The Johns Hopkins Learning Environment Scale: Measuring Medical Students' Perceptions of the Processes Supporting Professional Formation

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Abstract

Purpose

To construct a new measure to assess students' perceptions of the medical school learning environment (LE).

Method

In 2012, students at Johns Hopkins University School of Medicine completed a survey containing 32 LE items. Additional questions asked about overall perception of the LE, personal growth, and recommending the school to a friend. Validity evidence for content, response process, internal structure, and relation to other variables was collected for interpretation of scores.

Results

Of 465 students surveyed, 377 (81%) completed all LE items. Exploratory factor analysis yielded the 28-item Johns Hopkins Learning Environment Scale (JHLES) with seven factors/subscales: community of peers, faculty relationships, academic climate, meaningful engagement, mentoring, inclusion and safety, and physical space. Students' overall JHLES scores ranged from 51 to 139, of a possible 28 to 140, with a mean (SD) of 107 (15). Overall scores and most subscale scores did not differ significantly by gender or racial/ethnic background, but did differ significantly by overall perception of the LE ($P \leq .001$)

and increased incrementally as overall perception improved. Overall JHLES scores were significantly higher for students with higher personal growth scores and students who would recommend the school (both $P < .001$). Subscale scores for all seven factors increased with improved overall perception of the LE (all $P \leq .005$).

Conclusions

The JHLES is a new measure to assess students' perceptions of the medical school LE, with supporting validity evidence and content describing the social, relational, and academic processes of medical school that support students' professional formation.

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.[1–3] The LE encompasses the student's broadest experience of an academic institution—including the curriculum, the facilities, and interactions with peers, faculty, and

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staff—as well as the student's sense of the learning climate, or institutional ethos.[4,5] In a compelling text on the future of medical education, Cooke and colleagues[6] envision a greater focus on medical students' professional formation and argue that a supportive LE is necessary to foster students' development of professional values, attitudes, and behaviors.

Evidence suggests that optimized medical school LEs may enhance student outcomes, whereas LEs that engender distress may be associated with declines in student empathy, wellness, and academic performance.[7–10] The Liaison Committee on Medical Education has acknowledged the important impact of the LE on students' development in its accreditation standard MS-31-A, which calls for each medical school to "ensure that its learning environment promotes the development of explicit and appropriate professional attributes in its medical students" and to "regularly evaluate" the quality of its LE.[11]

However, despite efforts dating back more than 50 years to measure students'

perceptions of the medical school LE, existing LE scales are viewed as imperfect and outdated in terms of serving as rich, contextual measures of the current LE.[12,13] The Dundee Ready Educational Environment Measure (DREEM),[14] a generic undergraduate health professions LE tool that has been used internationally, may not be able to capture nuances of the LE at U.S. and Canadian medical schools; we were able to find only one report of DREEM use in a Canadian medical school.[15] Other investigators have developed a variety of LE tools that focus on specific aspects of the LE rather than the LE as a whole, including students' perceptions of teacher–learner and patient–physician relationships, patient-centered attitudes and practice, and professional behaviors.[16–18]

Evidence suggests that the educational landscape is changing in significant ways in U.S. and Canadian medical schools. Educational reforms, such as learning communities and longitudinal clinical clerkships, are being introduced to enhance learning, relational continuity, and a sense of community among faculty and students.[19–21] In addition,

the construct for understanding medical professionalism is shifting to a systems-based, developmental growth model.[22] Existing LE scales typically characterize identifiable stressors in medical school and aggregate learner responses to inform future efforts in institutional change.[23] However, in a recent study,[24] we showed that students' perceptions of the LE were more strongly influenced by an appreciation of their positive experiences than by their negative experiences. Additionally, even though students reported similar types of experiences, they judged the impact of their experiences on their perceptions of the LE quite differently. These findings led us to consider the LE as a dynamic ecosystem that generates unique patterns of experiential learning that influence professional identity formation.[25,26] We thus set out to develop a new measure of students' perceptions of the LE that would capture the richness and variety of each student's relational, academic, and institutional engagement in medical school. In this article, we describe the development of the resulting Johns Hopkins Learning Environment Scale (JHLES) and present validity evidence to support its scores.

Method

Scale development

We began our scale development process in January 2011 with a literature review of LE studies in health professions schools published since 1961; in this review, we also included constructs from the collegiate LE literature as part of our efforts to establish content validity.[27,28] Our team's precursor LE study,[24] in which we used a 55-item inventory to gauge the influence of events on Johns Hopkins University School of Medicine (JHUSOM) students' perceptions of the LE, informed this process as we considered critical experiences and relationships in medical school.

In creating the LE survey blueprint for the current study, we mapped 65 processes—some adapted from the 55 events and experiences described above[24]—into 10 domains we felt represented the most influential aspects of the medical school LE: role models and mentors; support; quality of teaching; exposure to high-impact events; feeling welcomed and valued; engagement–

affiliation; autonomy; personal growth; personal contribution; and physical learning space. Through an iterative review by the authors (R.S., J.C.G., S.W.), we then revised this pool to 37 items, which we tested in a spring/summer 2011 JHUSOM-wide student survey (362 respondents, 80% response rate). We analyzed the data for factor structure with exploratory factor analysis (EFA), which yielded a 22-item survey with 6 factors after inappropriate cross-loading variables were omitted. We then put the 2011 survey construct through further revision, rewriting 11 of the original 37 items and deleting others, yielding a pool of 32 LE items for the LE survey used in this study. Each of these 32 items had a five-point Likert response scale that ranged from strongly disagree (1) to strongly agree (5) or from not at all (1) to tremendously (5).

Data collection

We incorporated the 32 LE survey items into a larger online survey administered in spring/summer 2012 to all enrolled JHUSOM students (N = 465). This survey, hosted at SurveyMonkey.com (SurveyMonkey, Palo Alto, California), also included questions about students' advising experiences, personal growth, and career choices. Students participated on a voluntary basis after reading an e-mailed cover letter and clicking on a link to the online survey. Students who completed the survey were entered into weekly drawings to win 1 of 16 restaurant gift certificates worth $50 each. This study was approved by the JHUSOM institutional review board.

Data analysis

We analyzed all data using IBM SPSS version 19 (IBM Corp., Armonk, New York). To address response process validity evidence (i.e., the actions, strategies, and thought processes of individual respondents), we included data only from students who answered all 32 LE survey items and an additional question about their overall perception of the LE (described below).[29] In addition, we reviewed the distribution of responses for each survey item to ensure that students were not selecting the same option for each item to complete the survey quickly.

We addressed internal structure validity evidence of the LE survey with EFA. We reverse coded negatively worded

survey items, so that higher scores on these items suggested more positive perceptions of the LE. We calculated tests of factorability (Kaiser-Meyer-Olkin measure of sampling adequacy, Bartlett test of sphericity) to ensure that the data were appropriate for EFA. We performed EFA on the correlation matrix using principal axis factoring with no rotation to determine how many factors to retain and the amount of variance explained by the factors. For inclusion of an item in interpretation of a factor, we used a minimum factor coefficient of 0.40 as the threshold. We performed subsequent EFAs on the data; cross-loading items and/or items that did not load on a factor were omitted one at a time. We calculated Cronbach alpha for each factor along with the correlation coefficient (Spearman rho) between all factor pairs. When the final solution was reached, we computed composite LE factor scores and overall LE scores (the latter hereafter called the overall JHLES score) by summing the items within each factor.

We analyzed overall JHLES scores by race/ethnicity and medical school year with one-way analyses of variance (ANOVAs) and, as appropriate, Scheffé post hoc tests. We also analyzed overall JHLES scores by gender with the Mann-Whitney U test.

We addressed relationships to other variables' validity evidence by asking students to rate their overall perceptions of the LE on a five-point Likert scale (from 1 = terrible to 5 = exceptional) to assess whether a high overall JHLES score correlated with a positive global assessment of the LE. The item and rating anchors were worded as follows:

> Please rate your overall perception of the learning environment at the SOM. The learning environment includes formal learning activities, as well as attitudes, values, and informal "lessons" conveyed by individuals with whom the student comes into contact.
>
> 1. Terrible (not learner-centered, no opportunities for reflection, authoritarian, not trustworthy, disrespectful of diversity and alternative perspectives, predominantly negative aspects, positive aspects few and not mediated by negative ones)
>
> 2. Poor (overall mostly negative environment with some positive aspects)
>
> 3. Fair (equal mix of positive and negative features)

4. Good (overall mostly positive with some negative aspects)

5. Exceptional (environment marked by safety, trust, respect, welcoming of diversity, provides opportunities for the learner to challenge themselves with appropriate supervision and feedback, opportunities to reflect, predominantly positive aspects which mediate negative aspects)

We conducted this analysis using one-way ANOVAs and, if appropriate, Scheffé post hoc tests.

Second, for further convergent validity evidence, we asked students to complete a personal growth survey, a modified seven-item version of a previously validated nine-item scale,[30] to rate their personal growth since the start of medical school. Response options on this personal growth scale were much worse, worse, no change, better, and much better (assigned values of −2, −1, 0, 1, and 2, respectively). We computed composite personal growth scores by summing ratings across the seven items. Then, we placed students into one of two groups: a high personal growth group (composite personal growth score > median of 3) or a low personal growth group (composite personal growth score ≤ median of 3).

Third, we asked students to indicate whether they would recommend JHUSOM: "Based on my sense of the learning environment at the SOM, I would recommend it to a close friend as a great school to attend." The five-point Likert scale for responses ranged from strongly disagree (1) to strongly agree (5). We considered responses of strongly agree and agree as positively endorsing the school.

Finally, we conducted analyses to ascertain whether responses across the JHLES subscales (based on factors from the EFA results, as described below) differed by demographic variable using Mann-Whitney U tests (for gender) and ANOVAs (for race/ethnicity, medical school year, and overall perception of the LE).

Results

Of the 465 JHUSOM students who were invited to participate in the survey, 386 (83%) responded. We analyzed data for the 377 students (81%) who answered all 32 LE survey items and the question about their overall perception of the

LE. Table 1 provides demographic data for those respondents. Nonrespondents were not different from respondents with respect to gender and medical school year (both $P > .05$). Our visual inspection of the distribution of survey item responses suggested that there were no items for which all or a large majority of students selected the same option.

Internal structure validity evidence: Factor analysis

Tests of factorability suggested that the survey data were appropriate for EFA: The Kaiser-Meyer-Olkin value of 0.93 was above 0.50, suggesting that there was appropriate common variance in the LE survey items, and the Bartlett test of sphericity was statistically significant ($\chi^2 = 6827.32$, $df = 496$, $P \leq .001$), suggesting that the survey items were interrelated. With 377 respondents and 32 items, the person-to-item ratio was above 10:1. Kaiser criteria and the scree plot suggested that seven factors should be retained. The initial eigenvalues for factors 1 to 7 were 11.84, 2.26, 1.92, 1.60, 1.24, 1.16, and 1.09, respectively. The percentages of variance for factors 1 to 7 were 37%, 7%, 6%, 5%, 4%,

Table 1

Overall Johns Hopkins Learning Environment Scale (JHLES) Scores for 377 Medical Students by Student Characteristic[a]

Student characteristic	No. (%) of students	Overall JHLES score, mean (SD)[b]	P value
Gender			.80
Female	184 (50)	107 (13)	
Male	183 (50)	107 (16)	
Race/ethnicity			.67
Caucasian	185 (52)	108 (14)	
Asian	124 (35)	108 (13)	
Underrepresented minority[c]	44 (13)	106 (13)	
Medical school year			.003
First	112 (30)	111 (12)	
Second	96 (26)	104 (14)	
Third	81 (21)	107 (14)	
Fourth	88 (23)	105 (17)	
Overall perception of the LE			< .001
Exceptional	64 (17)	121 (9)	
Good	225 (60)	110 (9)	
Fair	63 (17)	96 (9)	
Poor/terrible	25 (7)	76 (12)	
Personal growth[d]			< .001
Composite score > median of 3	175 (47)	112 (12)	
Composite score ≤ median of 3	198 (53)	103 (15)	
School endorsement			< .001
Would recommend this school	303 (81)	112 (10)	
Neutral	42 (11)	92 (12)	
Would not recommend school	29 (8)	81 (14)	

Abbreviation: LE indicates learning environment.

[a]Data are for the 377 first-year through fourth-year students at Johns Hopkins University School of Medicine who responded to all LE survey items, plus an item asking about their perception of the overall LE, included in a larger institution-wide survey in spring/summer 2012. Not all of these students provided demographic and other types of data, so the total number of students does not add up to 377 for each characteristic. Percentages may not total 100 because of rounding.

[b]Possible overall JHLES scores range from 28 to 140, with higher scores indicating a more positive perception of multiple facets of the LE.

[c]Includes all students who self-identified as African American or Hispanic (alone or in combination with another racial category).

[d]The nine-item Personal Growth Scale[30] was adapted to a seven-item scale for this study. Each of the seven items had five response options: much worse, worse, no change, better, and much better. This rating scale was converted to −2, −1, 0 (no change), 1, and 2, respectively. Students' composite personal growth scores were created by summing their ratings across the seven personal growth items; students were placed into one of two groups based on a median score of 3.

4%, and 3%, respectively. These seven factors were extracted, and Varimax rotation was performed. All but one item had a coefficient ≥ 0.40 for at least one factor ("I feel respected by faculty at the SOM [school of medicine]": factor 2 = 0.39, factor 4 = 0.39). Another item cross-loaded on two factors ("The overall quality of the educational experience at the SOM is excellent": factor 3 = 0.52, factor 4 = 0.42). Both of these items were removed from the final factor structure. Two additional items were removed because they had coefficients < 0.50, and the factor they loaded on had at least five other items with loadings ≥ 0.50 with high communality values ("I am comfortable being myself at the SOM": factor 1 = 0.43; "I am satisfied with the frequency and quality of feedback I receive at our SOM": factor 3 = 0.48). A new EFA was performed each time one of the four items was omitted. The factors to retain remained at seven with a cumulative percentage of variance of 57%.

The final factor structure, with seven titled subscales—community of peers; faculty relationships; academic climate; meaningful engagement; mentoring; inclusion and safety; and physical space—and 28 items is termed the JHLES and is shown in Table 2. Correlations between factor pairs and Cronbach alpha for each factor are shown in Table 3. Only 2 items loaded on each of factors 5 and 7 (mentoring and physical space subscales, respectively), but these factors represent distinct dimensions of the LE, as supported by the low correlations they share with other factors.

Overall JHLES scores

All 28 items of the JHLES linked to five-point Likert scale response options, resulting in an overall possible scoring range of 28 (28 × 1) to 140 (28 × 5), with higher scores indicating a more positive perception of multiple facets of the LE. Actual overall student JHLES scores ranged from 51 to 139, with a mean of 107 (standard deviation [SD] = 15). A histogram of the distributed scores is illustrated in Figure 1. Table 1 displays overall JHLES scores broken down by gender, race/ethnicity, and medical school year. The significant main effect of MS year was due to first-year students having significantly higher overall JHLES scores (mean = 111, SD = 12) than

second-year students (mean = 104, SD = 14; P = .01) and fourth-year students (mean = 105, SD = 17; P = .03). All other medical-school-year analyses showed no significant differences.

Relationship between overall JHLES score and other variables

Table 1 also provides overall JHLES scores by overall perception of the LE, median PG score, and endorsement of the school to a friend. Of the 377 responding students, 64 (17%) rated their overall perception of the LE as exceptional (17%), 225 (60%) as good, 63 (17%) as fair, 21 as poor (6%), and 4 as terrible (1%). The poor and terrible categories were combined in the analyses that follow.

There was a significant main effect of overall perception of the LE on overall JHLES scores. Specifically, students who rated their overall perception of the LE as exceptional had higher overall JHLES scores than students who rated it as good, fair, or poor/terrible; students who rated their overall perception of the LE as good had higher overall JHLES scores than students who rated it as fair or poor/terrible; and students who rated their overall perception of the LE as fair had higher overall JHLES scores than students who rated it as poor/terrible, all P ≤ .001. Additionally, students in the high personal growth group (composite score > the median of 3 on the personal growth scale) had higher overall JHLES scores than students in the low personal growth group (composite score ≤ the median of 3), P ≤ .001. Furthermore, students who positively endorsed the school (agreed/strongly agreed with recommending the school to a close friend) had higher overall JHLES scores than students who did not give such an endorsement, P ≤ .001.

JHLES subscale scores

In analyzing the seven JHLES subscale scores as a function of gender, race/ethnicity, medical school year, and overall perception of the LE, we noted some statistically significant differences for each of the subscales (see Table 4). For gender, only the inclusion and safety subscale showed a significant difference, with male students having higher scores than female students, P ≤ .005. For overall perceptions of the LE, there were significant differences for all seven

subscales, all P ≤ .005. Within each of the seven subscales, mean scores increased in stepwise fashion as overall perceptions of the LE increased, P ≤ .005. Among students rating their overall perception of the LE as exceptional, the highest mean subscale scores were in the faculty relationships domain. In comparing students rating their overall perception of the LE as exceptional versus those rating it as poor/terrible, the largest differences (delta) in mean subscale scores were in the community of peers and meaningful engagement domains (Table 4).

Discussion

This study describes the development of the JHLES, a new medical school LE scale, and provides validity evidence for interpretation of its scores. The JHLES characterizes medical students' perceptions of the LE across a spectrum of the curriculum, institutional climate and facilities, relationships with peers and faculty, and engagement in the academic community. In developing our survey blueprint and item pool, we sought to describe the patterns of interpersonal and institutional engagement necessary to optimize medical students' growth as adult learners and developing physicians. In addition to this survey construct and content validity evidence, we also were able to show evidence for response process, internal structure, and relationships to other variables. For response process, we included only students who completed all of the LE survey items, and we visually inspected all item frequencies to ensure that students had not selected the same option to complete the survey quickly. For internal structure, our EFA yielded an LE scale of 28 items, retaining seven distinct factors which explain 57% of the variance. For relationships to other variables, overall JHLES and subscale (factor) scores were significantly higher for students with more favorable overall perceptions of the LE and for those reporting more PG in medical school. Finally, overall JHLES scores were higher for students who indicated that they would recommend the medical school to a close friend.

The current medical school LE differs from the LEs of decades past, and new metrics are needed to assess the impact of evolving learning constructs,

Table 2

The 28 Items and Seven Subscales of the Johns Hopkins Learning Environment Scale (JHLES): Varimax Rotated Pattern/ Structure Coefficients for Each Factor, Extracted Communalities (h^2), and Eigenvalues for Exploratory Factor Analysis of 377 Medical Students' Scores[a]

Item or type of data	JHLES factor coefficient, with subscale name							
	1 Community of peers	2 Faculty relationships	3 Academic climate	4 Meaningful engagement	5 Mentoring	6 Inclusion and safety	7 Physical space	h^2
JHLES item[b,c]								
How connected do you feel to other SOM students?[d]	0.85							0.80
How supported do you feel in your personal and professional pursuits by other SOM students?[d]	0.77							0.75
It's been easy to make friends at the SOM.	0.73							0.64
I feel a sense of community at the SOM.	0.67							0.67
To what extent have you felt a sense of belonging during your time as a student at the SOM?[d]	0.63							0.72
I've encountered an abundance of positive, inspiring role models among fellow students at the SOM.	0.61							0.53
I feel that the SOM faculty I encounter are supportive of my professional goals.		0.70						0.70
I feel that SOM faculty members have taken the time to get to know me.		0.67						0.58
I feel that the SOM faculty I encounter genuinely care about my well-being.		0.64						0.71
I've encountered an abundance of positive, inspiring faculty role models at the SOM.		0.61						0.65
There are faculty members that I feel comfortable confiding in when important concerns come up.		0.60						0.45
The faculty advisors in the Colleges Advisory Program are readily accessible and interested in students.		0.54						0.35
Our medical school's curriculum allows me to use my preferred learning style.			0.75					0.65
I feel that course exams and assessments test my knowledge and abilities fairly.			0.70					0.55
I understand the goals and objectives of the SOM curriculum.			0.52					0.52
To what extent do you trust that the institution has fulfilled your needs as a medical student?[d]			0.51					0.63
The workload during medical school is manageable.			0.53					0.32
The SOM engages students as meaningful participants.				0.69				0.76
The SOM is flexible and responsive to my needs as a student.				0.61				0.59
I feel that I have a say in decision making about courses and curricular changes.				0.60				0.48
The SOM encourages scholarship and innovation.				0.51				0.42

(Table continues)

     5

Table 2
(Continued)

Item or type of data	JHLES factor coefficient, with subscale name							
	1 Community of peers	2 Faculty relationships	3 Academic climate	4 Meaningful engagement	5 Mentoring	6 Inclusion and safety	7 Physical space	h^2
I've found a mentor in a research field that interests me.					0.74			0.61
I've found a mentor in a clinical specialty or discipline that I am passionate about.					0.73			0.60
I am concerned that students are mistreated at the SOM.[†]						0.72		0.73
I sense there is discrimination based on gender, race, ethnicity, or sexual identity at the SOM.[†]						0.47		0.33
I feel concerned at times for my personal safety at the SOM.[†]						0.46		0.23
The preclinical SOM building has a significant effect on my perception of the learning environment.							0.65	0.51
The work spaces where clinical teaching occurs contributes positively to my sense of the SOM learning environment.							0.62	0.51
Rotated sums of squared loadings[e]	3.84	3.38	2.63	2.50	1.28	1.20	1.16	
Rotated % variance	14	12	9	9	5	4	4	

Abbreviation: SOM indicates school of medicine.
[a]Data analyses used the responses of 377 first-year through fourth-year Johns Hopkins University School of Medicine students on a 2012 survey.
[b]Factor loadings < 0.40 are suppressed. Items marked with the dagger symbol ([†]) were reverse scored.
[c]Likert scale for responses (unless otherwise designated): strongly disagree, disagree, neutral, agree, strongly agree.
[d]Likert scale for responses to this item: not at all, a little, a fair amount, a lot, tremendously.
[e]Eigenvalues.

curricula, and informal learning on students' professional formation.[6,19] In developing the JHLES, we were interested in characterizing how students navigate the complex terrain of academic, social, and relational resources and processes that support their learning and professional growth. We focused less on creating a tool to scan for a hidden curriculum—that is, a set of negative influences at the level of organizational culture and structure.[31] Viewing the LE through a lens of Bandura's[32] social learning theory, individuals learn within a social context through continuous reciprocal interactions between cognitive, behavioral, and environmental determinants. Building on this, Kolb[26] and Jonassen[33] theorized that knowledge is constructed by individual learners based on their interpretations of experiences in the world.

In developing the JHLES, we sought to incorporate social and experiential learning theory, believing that it might offer a window to gain a better understanding of how students interpret a range of experiences in medical school. The seven EFA-derived factors (subscales) of the JHLES—community of peers; faculty relationships; academic climate; meaningful engagement; mentoring; inclusion and safety; and physical space—describe this range of social, relational, and cognitive–emotional processes.

In this study, mean subscale scores differed significantly according to

Table 3
Observed Correlations Between Johns Hopkins Learning Environment Scale (JHLES) Factors With Cronbach Alpha Coefficient for Each Factor in Parentheses[a]

Factor	Factor						
	1	2	3	4	5	6	7
1	(0.91)	0.56	0.43	0.49	0.21	0.33	0.44
2		(0.8)	0.42	0.51	0.37	0.31	0.32
3			(0.86)	0.59	0.23	0.29	0.34
4				(0.82)	0.22	0.30	0.29
5					(0.74)	0.03	0.09
6						(0.58)	0.25
7							(0.66)

[a]Correlations were calculated with Spearman rho. The JHLES includes 28 items in seven subscales that correspond to these factors (see Table 2).
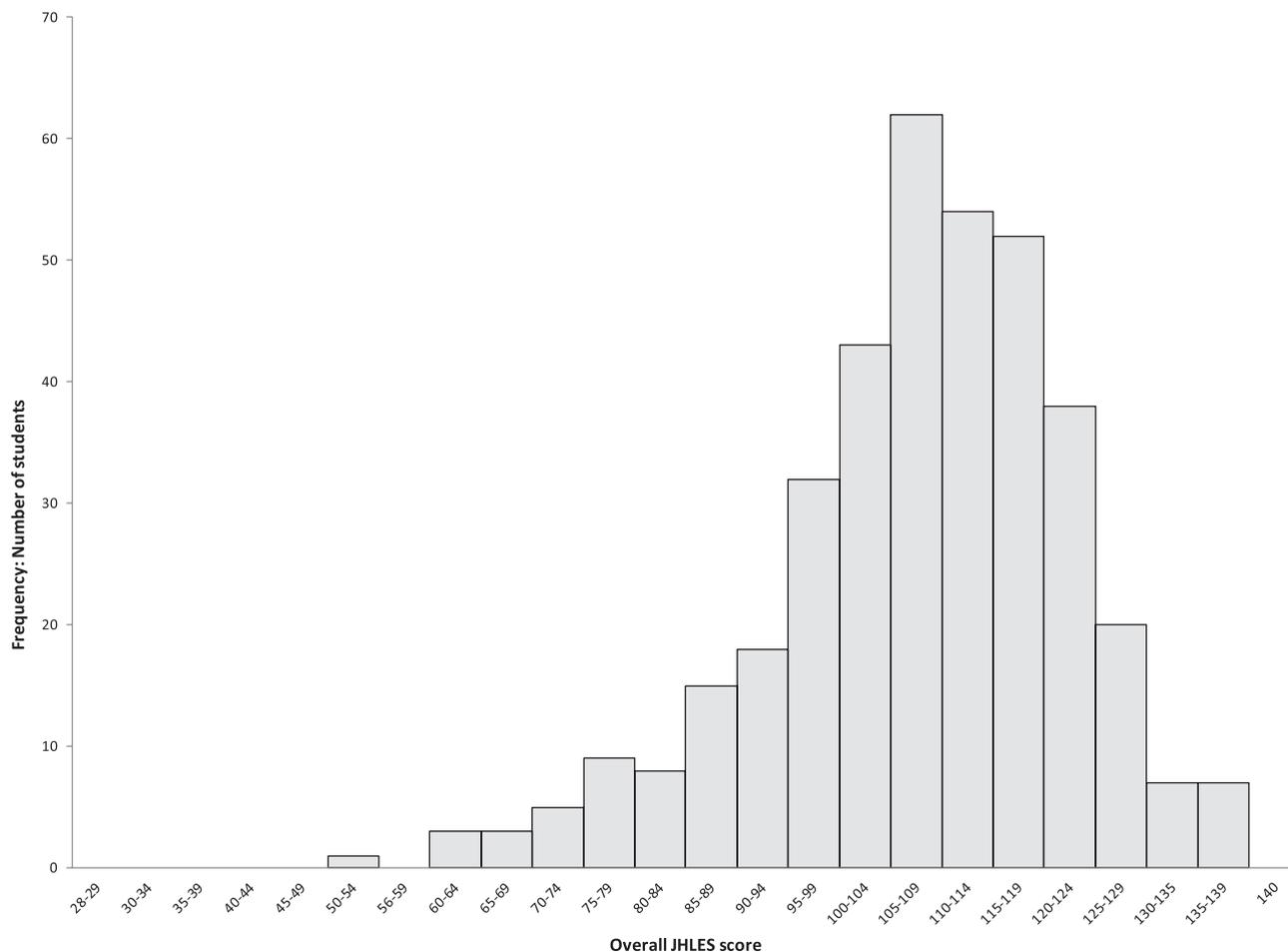
Figure 1 Distribution of overall Johns Hopkins Learning Environment Scale (JHLES) scores for 377 medical students, Johns Hopkins University School of Medicine, 2012. Possible scores range from 28 to 140; actual student scores ranged from 51 to 139, with a mean (standard deviation) of 107 (15).

students' overall perceptions of the LE. Among students rating their overall perception of the LE as exceptional, the faculty relationships domain received the highest subscale score. Palmer[34] eloquently described the central role of teacher–learner relationships in adult education, and numerous studies have affirmed the importance of faculty in medical students' professional development, whether as mentors, role models, or advisors.[35–37] Furthermore, the understanding of faculty–student relationships is evolving, with recent evidence suggesting that longitudinal relationships facilitate greater partnering, skill development in students, and focus on mutual goals.[38]

Among students rating their overall perception of the LE as poor or terrible, the community of peers and meaningful engagement domains showed the lowest mean subscale scores, potentially revealing a link between the quality of peer relationships and perceptions of the LE. Haidet et al,[39] in a study of

medical students' social networks and their relationship to professional identity formation, described students' peer relationships as complex "webs" that temper the impact of significant events or stressors. Peer interdependence is becoming more relevant to students' professional growth, as emerging structures for continuity offer "safe spaces" for learning and reflecting.[40] Additionally, experiencing a sense of belonging with colleagues, or of belonging to the institution as a whole, may be an important requisite for viewing the LE as healthy.[41] As the JHLES is tested in more settings, it will be interesting to see if the community of peers and meaningful engagement subscale scores remain significantly lower among individuals struggling to navigate the LE. If so, such findings may suggest a need to broaden interventions beyond those focused on academics in order to optimize the medical school LE.

Overall JHLES scores did not vary significantly by gender or by race/

ethnicity, nor did most subscale scores (see Table 4). However, overall JHLES scores and several subscale scores did differ significantly by medical school year, with first-year students scoring higher than more senior students. At JHUSOM, this finding may be explained by an active student learning community that focuses teaching and advising resources on first-year students.[42,43] By contrast, fourth-year students had the highest scores on the mentoring subscale, presumably related to their having more opportunities to form satisfying mentoring relationships over their years of study and across clinical and research venues. We intend to track JHLES scores over time to better understand whether these results represent a developmental or curricular phenomenon or a variation in student cohorts.

Limitations

Several limitations of this study should be considered. First, as this study was conducted at a single institution, the items included in the JHLES may not be

Table 4
Johns Hopkins Learning Environment Scale (JHLES) Subscale Scores by Medical Student Characteristics[a]

Student characteristic	JHLES subscale score, mean (SD)[b]						
	Community of peers	Faculty relationships	Academic climate	Meaningful engagement	Mentoring	Inclusion and safety	Physical space
Gender						*	
Female	3.76 (0.77)	4.14 (0.60)	3.66 (0.58)	3.62 (0.70)	3.72 (0.97)	3.86 (0.66)	4.14 (0.64)
Male	3.74 (0.85)	4.06 (0.66)	3.62 (0.70)	3.63 (0.85)	3.77 (0.92)	3.98 (0.82)	4.12 (0.76)
Race			*			*	
Caucasian	3.78 (0.79)	4.10 (0.60)	3.71 (0.62)	3.57 (0.81)	3.77 (0.92)	4.07 (0.65)	4.18 (0.67)
Asian	3.81 (0.78)	4.17 (0.64)	3.67 (0.55)	3.69 (0.68)	3.79 (0.91)	3.81 (0.76)	4.14 (0.63)
Underrepresented minority[c]	3.65 (0.88)	4.14 (0.58)	3.41 (0.77)	3.86 (0.76)	3.70 (1.02)	3.83 (0.84)	4.05 (0.77)
Medical school year	*	*			*	*	*
First	4.12 (0.71)	4.23 (0.53)	3.54 (0.57)	3.72 (0.66)	3.68 (0.96)	4.12 (0.56)	4.35 (0.63)
Second	3.51 (0.79)	3.99 (0.65)	3.60 (0.62)	3.58 (0.76)	3.45 (0.98)	3.97 (0.68)	4.20 (0.67)
Third	3.75 (0.71)	4.11 (0.66)	3.71 (0.72)	3.56 (0.80)	3.80 (0.94)	3.80 (0.89)	4.04 (0.71)
Fourth	3.48 (0.84)	4.00 (0.70)	3.72 (0.76)	3.60 (0.89)	4.10 (0.74)	3.70 (0.81)	3.84 (0.70)
Overall perception of the LE	*	*	*	*	*	*	*
Exceptional	4.30 (0.58)	4.60 (0.43)	4.10 (0.56)	4.22 (0.57)	4.23 (0.94)	4.18 (0.84)	4.55 (0.49)
Good	3.87 (0.62)	4.17 (0.48)	3.75 (0.44)	3.72 (0.56)	3.73 (0.84)	4.03 (0.59)	4.22 (0.60)
Fair	3.20 (0.68)	3.77 (0.63)	3.17 (0.60)	3.20 (0.76)	3.64 (0.97)	3.52 (0.82)	3.65 (0.69)
Poor/terrible	2.38 (0.90)	2.95 (0.60)	2.56 (0.67)	2.22 (0.74)	2.94 (1.08)	3.19 (0.78)	3.38 (0.83)

Abbreviations: SD indicates standard deviation; LE, learning environment.
[a]Data are from responses of 377 first-year through fourth-year Johns Hopkins University School of Medicine students who responded to a 2012 institution-wide survey.
[b]Possible range for each subscale's mean score is 1 to 5. An asterisk (*) indicates a significant main effect, $P \leq .005$.
[c]Includes all students who self-identified as African American or Hispanic (alone or in combination with another racial category).

generalizable to other medical schools. Though the survey construct focused on fundamental influences that support medical students' professional growth, it is unclear how the JHLES might account for differences in medical school LEs outside the United States and Canada. Future research could compare the JHLES with existing international LE measures tools. Second, the survey was administered during one academic year, in spring/summer 2012. In future research, it will be important to test the utility of the JHLES across multiple institutions, with greater numbers of students, and at multiple points during a student's medical school career. Finally, the EFA resulted in seven factors, which may seem high for a 28-item scale. However, this result may not be unexpected because the LE encompasses a wide range of influences. Each of the 28 items clearly loaded on a single factor, and all loadings were high. We used standard methodology for factor analysis, and the EFA guided the final length and structure of the JHLES. On the basis of the validity evidence and the percentage of variance

explained, we believe the JHLES is a scale that represents an efficient and comprehensive way to assess students' perceptions of a medical school's LE.

Conclusions

The JHLES is a new tool to measure students' perceptions of the current LE in medical schools and has supporting validity evidence. The JHLES is relevant and timely given the mandates to pay more attention to and measure the LE in medical education.[6,11] We believe that the content of the JHLES describes social, relational, and academic processes of medical school that support students' professional formation. Opportunities for future study include determining how students' JHLES scores relate to their academic outcomes, observing score trajectories over time, and comparing scores across multiple institutions. Although LE measures are typically employed to provide an aerial view of an institution's LE, reviewing individual JHLES scores to learn how students successfully or unsuccessfully navigate

the LE merits future study; reviewing students' scores on the JHLES could also become a resource for iterative discussions between students and their advisors. Gaining a better understanding of how students perceive the LE may offer new insights about the ways in which they interpret experiences, construct knowledge, and use multiple resources for their professional growth.

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