Cause or effect? The relationship between student perception of the medical school learning environment and academic performance on USMLE Step 1

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Abstract

Background: A school’s learning environment is believed to influence academic performance yet few studies have evaluated this association controlling for prior academic ability, an important factor since students who do well in school tend to rate their school’s environment more highly than students who are less academically strong.

Aim: To evaluate the effect of student perception of the learning environment on their performance on a standardized licensing test while controlling for prior academic ability.

Methods: We measured perception of the learning environment after the first year of medical school in 267 students from five consecutive classes and related that measure to performance on United States Medical Licensing Examination (USMLE) Step 1, taken approximately six months later. We controlled for prior academic performance by including Medical College Admission Test score and undergraduate grade point average in linear regression models.

Results: Three of the five learning environment subscales were statistically associated with Step 1 performance ($p < 0.05$): meaningful learning environment, emotional climate, and student–student interaction. A one-point increase in the rating of the subscales (scale of 1–4) was associated with increases of 6.8, 6.6, and 4.8 points on the Step 1 exam.

Conclusion: Our findings provide some evidence for the widely held assumption that a positively perceived learning environment contributes to better academic performance.

Introduction

A school’s learning environment is described by Genn (2001) as “its overall atmosphere or characteristics, the kinds of things that are rewarded, encouraged, emphasized, and the style of life that is most visibly expressed and felt.” Theories about the learning environment draw from situated cognition which posits that learning is situated in the context of the social and physical environment, and that learning emerges as a result of the learner interacting with this environment (Durning 2011). Most surveys seeking to measure student perception of the learning environment focus on the four areas described by Bransford (2000) as necessary for an effective learning environment: students, knowledge, assessment, and community.

The learning environment is believed to influence student behavior and academic performance, and at first glance it makes sense that students who find the learning environment supportive may work harder and perform better. However, it can be difficult to distinguish cause from effect. Students who do well in school tend to rate their school’s environment positively; Mayya and Roff (2004) found that academically strong medical students rated their environment significantly higher than did poorer performers. Without some control for baseline academic ability, it is difficult to know whether a positive perception of the learning environment leads to improved academic performance, or is simply the result of academically strong students giving high marks to an environment that is already supportive.

Practice points

- The presumed association between a school’s perceived learning environment and student performance is muddled by the fact that high performing students tend to rate their schools more positively than lower performing students.
- Our results showed that, regardless of prior academic ability, students who reported a positive perception of their school’s learning environment performed better on a standardized exam than did students who reported less positive perceptions.
- Specific areas of the learning environment that were associated with better performance were the perception of a meaningful learning environment, a positive emotional climate, and closeness among students.
- Efforts schools make to improve their learning environments should be encouraged.

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environment in which they thrive. In seeking “best evidence medical education” (Harden 2000), which considers quality, utility, and strength of evidence, we investigated the presumed link between academic performance and the perceived learning environment.

The purpose of the study was to determine whether student perception of the learning environment is associated with academic performance when controlling for prior academic ability. Demonstration of this association independent of academic aptitude would strengthen the argument that perception of the learning environment actually influences performance. We used United States Medical Licensing Examination (USMLE) Step 1 score as our measure of academic performance. USMLE Step 1 is the first of three tests students must pass in order to be licensed in the United States. The exam has a maximum score of 260; a passing score, in 2012, was 188. We controlled for prior academic ability by including both Medical College Admission Test (MCAT) results and undergraduate grade point average (GPA) in the regression models since both of these variables are independently and significantly associated with Step 1 scores (Julian 2005; Donnon 2007). We also included gender in our prediction models because there are small but significant gender differences in USMLE results: men have higher scores than women on Step 1 exams while the reverse is true for Step 2 scores (Cuddy 2007, 2008). We hypothesized that, regardless of gender, MCAT score, or undergraduate GPA, students who reported a more positive perception of their learning environment would have higher scores on USMLE Step 1 exam than did students who rated their environment less highly.

Methods

This study was conducted at the University of New Mexico School of Medicine (UNMSOM), a publicly funded school that, at the time of the study, enrolled 75 students each fall. UNMSOM is New Mexico’s sole medical school and it admits a diverse group of students with respect to age, minority status, socioeconomic level, and educational background. The research reported here was approved by the UNMSOM Human Research Review Committee.

At the beginning of the second year of medical school, we evaluate students’ perception of their learning environment using the Learning Environment Questionnaire (LEQ) (Moore-West et al. 1989); the administration of this survey is roughly six months before students take the Step 1 exam. The LEQ was based on a longer questionnaire, the Medical School Learning Environment Survey (MSLES) designed by Marshall (1978), which was in turn based on the work of Rothman and Ayoade (1970). The 50-item MSLES contained seven subscales and was reported to have good content validity and reliability (Marshall 1978; Feletti & Clarke 1981). The shortened survey, the LEQ, contains 30 items and five subscales: meaningful learning environment, emotional climate, student–student interaction, nurturance, and flexibility. Table 1 describes the subscales in more detail. Moore-West and colleagues reported that the LEQ subscales had coefficients of reliability ranging from 0.70 to 0.86, which they described as moderate to high reliability (Moore-West et al. 1989). Students rank each item on a scale of 1–4 (seldom, occasionally, fairly often, and very often); a higher score indicates a more favorable perception of the learning environment. Completion of surveys at UNMSOM is voluntary; we began administering the LEQ in 1994.

For the present study we used five consecutive medical school classes, students matriculating between 2005 and 2009. We chose 2005 as the first year because the year prior, 2004, we had technical difficulties with the administration of the LEQ survey which prevented us from matching much of the data. We chose 2009 as the end year because we do not yet have complete USMLE Step 1 data for students matriculating more recently. We ran one linear regression model for each of the five LEQ subscales and included in each model MCAT score, undergraduate GPA (categorized at the median due to its skewed distribution), and gender.

Results

Between 2005 and 2009, 378 students began medical school at UNMSOM and of these 271 (72%) completed the LEQ at the

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Purpose</th>
<th>Sample statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaningful learning environment</td>
<td>Measures the extent to which students perceive the curriculum as relevant to training them to be good physicians</td>
<td>Students feel that they are learning what they need to learn in order to become competent physicians.</td>
</tr>
<tr>
<td>Emotional climate</td>
<td>Reflects students’ affective responses to their medical education</td>
<td>The relationship between basic science and clinical material is unclear (reverse-coded).</td>
</tr>
<tr>
<td>Student–student interaction</td>
<td>Measures the perception of closeness among students</td>
<td>The educational experience tends to make students feel a sense of achievement (reverse-coded).</td>
</tr>
<tr>
<td>Nurturance</td>
<td>Assesses students’ perception of the supportiveness of the faculty</td>
<td>Students talk about leaving school (reverse-coded).</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Differentiates between perceptions of an open, flexible versus a closed, rigid environment</td>
<td>Students in the school get to know each other well (reverse-coded).</td>
</tr>
</tbody>
</table>

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beginning of their second year of medical school; we have USMLE Step 1 scores for all but four of these students. Students who completed the LEQ were significantly younger (median age 24 vs. 25) and more likely to be female than students who did not complete the LEQ; the two groups did not differ by minority status or USMLE Step 1 score.

Table 2 describes the 267 students in this study with regard to demographics, academics, and the LEQ subscales. Our study group is 62% female and 36% classify themselves as underrepresented minorities (of which the predominant ethnic group is Hispanic). Students' perception of their learning environment, at the beginning of the second year of medical school, is shown for each of the five subscales. Mean scores range from a low of 2.79 (Flexibility) to 3.27 (Nurturance). The means of all subscales are above the midpoint score of 2.5 (on a scale of 1–4).

Table 3 shows the beta coefficients and p-values resulting from five linear regression models, one for each of the five LEQ subscales. The beta coefficient for the meaningful learning environment subscale is 6.78, a statistically significant association (p < 0.05). This indicates that a one point increase in the rating of the meaningful learning environment is associated with an almost seven point increase in Step 1 score, regardless of MCAT, undergraduate GPA, or gender.

The emotional climate and student–student interaction subscales were also significantly associated with Step 1 score; the beta coefficients were 6.68 and 4.81, respectively. The nurturance and flexibility subscales were not associated with Step 1 score.

As the five LEQ subscales were correlated with each other (correlation coefficients ranged from 0.36 for student–student interaction and flexibility to 0.68 for meaningful learning environment and emotional climate), we did not include more than one subscale in a model.

### Table 2. Description of 267 students who matriculated to UNM SOM between 2005 and 2009 who completed the LEQ at the beginning of their second year of medical school and have taken USMLE Step 1 exam.

<table>
<thead>
<tr>
<th>Description of 267 students who matriculated to UNM SOM between 2005 and 2009 who completed the LEQ at the beginning of their second year of medical school and have taken USMLE Step 1 exam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total N</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Underrepresented minority</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Age at matriculation Mean (SD)</td>
</tr>
<tr>
<td>MCAT</td>
</tr>
<tr>
<td>Undergraduate science GPA</td>
</tr>
<tr>
<td>Step 1 score</td>
</tr>
<tr>
<td>LEQ subscales (after one year of medical school) Mean (SD)</td>
</tr>
<tr>
<td>Meaningful learning environment</td>
</tr>
<tr>
<td>Emotional climate</td>
</tr>
<tr>
<td>Student–student interaction</td>
</tr>
<tr>
<td>Nurturance</td>
</tr>
<tr>
<td>Flexibility</td>
</tr>
</tbody>
</table>

### Table 3. Results of linear regression models, one model for each of five LEQ subscales, assessing the effect of the learning environment on USMLE Step 1 performance; all models include MCAT, undergraduate science GPA, and gender.

<table>
<thead>
<tr>
<th>LEO subscale</th>
<th>Meaningful learning environment</th>
<th>Emotional climate</th>
<th>Student–student interaction</th>
<th>Nurturance</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>B coefficient</td>
<td>6.78</td>
<td>6.68</td>
<td>4.81</td>
<td>2.78</td>
<td>0.46</td>
</tr>
<tr>
<td>p-value</td>
<td>0.02</td>
<td>0.01</td>
<td>0.03</td>
<td>0.26</td>
<td>0.85</td>
</tr>
</tbody>
</table>

### Discussion

This study evaluated the association between student perception of the medical school learning environment and subsequent academic performance. The data suggest a significant association between three learning environment subscales and scores on the USMLE Step 1 exam that were independent of prior academic performance. Regardless of MCAT or undergraduate GPA scores, students who perceived their school as having a meaningful learning environment outperformed other students on Step 1 by almost seven points. Likewise, students who gave high marks to their school for its emotional climate and student–student interaction performed better on Step 1 than students who perceived these areas less favorably.

The associations reported in this study are of interest because, although it is often assumed that a positive learning environment is associated with improved performance, few studies have tested this assumption in a rigorous manner. Since the association between the perceived learning environment and academic performance is assumed, medical schools generally use data on the learning environment to identify the strengths and weaknesses in their school's curriculum (Seabrook 2004; Henzi et al. 2005; Miles & Leinster 2007) and/or to evaluate the effect of curricular changes (Moore-West et al. 1989; Lancaster et al. 1997; Edgren et al. 2010). We are aware of very few studies in the health sciences field that have evaluated the effect of the perceived learning environment on academic performance. Pimparyon et al. (2000) measured nursing students' perception of the learning environment using an early version of the Dundee Ready Education Environment Measure (DREEM) (Roff et al. 1997) and found a small but significant correlation between the overall educational environment and grade point average; however, in this study, there was no control for prior
academic performance. And since academically strong students tend to rate the learning environment higher than weaker students (Mayya & Roff 2004), it is important to control for academic ability in any study of the association between environment and performance. Artino et al. (2010) found that medical students’ achievement emotions were related to academic performance in the following ways: course-related enjoyment was positively related to standardized examination scores, and anxiety and boredom were negatively related to course examination grades. Again, since there was no control for prior academic ability, it is difficult to know if these results are measuring a true association or are masking the association between prior and current performance. Lieberman and colleagues (2008) restricted their sample to academically at-risk students; however, their definition of learning environment covered more than student perception: it included introduction of problem-based learning, expanded peer tutoring, earlier intervention for struggling students, and formal Step 1 exam preparation. We have found two studies that controlled for prior academic ability, but neither was conducted in a medical setting. Lizzio and colleagues (2002) used general university students as their study sample and showed that students’ perception of the teaching environment was directly associated with their grade point average after controlling for prior academic performance; the association was statistically significant but small. A longitudinal study of adolescents found a significant association between “developmental assets” (positive relationships, values, and self-perceptions) and future GPA, controlling for baseline GPA (Scales et al. 2006).

The three subscales that were associated with academic performance in our study were meaningful learning environment, emotional climate, and student–student interaction. These subscales are intended to measure, respectively, the extent to which students think the curriculum is relevant, their affective responses to their education, and the perception of closeness among students. The importance of a meaningful learning environment was noted by Marshall (1978), when he developed the MSLES. Prior to designing his survey, he asked medical students about the difficulty in coping with the large quantity of course work in medical school. The students explained that they found it easier to devote large amounts of time to learning if they felt the material was related to what they thought they needed to know to become doctors. The two remaining subscales, emotional climate and the student–student interaction, deal with affective or nonintellectual responses to the environment. According to Bandura (1995), affective responses are important because they help a learner acquire needed knowledge and skills via mastery, observation of others, feedback, and support.

The results of our study lend support to the theory of situativity, which argues that “knowledge, thinking, and learning are situated (or located) in experience” (Durning & Artino, 2011). This review article stresses that context, which includes the unique contribution of the learning environment, is vital to learning.

The strength of our study is its control of prior academic performance; we included MCAT and undergraduate GPA when assessing the association between the learning environment and academic performance. Our study has several limitations as well. First, the results are from a single school and may not generalize to other schools. Second, our instrument, the LEQ, is currently not as widely used as the DREEM survey (Roff et al. 1997), but the DREEM survey was developed in 1997 and we have been assessing our students’ perception of their environment with the LEQ since 1994. Soemantari et al. (2010) rate both the LEQ and DREEM robust in terms of their psychometric qualities, preferring the DREEM survey because it could be applied to students in many countries. Lastly, our response rate of 72% is lower than we would like, but in line with many other studies using voluntary completion of surveys (Kellerman 2001).

Conclusion

This study provides evidence in support of the common assumption that students’ perception of their school environment can influence student performance. Like many medical schools, UNMSOM has educational strategies based on the presumed influence of the learning environment on academic outcomes. These strategies include problem- and team-based learning, early clinical exposure, rural clinical/public health experiences, and ample interaction with faculty and peers. Although confirmatory studies are needed, these findings suggest that the efforts many schools make to improve their learning environments are worthwhile.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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References


