Pololi, L. and Price, J. (2000) Validation and Use of an Instrument to Measure the Learning Environment as Perceived by Medical Students. ***Teaching and Learning in Medicine*** 12(4):201-207 (Autumn 2000). Published by Lawrence Erlbaum Associates (ISSN: 1040-1334).

Validation and Use of an Instrument to Measure the Learning Environment as Perceived by Medical Students

Linda Pololi and Jammie Price

ABSTRACT

Background: Aiming to inform curriculum changes in medical school, we developed, administered, and validated a 31-question survey to measure the learning environment as perceived by medical students.

Description: We administered the survey annually in 4 medical school classes in a Southeastern medical school from May 1994 through May 1997 (N = 619).

Evaluation: The survey responses reflected 3 dimensions of the medical school learning environment: the teacher-learner relationship (T-L R), the physician-patient relationship (Phys-Pt R), and self-efficacy. We found that the 3 dimensions are equally valid and reliable for all students, but that the mean values on all 3 dimensions differed by year in school and number of survey responses.

Conclusions: As students progress through school, they perceive deteriorating T-L Rs, feel diminishing self-efficacy, and accord less value to the Phys-Pt R. Based on these results, we developed training programs for faculty members to promote teaching attributes known to facilitate relationship formation between teacher and learner, and learner-centered and self-directed learning.

The experience of studying in medical schools has been considered to be analogous to belonging to an abusive and dysfunctional family. [1] There is a considerable literature on the stressful and punitive nature of medical school education.[2-4] This education provides a stark contrast to the behaviors deemed necessary for physicians to be compassionate and caring of their patients, be patient-centered, and form therapeutic relationships with their patients.

Extensive press coverage of increasing medical litigation and decreasing patient satisfaction suggests that physicians optimally do not learn the communication skills necessary for providing care today.[5] Further, recent studies show that the behavior of physicians reflects their experience in medical school.[6] Given these findings, we suggest that change is necessary in our nation's medical schools. It is our goal to measure the learning environment as perceived by medical students and use this data to target curriculum changes.

We consider that the relationship between teacher and learner is analogous to that between physician and patient. To promote the ability in our medical students to form therapeutic physician-patient relationships (Phys-PT Rs), we believe it is necessary to model effective relationship formation between teacher and student in medical school. We hypothesized that if students have experienced facilitative instructional methods, they will be more likely to employ these same advantageous methods with their patients.

Likewise, the literature suggests that physicians are more likely to perform tasks about which they report a high degree of self-efficacy.[7] In turn, self-efficacy correlates with autonomy in learners,[8] and autonomy is a good preparation for becoming self-directed in learning--a requirement for all physicians.

In addition to learning to be self-directed, students today must learn to teach patients to take responsibility for their own health, make informed choices regarding their health care, and take optimal advantage of their physician's recommendations.[9] In other words, they must learn to facilitate learning in their patients, another parallel between the teacher-learner and physician-patient dyads.

This kind of process in which individuals take the initiative with or without the help of others in diagnosing their learning needs, formulating goals, identifying human and material resources, and evaluating learning outcomes is called learner-centered learning.[10] Through learner-centered learning, patients and students alike take responsibility for their goals and participate actively in reaching them.

A number of investigators have assessed medical students' perceptions of their education. Marshall[11] tested a survey instrument to measure the learning environment on a variety of dimensions including flexibility, student interaction, emotional climate, supportiveness, meaningful learning, organization, and breadth of interest. The same instrument later was modified and validated at Australian medical schools. [12] Levy et al. [13] also surveyed the learning environment in a Georgia medical school in the context of assessing curriculum change. Dimensions measured desirability of learning situation, academic enthusiasm, goal direction, authoritarianism, breadth of interest, student interaction, and intellectual maturity. In 1973, Atkinson[14] highlighted the differences in teaching as perceived by students in medical

and surgical clinical rotations in a Scottish medical school and found prevalent perceptions of apprenticeship and passive observer-only roles for students.

Rogers[15] postulated that three critical dimensions facilitate learning: empathy, congruence, and unconditional positive regard. Apsy[16] applied the same dimensions to classroom teaching and found them to be significantly and positively associated with student achievement. And, using survey research, Ashworth et al.[17] assessed provider beliefs about the psychosocial aspects of patient care.

Building on the concepts and instruments mentioned earlier, we designed a shorter survey to measure students' perceptions of their learning environment. Our questionnaire adds to the work of Marshall,[11] Felletti and Clarke,[12] and others in that it focuses specifically on attributes in teachers that are proven to facilitate learning. These dimensions include trust and positive relationship formation between students and faculty members, positive regard for students held by faculty members, [15, 16] student self-efficacy[7, 8] (i.e., their self-perceived ability to perform as a physician), learner-centered learning,[10] and attitudes about the relationship between physician and patient. We used this survey to gain a better understanding of the learning environment and the process of learning at our institution.

MEASURING STUDENTS' PERCEPTION OF EDUCATION

Instrument Development

To measure students' experiences with their medical school education, we developed a survey consisting of 31 questions intended to measure aspects of the learning environment. We sought the help of nationally recognized medical educators who shared questionnaire materials that they had developed regarding the learning environment. We gained feedback on an early draft of the survey from medical colleagues with expertise in these areas at other institutions. We incorporated their comments and revised the survey into the current form (see Appendix).

Referring to the Appendix, we intended survey questions 1-3, 13, and 15 to measure learner-centered learning; questions 4-12, 14, 16, 22-23, and 28-31 to measure the teacher-learner relationship (T-L R); and questions 1, 8-21, and 24-27 to measure self-efficacy. We included Question 17 to assess medical school teachers. We used the data on Question 17 in a separate analysis.

Participants and Setting

We administered the survey annually to 3 successive years of students in the four medical school classes in a southeastern medical school starting May 1994 and ending May 1997 (N = 619). The survey was given once a year, at the end of each school year, in a class attended by all students and took approximately 10 min to complete.

Students were asked to respond to each survey question as it applied to their experience in the year of medical school they had just completed. Each survey was precoded for year in school,

date of survey administration, and random student identification number. Students were promised confidentiality of their responses. The completed surveys and the random student identification numbers were locked in a filing cabinet. The latter information was not used, as exploring individual differences across time was not the purpose of the study.

This design produced two sets of groups. First, the data include students' reflections while in each of the 4 years of medical school (M1 = 197, M2 = 182, M3 = 176, M4 = 64). Second, the data include students who responded to the survey once (n = 319), students who responded twice (n = 174), and students who responded three times (n = 126).

Analysis

The first step in our analysis was to see if the survey was equally valid and reliable for students responding to the survey for the first, second, and third time (i.e., a testing effect). Next, we assessed the validity and reliability of the survey across students in different years of medical school. [18, 19] To assess the validity and reliability of the survey, we performed an exploratory factor analysis (principal components) and a Cronbach's reliability analysis on each of these groups.[20, 21]

Both factor and reliability analyses used shared variation among variables to indicate which variables seem to indicate or measure similar factors or concepts. The higher the shared variation, the more likely the variables measured a similar concept. Exploratory factor analysis produced factor loadings (range = 0-1), which indicated how strongly each variable loads on or reflects each factor or concept. Generally, researchers look for variables to load .5 or higher exclusively on one factor. Cronbach's reliability analysis produced interitem correlations (range = 0-1), which measured the internal consistency of a scale containing each of the variables. Generally, researchers look for correlations of .7 or higher.

Based on the factor and reliability analyses, we then summed the questions on each factor into an index. We averaged the respondents' scores on all of the indexes to position each on a scale ranging from 1 (never) to 4 (always). On all of the indexes, the higher the score, the more favorably the student responded. Finally, we compared the mean index values across different years of medical school and across the number of times the student took the survey.

EVALUATION

To look for a testing effect, we first grouped the data into those who responded once, twice, and three times to the survey. The factor analysis shows that the students in each of these groups responded similarly to questions 6-15, 19-21, and 30-31.[a] These three sets of questions consistently reflect three factors for the students, regardless of how many times they took the survey or their year in medical school. We named the three factors the T-L R, self-efficacy, and the Phys-Pt R, respectively. Table 1 shows the final factor solutions, explained variation, and reliabilities for each of the three factors.

As shown in Table 1, across the groupings for numbers of times the respondents took the survey, the factor loadings are mostly in the .70s and .80s for T-L R, mostly in the .80s and .90s for self-efficacy, and all in the .90s for Phys-Pt R. Each factor explains a similarly large amount of variation across the three groups, ranging from 59% to 62% on the T-L R, 74% to 86% on self-efficacy, and 81% to 92% on the Phys-Pt R. The reliabilities are all sufficiently high, ranging from .92 to .93 for the T-L R, .81 to .92 for self-efficacy, and .76 to .90 for Phys-Pt R.

Table 1. *Factor Loadings, Explained Variation, and Reliabilities*

	Times Taken Survey			Year in Medical School			
	1[a]	2[b]	3[c]	1[d]	2[e]	3[f]	4[g]
Factor 1: Teacher–Learner Relationship							
q6	0.81	0.82	0.75	0.80	0.82	0.79	0.77
q7	0.69	0.69	0.76	0.63	0.71	0.74	0.78
q8	0.77	0.76	0.80	0.77	0.77	0.75	0.81
q9	0.72	0.81	0.79	0.67	0.80	0.80	0.78
q10	0.70	0.65	0.75	0.68	0.69	0.68	0.67
q11	0.80	0.79	0.85	0.78	0.82	0.79	0.84
q12	0.84	0.87	0.81	0.87	0.88	0.79	0.81
q13	0.72	0.74	0.77	0.72	0.77	0.76	0.73
q14	0.84	0.82	0.81	0.87	0.86	0.79	0.76
q15	0.73	0.69	0.76	0.74	0.70	0.76	0.75
Explained Variation (%)	58.60	58.80	62.00	57.40	61.40	58.80	59.40
Reliability	0.92	0.92	0.93	0.92	0.93	0.92	0.92
Factor 2: Self-Efficacy							
q19	0.95	0.95	0.88	0.95	0.95	0.96	0.89
q20	0.95	0.96	0.90	0.96	0.95	0.96	0.89
q21	0.87	0.85	0.80	0.88	0.82	0.92	0.78
Explained Variation (%)	85.60	84.40	73.80	87.10	82.90	89.80	73.40
Reliability	0.92	0.91	0.81	0.92	0.90	0.94	0.81
Factor 3: Physician–Patient Relationship							
q30	0.95	0.95	0.90	0.96	0.95	0.96	0.92
q31	0.95	0.95	0.90	0.96	0.95	0.96	0.92
Explained Variation (%)	91.10	91.00	81.00	92.40	91.00	92.00	85.20
Reliability	0.90	0.90	0.76	0.92	0.90	0.91	0.83

[a] $n = 319$. [b] $n = 174$. [c] $n = 126$. [d] $n = 197$. [e] $n = 182$. [f] $n = 176$. [g] $n = 64$.

Having found that the survey holds equally well regardless of the number of times a student takes it, we next grouped the data into the 4 years of medical school to see if students' perceptions of medical tion change as they progress through school. The analysis shows that the students in each year of school respond similarly to questions 6-15, 19-21, and 30-31 (the same question sets as from the previously discussed analysis). These three sets of questions consistently reflect three factors for the students, regardless of how many times they took the survey or their year in medical school. Again, we named the three factors T-L R, self-efficacy,

and Phys-Pt R, respectively. Table 1 shows the final factor solutions, explained variation, and reliabilities for each of the three factors.

As shown in Table 1, across the four groups for year in medical school, the factor loadings are mostly in the .70s and .80s for the T-L R, mostly in the .80s and .90s for self-efficacy, and all in the .90s for Phys-Pt R. Each factor explains a similarly large amount of variation across the four groups, ranging from 57% to 61% on the T-L R, 73% to 90% on self-efficacy, and 85% to 92% on Phys-Pt R. The reliabilities are all sufficiently high, ranging from .92 to .93 for the T-L R, .81 to .94 for self-efficacy, and .83 to .92 for the Phys-Pt R.

The similarity in the factor and reliability analyses across the seven groups suggests that the measurement models for T-L R, self-efficacy, and Phys-Pt R are equally valid and reliable for students in different years of medical school and for students responding to the survey once or multiple times. Having found that the measurement models hold equally well for all the groups, we then computed additive indexes based on the factor and reliability analyses. Because all of the factor loadings were about equal across the groups, we assigned equal weights for the variables in each scale. We substituted the mean for the group for any student that was missing data on any variable in an index.[a] Next, we tested the mean differences on each index across the two sets of groups using F tests and individual multiple-comparison t tests. All tests were done at a = .05. Tables 2 and 3 present descriptive statistics and the means tests for the three indexes.

As shown in Table 2, there are significant differences in the means on all three indexes across the different years in school. These mean differences suggest that students in different years of medical school cannot be combined into one analysis. Specifically, M1 students hold more favorable perceptions of the T-L R in medical school than do M2 and M3 students. M4 students possess less self-efficacy than do M1, M2, and M3 students. And M4 students think the relationship between physician and patient is less important than do M1, M2, and M3 students.

Similarly, as shown in Table 3, there are significant differences in the means on all three indexes for students responding to the survey once or multiple times. These mean differences suggest that students who have taken the test more than once can not be combined into one analysis with those who have taken the survey for the first time.

Specifically, first-time survey respondents hold more favorable perceptions of the relationship between teacher and learner in medical school than do second-time and third-time respondents. First-time survey respondents also possess more self-efficacy than do second-time and third-time respondents. Second-time survey respondents possess more self-efficacy than do third-time respondents. First-time survey respondents think that the relationship between physician and patient is more important than do second-time and third-time respondents. Finally, second-time survey respondents think that the relationship between physician and patient is more important than do third-time respondents.

CONCLUSIONS

The survey responses reflected three dimensions of medical school learning: the relationship between teacher and learner, self-efficacy, and the relationship between physician and patient. We built measurement models for these three dimensions and found that they are equally valid and reliable for students in different years of medical school and for students responding to the survey once or multiple times. However, there were significant differences in the means on all three dimensions across students in different years of medical school and students responding to the survey once or multiple times.

Table 2. *Year in Medical School: Means Tests for Additive Indexes*

	1[a]	2[b]	3[c]	4[d]	Group Means Test (*F*)	Individual Means Test (*t*)[e]
Factor 1: Teacher–Learner Relationship						
M	2.58	2.40	2.40	2.41	4.26**	a*, b*
SD	0.57	0.60	0.57	0.53		
Factor 2: Self-Efficacy						
M	2.73	2.68	2.77	1.74	27.16**	c**, d**, e**
SD	0.91	0.89	0.98	0.46		
Factor 3: Physician–Patient Relationship						
M	2.76	2.66	2.72	1.54	29.31**	c**, d**, e**
SD	1.08	1.07	1.03	0.53		

Note: Higher means indicate more favorable responses. Range for each index is 1 (*never*) to 4 (*always*). a = Year 1 differs statistically from Year 2. b = Year 1 differs statistically from Year 3. c = Year 1 differs statistically from Year 4. d = Year 2 differs statistically from Year 4. e = Year 3 differs statistically from M4.
[a]$n = 197$. [b]$n = 182$. [c]$n = 176$. [d]$n = 64$. [e]Scheffé Multiple Comparisons.
*$p < .05$. **$p < .001$.

Table 3. *Number of Times Taken Survey: Means Tests for Additive Indexes*

	1st Time[a]	2nd Time[b]	3rd Time[c]	Group Means Test (*F*)	Individual Means Test (*t*)[d]
Factor 1: Teacher–Learner Relationship					
M	2.55	2.38	2.32	8.99*	a*, b*
SD	0.58	0.59	0.55		
Factor 2: Self-Efficacy					
M	2.95	2.67	1.68	113.31**	a*, b**, c**
SD	0.84	0.92	0.51		
Factor 3: Physician–Patient Relationship					
M	2.97	2.64	1.67	86.33**	a*, b**, c**
SD	0.98	1.07	0.58		

Note: Higher means indicate more favorable responses. a = first-time takers differ statistically from second-time takers. b = first-time takers differ statistically from third-time takers. c = second-time takers differ statistically from third-time takers.
[a]$n = 319$. [b]$n = 174$. [c]$n = 126$. [d]Scheffé Multiple Comparisons.
*$p < .01$. **$p < .001$.

These mean differences indicate that when using this validated measurement model to assess students' perceptions of the learning environment, students in different years of school cannot be combined into one analysis; neither can students who have taken the survey different numbers of times.

As students progress through medical school, they perceive a deterioration in the relationship between teacher and learner, profess diminished self-efficacy, and accord less value to the relationship between physician and patient. We attribute these findings to the cumulative effect of the negative aspects of medical education across 4 years of schooling, which include growing cynicism[22] and the dehumanizing effect of medical education;[23] however, we cannot exclude the possibility that prior exposure to the instrument might influence responses.

Our finding that questions that were intended to measure learner-centered learning grouped with questions on the T-L R is not surprising. A trusting and constructive T-L R is essential for learner-centered learning to be optimally achieved; hence, we should expect reasonable overlap between these different perspectives on learning.

Researchers who want to build on this work could consider using only the questions from this survey shown to validly measure the T-L R (questions 6-15), self-efficacy (questions 19-21), and the Phys-Pt R (questions 30-31). This would provide an opportunity to use a 15-item questionnaire to assess these crucial aspects of effective medical education. More research is needed to explore other aspects of these scales' validity and reliability.

The disturbing findings regarding the adverse effect of medical school have prompted us to restructure some o four teaching programs, with increased attention to the learning environment for students. We also have designed and implemented a series of faculty development programs focused on teaching skills for medical educators. In these programs, faculty experienced a safe and effective learning environment, which facilitated the learner-centered process of their learning with resultant skill development and enhanced self-efficacy. We also paid significant attention in these programs to activities that promote relationship formation among participating faculty and require reflection on each participant's experiences in medical school, practice, and teaching. Our assumption is that as faculty members participate in these programs they will model the same behaviors and strategies for their students. In the next 5 years, we plan to repeat the learning environment surveys to assess the effectiveness of the new programs on faculty and curriculum development.

REFERENCES

1. McKegney CP. Medical education: A neglected and abusive family system. Family Medicine 1989;21:452-7.

2. Baldwin DC Jr., Daugherty SR, Eckenfels EJ. Student perceptions of mistreatment and harassment during medical school--A survey of ten United States schools. Western Journal of Medicine 1991; 155:140-5.

3. Cleve-Hogg D, Rothman AI. Discerning views--Medical students' perceptions of their learning environment. Evaluation & The Health Professions 1991; 14:456-74.

4. Kassebaum DG, Cutler ER. On the culture of student abuse in medical school. Academic Medicine 1998;73:1149-58.

5. Levinson W, Roter DL, Mullod J, Dull VT, Frankel RM. Physician-patient communication: The relationship with malpractice claims among primary care physicians and surgeons. Journal of the American Medical Association 1997;277:553-9.

6. Pololi L, Frankel R, Jobe A. Back when I was in school A link between faculty experience as students and current attitudes and values about teaching. Paper presented at the 35th Annual Research in Medical Education Conference, Washington, DC, November 1996.

7. Bandura A, Cerrone D. Differential engagement of self-reactive influences m cognitive motivation. Organizational Behavior and Human Decision 1986;38:92-113.

8. Williams GC, Deci EL. The importance of supporting autonomy m medical education. Annals of Internal Medicine 1998; 129:303-8.

9. Laine C, Davidoff F. Patient-centered medicine--A professional evolution. Journal of the American Medical Association 1996;275:152-5.

10. Brookfield SD. Understanding and facilitating adult learning San Francisco: Jossey-Bass, 1986.

11. Marshall RE. Measuring the medical school learning environment. Journal of Medical Education 1978 ;53:98-104.

12. Feletti GI, Clarke RM. Review of psychometric features of the medical school learning survey. Medical Education 1981;15:92-6.

13. Levy M, Morse PK, Liebelt RA, Dallman JJ, McDonald TF. Use of the learning environment questionnaire to assess curriculum change. Journal of Medical Education 1973;48:840-4.

14. Atkinson P. Worlds apart--Learning environments m medicine and surgery. British Journal of Medical Education 1973;7:218-24.

15. Rogers C. The facilitation of significant learning. In L Siegel (Ed.), Instruction: Some contemporary, viewpoints (pp. 37-54). San Francisco: Chandler, 1967.

16. Apsy D, Roebuck FN. A lever long enough. Washington, DC: The National Consortium for Humanizing Education, 1976.

17. Ashworth CD, Williamson P, Montano D. A scale to measure physician beliefs about psychosocial aspects of patient care. Social Science and Medicine 1989; 19:1235-8.

18. Campbell DT, Stanley JC. Experimental and quasi-experimental designs for research. Dallas, TX: Houghton Mifflin, 1963.

19. Carmines EG, Zeller RA. Reliability and validity assessment. Beverly Hills, CA: Sage, 1988.

20. Kim J-O, Mueller CW. Factor analysis: Statistical methods and practical issues. Beverly Hills, CA: Sage, 1978.

21. Cronbach LJ. Coefficient alpha and the internal structure of a test. Psychometrika 1951; 16:297-334.

22. Silver HK. Medical students and medical school. Journal of the American Medical Association 1984;251:739-42.

23. Hafferty FN. Beyond curriculum reform: Confronting medicine's hidden curriculum. Academic Medicine 1998;73:403-7.