete a survey. To participate, you must be 18 years of age or older, and currently a faculty, staff, or student at the medical school. Participation is completely voluntary.

If you are interested, please click on the link for the survey and additional information: LINK WILL GO HERE.

If you have any questions, please do not hesitate to contact me (kidder@tamu.edu) or Dr. [redacted].

Thank you for your time.

Kevin Kidder

Appendix H – Letter of Support

COLLEGE OF MEDICINE

Office of the Dean

[redacted]

Date: September 26, 2019

To: University of Tennessee

From: [redacted]

Re: Letter of Support for Dissertation Research

As the Interim Dean for the College of Medicine and the Associate Dean for the Office of Evaluation and Assessment, we offer full support for the dissertation research of Kevin E. Kidder in fulfillment of the requirements of the PhD at the University of Tennessee. This support includes allowing Mr. Kidder to:

a. develop, on behalf of the [redacted], a learning environment survey of faculty, staff, and students at [redacted]
b. oversee the survey data collection of for the Office of Evaluation and Assessment; and
c. use de-identified data from the survey to conduct a validation study of the survey.

We support Mr. Kidder pursuing publication of this study, with the caveats that the data belong to [redacted] involved in our learning environment initiatives will serve as co-authors.

Respectfully,

[redacted]

[redacted]

[redacted]

Appendix I – R Code

```
library(dplyr)
library(psych)
library(lavaan)
library(semPlot)
library(semTools)
library(knitr)
library(MVN)

# read the dataset
LES <- read.csv("C:/Users/cwaller/Desktop/LE Survey - Items Only.csv",
            header=TRUE)

# MULTIVARIATE NORMALITY
# since CFA is estimated using ML, it is suceptible to violations of normality,
# espcially skewness and outliers that can affect covariances.
psych::mardia(LES)
# Notice the dots trail off at the ends of the QQ plot

# We can also use the MVN package to check normality of our variables
# par("mar")
par(mar=c(1,1,1,1)) #this just enlarges the size of my viewer
MVN::mvn(data=LES, univariatePlot="histogram")

# # run descriptives
# describeBy(LES)

# specify the CFA model
HS.model1 <- ' GLE  =~ LES1 + LES2 + LES5 + + LES6 +
                  LES7 + LES8 + LES11 + LES12 +
                  LES13 + LES15 + LES16 + LES18 +
                  LES20 + LES21 + LES26 + LES27 +
                  LES28
           LES7~~LES11
           SCDI =~ LES9 + LES10 + LES19
           KPP  =~ LES22 + LES23 + LES24 + LES25
           TPS  =~ LES3 + LES4 + LES14 + LES17 '

# fit the model
fit1 <- cfa(HS.model1, data=LES,
         ordered=c("LES1","LES2","LES3","LES4","LES5","LES6",
                "LES7","LES8","LES9","LES10","LES11","LES12",
```

```
                "LES13","LES14","LES15","LES16","LES17","LES18",
                "LES19","LES20","LES21","LES22","LES23","LES24",
                "LES25","LES26","LES27","LES28"))

# display CFA summary output
summary(fit1, fit.measures=TRUE, standardized = TRUE, rsquare = TRUE)
#
# # CFA modification indices
# modindices(fit1, power=TRUE, sort=TRUE)
#
# # Correlation Residuals
# cor_table <- residuals(fit1, type = "cor")
# kable(cor_table, digits=2) # makes a nice table and rounds everyhing to 2 digits

lavresid <- residuals(fit1, type="cor")
resid <- lavresid$cov
resid <- as.matrix(resid[upper.tri(resid)])
large.resid <- abs(resid) > .1
sum(large.resid)
round(sum(large.resid)/nrow(resid),3)
#
# draw the model
semPaths(fit1, "model", "std", sizeMan = 8, sizeMan2 = 2, sizeLat = 10,
       groups = "latents", unCol = "#000000", pastel = TRUE,
       rotation = 4, curve = 4, intercepts = FALSE, mar =c(1, 20, 1, 20))

# 2 Factor solution
# specify the CFA model
HS.model2 <- ' GLE  =~ LES1 + LES2 + LES3 + LES4 + LES5 +
                LES6 + LES7 + LES8 + LES9 + LES10 +
                LES11 + LES12 + LES13 + LES14 + LES15 +
                LES16 + LES17 + LES18 + LES19 + LES20 +
                LES21 + LES26 + LES27 + LES28
          LES7~~LES11
          KPP  =~ LES22 + LES23 + LES24 + LES25 '

# fit the model
fit2 <- cfa(HS.model2, data=LES,
        ordered=c("LES1","LES2","LES3","LES4","LES5","LES6",
                "LES7","LES8","LES9","LES10","LES11","LES12",
                "LES13","LES14","LES15","LES16","LES17","LES18",
                "LES19","LES20","LES21","LES22","LES23","LES24",
                "LES25","LES26","LES27","LES28"))
```

```
# display CFA summary output
summary(fit2, fit.measures=TRUE, standardized = TRUE, rsquare = TRUE)

# CFA modification indices
modindices(fit2, power=TRUE, sort=TRUE)

# Correlation Residuals
# cor_table <- residuals(fit2, type = "cor")
# kable(cor_table, digits=2) # makes a nice table and rounds everyhing to 2 digits

lavresid <- residuals(fit2, type="cor")
resid <- lavresid$cov
resid <- as.matrix(resid[upper.tri(resid)])
large.resid <- abs(resid) > .1
sum(large.resid)
round(sum(large.resid)/nrow(resid),3)
round(mean(abs(resid)),3)
round(sd(abs(resid)),3)

# draw the model
semPaths(fit2, "model", "std", sizeMan = 8, sizeMan2 = 2, sizeLat = 10,
        groups = "latents", unCol = "#000000", pastel = TRUE,
        rotation = 4, curve = 4, intercepts = FALSE, mar =c(1, 20, 1, 20))

reliability(fit2)

anova(fit1, fit2)
lavTestLRT(fit1, fit2)


# 1 Factor solution
# specify the CFA model
HS.model2 <- ' GLE  =~ LES1 + LES2 + LES3 + LES4 + LES5 +
                  LES6 + LES7 + LES8 + LES9 + LES10 +
                  LES11 + LES12 + LES13 + LES14 + LES15 +
                  LES16 + LES17 + LES18 + LES19 + LES20 +
                  LES21 + LES22 + LES23 + LES24 + LES25 +
                  LES26 + LES27 + LES28
            LES7~~LES11 '

# fit the model
fit3 <- cfa(HS.model2, data=LES,
```

```
        ordered=c("LES1","LES2","LES3","LES4","LES5","LES6",
                "LES7","LES8","LES9","LES10","LES11","LES12",
                "LES13","LES14","LES15","LES16","LES17","LES18",
                "LES19","LES20","LES21","LES22","LES23","LES24",
                "LES25","LES26","LES27","LES28"))

anova(fit2, fit3)
```

Vita

Kevin Kidder was born and raised in Edwardsburg, Michigan. In 2005 he graduated from Edwardsburg High School. After pursuing a career in the beauty industry, Kevin enrolled at Pellissippi State Community College – Knoxville in 2013 and received his A.S. degree that same year. In January 2014, Kevin continued his education at Middle Tennessee State University (MTSU) in Murfreesboro, Tennessee where he graduated with a B.S. in Psychology and double minors in Behavioral Research and Biology in May 2015. In August of 2015, Kevin enrolled at the University of Tennessee – Knoxville (UTK) in the Evaluation, Statistics, and Measurement (ESM) program to pursue a Ph.D. While a graduate student at UTK, Kevin worked as a Graduate Research Assistant (GRA) in the department of Educational Leadership and Policy Studies. After working as a GRA for over a year, Kevin took a fulltime position as an Evaluation Specialist at the National Institute for STEM Evaluation and Research (NISER) at UTK. Upon completion of his doctoral coursework and successfully completing his comprehensive exams for the ESM program, Kevin accepted a position at Texas A&M University, where he currently works as the Program Manager for Curriculum Evaluation within the College of Medicine.