Assessing Students in Community Settings: The Role of Peer Evaluation

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Abstract. The assessment of students in community settings faces unique difficulties. Since students are usually posted in small groups in different community settings and since the learning (largely) takes place outside the classroom, assessing student performance becomes an intrinsically complex endeavor. In this article, the proposition is made and tested that peers may be used to accurately assess particular aspects of performance, in particular those which need extensive and close observation. Examples are: Effort displayed while working in a community, quality of the interaction with that community, display of leadership, and subject-matter contributions.

The Faculty of Medicine of the University of Gezira, a community-based medical school, uses peer evaluation to assess these attributes of its students. Thirty four students divided into three groups participated in the present study. Goals of the study were to appraise the reliability, validity and acceptability of an instrument designed to measure these characteristics. Reliability was estimated using generalizability theory. A high generalizability coefficient (G) was found when all items were taken into account. In this case, G equaled 0.97. Its sub-scales each had also fairly high G-coefficients: Effort: 0.89, Subject-matter Contribution: 0.91, Community Interaction: 0.89, and Leadership: 0,88 respectively. The validity of the instrument was studied using confirmatory factor analysis. The results suggested that the proposed model of peer evaluation is reasonably valid. Finally, the instrument turned out to be quite acceptable to students.

Key words: peer evaluation, student assessment, reliability, validity, acceptability

Introduction

In the past ten years, a growing number of health institutions have adopted community-oriented, community-based education as a strategy for learning and instruction (Schmidt et al., 1991). Community-based education is defined as a set of instructional activities that uses the community extensively as a learning environment. The community involved may be suburban or rural (Report of WHO Study Group, 1987). A characteristic unique to community-based education (CBE) is that learning inherently takes place outside the class or the university campus. This feature, of course, limits teacher control over learning and, particularly over student assessment. Because learning in the community partly depends on opportunities that spontaneous arise while being on location, instruction is difficult to plan. In addition, this type of learning often requires that students work in small groups and are posted in different communities. Under these circumstances

assessment becomes a formidable task, since it is almost impossible to maintain common standards against which student performance is to be judged. The fact that most community-based programs aim at fostering the development of high-level skills, such as communication skills, leadership qualities and managerial skills, even further complicates the assessment issue, since these skills are not easily assessed through standard procedures. Assessing these skills requires a multi-source approach and probably the involvement of many raters, making student assessment in the community almost impossible to carry out.

The development of relevant methods for student assessment in community settings is a challenge for all institutions adopting CBE, because irrelevant assessment methods will reflect directly on students attitudes towards CBE. Because assessment drives the learning to a large extent, irrelevant assessment will direct students to the pursuit of learning activities that may be irrelevant to the goals of CBE. To solve this problem, different approaches and instruments have been proposed. In general, two main approaches to student assessment in community settings can be distinguished. The most common approach used is measuring student performance on tests at the end of the CBE learning activity. These tests involve instruments measuring knowledge gains or staff judgments regarding student reports of their learning, or both (Jinadu, 1992; Omatara, 1992). The second, less prevalent, approach, is assessment of students during the *process* of learning. Various instruments have been suggested, among them logbooks (Des Marchais, 1993; Manalo, 1993), supervisory visits (Bollag et al.; 1982; Magzoub, 1993) and peer assessment (Hassan, 1993; Morales-Samaneago, 1993). An advantage of the latter, process-oriented approach is that assessment is continuous. Therefore, it is helpful for informed decision-making and feedback to students; it happens to be less stressful for students and can more easily tailored to cover the course objectives.

Among the process-oriented methods, peer evaluation has a special attraction for community-based education. As students are working and living together for quite some time in the community, they are in a good position to judge each other's contributions and the extent of their peer's learning. There are several other advantages of this approach reported in the literature. De Grave and De Volder (1985) suggest that the advantages of peer evaluation over more conventional paper-and-pencil-based methods are most clear in the areas of skills acquisition and attitude learning. Peer evaluation is best suited for the evaluation of humanistic qualities, such as integrity, compassion, respect, and the ability to build and maintain interpersonal relations (Jennet et al., 1990). Presently, three methods of peer assessment are distinguished: Peer nomination, peer ranking and peer rating (Kane and Lawler, 1978). In peer nomination, each group member is asked to nominate a specified number of group members as being the highest or, alternatively, lowest in the group on a particular characteristic or dimension of performance. In peer ranking, each group member ranks all of the others from best to worst on one or more factors. In peer rating, finally, each group member rates each other group member on a given

set of behaviors, using any one of several kinds of rating scales. Peer rating has several advantages over the other methods, it is most useful for feedback purposes since it considers each individual member in the group in his own right without forcing the judge to rank-order subjects. The disadvantage of peer rating, however, is its potentially low reliability and validity compared to the two other methods of peer assessment (Love, 1981).

For peer assessment to be successful, Kane and Lawler (1978), suggested that three conditions should be met: 1) Peers should be in a position to observe unique aspects of each other's behaviors; 2) Peers should be capable of accurately perceiving and interpreting the salient aspects of each other's behaviors; 3) There should be a perceived need to improve the effectiveness with which the characteristics of group members are assessed.

The Faculty of Medicine, Gezira University, Wad Medani, the Sudan, is a community-based, community-oriented school that sends students for posting in rural areas on a regular basis. The students are assigned to villages and work in small groups in their selected villages. The students stay in rural areas for periods ranging from one week up to one month. The school, therefore, faces the difficulties in assessing students mentioned earlier. This applies in particular to interaction skills, which require continuous and intimate observation. In order to deal with this problem, the school decided to experiment with peer evaluation, using the peer rating method, as part of a multi-source assessment program. The objective of this paper is to report on a series of studies examining the reliability, validity and acceptability of peer assessment as an instrument in assessing students in community settings.

Method

INSTRUMENT

Following a discussion with tutors and students, it was felt that students were in a better position compared to tutors to evaluate each other on four factors of interest. Each of these factors needs extensive and intimate observation. Consequently, a peer evaluation rating scale was developed which included four factors. The four factors were: (1) Effort: 8 items, reflecting the input of students in the different activities carried out during this course. (2) Community Interaction: 6 items, reflecting the students' ability to communicate with the community to facilitate data collection and consent to advice. This skill is considered to be important for the future work of a physician and for developing a doctor-patient-community relationship. (3) Leadership: 4 items were developed, reflecting aspects such as leading a group discussion, decision making and directing the division of labor. This is a very important skill for doctors in the Sudan, because they will act as health team leaders when they are assigned to work in rural hospitals. Objective assessment of this important skill is essential if one wishes to graduate doctors who are able to respond to community health needs. (4) Use of Subject matter Knowledge: 4 items,

Table I. Items included in the peer evaluation rating scale. Mean scores standard deviations (SD) for each item. $N = 184$

		Mean	SD
Factor (1): Peer evaluation of effort			
1.	Contribution to the design of forms for data collection	4.23	0.95
2.	Contribution to data collection in the village	4.47	0.76
3.	Participation in the assigned activities in the village	4.01	1.14
4.	Problem identification	3.96	1.21
5.	Participation in report writing	3.64	1.21
6.	Contribution to the group activities concerning living, accommodation, housing in the village	3.39	1.24
7.	Participation in preparation for the group seminar	3.86	1.27
8.	Physical attendance in announced group activities	4.17	1.16
Factor (2): Peer evaluation of community interaction			
9.	The terminology used by the student was understandable to the community members	4.10	0.86
10.	He was always responding to community members' questions in a clear way	3.92	0.97
11.	He is a good listener to community problems	3.91	0.95
12.	His advice and suggestions seem to convince the community	3.83	0.99
13.	He was frequently present in the community	3.44	1.13
14.	He was able to befriend community members	3.76	1.24
Factor (3): Peer evaluation of Leadership			
15.	He was able to contact community leaders	3.77	1.06
16.	He was a good leader of group discussion	3.38	1.08
17.	He was able to divide labor equally among group members	3.44	1.11
18.	He is a good decision maker	3.50	1.07
Factor (4): Peer evaluation of subject-matter contribution			
19.	He gave useful information to the group	3.70	1.08
20.	His suggestions and thoughts were helpful to the group's work	3.71	1.10
21.	He formulated good questions	3.38	1.11
22.	He made use of references and resources	3.60	1.12

reflecting the student's ability to utilize his gained knowledge to help the group progress towards the course objectives. The items comprising the rating scale can be found in Table I.

SUBJECTS AND PROCEDURE

Three groups of University of Gezira students participated in this study. The first group included 12 students, the second and third groups composed each of 11 students. The rating scale was administered following their rural field training.

Students were asked to rate each other on a six-point scale, where 1 represented strong disagreement with the statement and 6 strong agreement. Ratings conducted by 8 raters for each student, were included in the study, because the statistical analysis required equal numbers of judgments per student.

ANALYSES

Reliability study. Generalizability studies were conducted to estimate the reliability of the four factors. In total 34 students were involved that were each judged by eight raters. Thus, 272 ratings (34 * 8) were available. One of the advantages of this approach over classical test theory is that it recognizes multiple sources of variability, such as differences among students, item differences and inter-rater differences, instead of only one single undifferentiated error component (Brennan and Kane, 1979). The object of measurement in this study is students, since the main purpose of assessment in the educational context described is to discriminate between students on the four dimensions measured by the rating scale. Therefore, the largest source of variance is expected to be among students. Both the student and the item sample are treated as "random" since they are both considered to be exchangeable with any other sample of the same size drawn from an imaginary universe (Shavelson and Webb, 1991). Five sources of variability were included in the analysis: (1) differences between students (S), (2) differences in "item difficulties" (I), (3) differences between raters nested within students (inter-rater differences) (R:S), (4) interaction between students and items (SI), and (5) differences arising both from items crossed with raters within students and from error effects or unidentified events (IR:S,e). Generalizability studies were conducted for each separate factor.

Validity study. A confirmatory factor analysis was carried out to assess the adequacy of the latent variables, or factors, underlying the rating scale described above. In the confirmatory factor model as applied in this study, all common factors are correlated, observed variables 1 through 8 are considered to be affected by the first common factor (Effort), observed variables 9 to 14 are affected by the second common factor (Community Interaction), 14 to 18 are affected by the third common factor (Leadership), and the last four items are affected by the fourth common factor (Subject-matter Contribution). Furthermore, all observed variables are assumed to be affected by a unique factor (error), and no pairs of unique factors are correlated. The Lisrel VII program (Joreskog and Sorborn, 1990) was used to determine whether the data confirmed this model.

Acceptability. Students were interviewed to find out to what extent they accepted the method, whether it was interfering with their activities, and whether they judged it as a valid method of assessment.

Table II. Descriptive statistics for each factor

Factor	N items	Mean value	SD value	Minimum	Maximum	N
Effort	8	3.97	0.90	0.38	5.00	272
Community interaction	6	3.83	0.86	1.00	5.00	272
Leadership	4	3.52	0.97	0.25	5.00	272
Subject-matter contribution	4	3.60	0.95	0.00	5.00	272
Total	22	3.78	0.81	0.91	5.00	272

Results

Reliability. Table II contains the descriptive statistics for each factor, notably means and standard deviations. In Table III the sources of variability are summarized. The first source of variance in this table involves students (S). The estimated variance component for the student source reflects the magnitude of error in generalizing from one student score to the universe of student scores. The standard error in Table III indicates the accuracy of the estimated variance component. The standard error is relatively high, possibly because of the relatively small sample size of students (34) and items (22). As can be seen in the last column of Table III, the percentage of variance associated with students for the four factors varies between 30.5 and 43.3. This percentage represents the true variance or variance of interest. The estimated variance components presented in Table III were used to estimate reliability indices. The generalizability coefficient (or G-coefficient) for each factor was found to be 0.90, 0.89, 0.88 and 0.91, respectively, with eight raters for each student, as summarized in Table IV. The standard error of measurement (SEM) can be used to estimate confidence intervals for individual scores. For example, the 95 percent interval of a score can be estimated by multiplying the SEM by 1.96. Taking the arbitrary standpoint that at least a difference of 1 point is required, the SEM should be lower than or equal to 0.26 (0.5/1.96) at the 95 percent level. As can be seen in Table IV, the SEM for the four factors is 0.25, 0.21, 0.25 and 0.23, respectively. These results demonstrate that the reliability is acceptable with eight raters for each student.

Validity. A validity study was performed using confirmatory factor analysis. The correlation coefficients between the observed variables vary between 0.31 and 0.78 for Effort, 0.49 to 0.80 for Community Interaction, 0.66 to 0.77 for Leadership and 0.59 to 0.78 for Knowledge Use. The correlations between the four common factors varied between 0.61 to 0.89 as shown in Table V. Although these coefficients are relatively high, a one-factor model did not fit the data. A model is assumed to fit the data if three conditions are met: (1) The Chi square divided by its degrees of freedom is lower than 5, a *p*-value higher than 0.05, (2) the root mean square residual is

Table III. Estimated variance components of the four factors (scale 1-5)

Source	DF	Estimated variance component	Standard error	Percentage of total variance
Effort				
Students (S)	33	0.5375	0.1436	38.5
Items (I)	7	0.0000	0.0009	0.0
Raters within Students (R:S)	238	0.2409	0.0266	17.3
Students by Items (SI)	231	0.2151	0.0246	15.4
IR:S, e	1666	0.4021	0.0139	28.8
Community-interaction				
Students (S)	33	0.3475	0.0929	30.5
Items (I)	5	0.0080	0.0046	0.0
Raters within Students (R:S)	238	0.0000	0.0280	0.0
Students by Items (SI)	165	0.1883	0.0290	16.5
IR:S, e	1190	0.6040	0.0247	52.6
Leadership				
Students (S)	33	0.4509	0.1226	37.4
Items (I)	3	0.0133	0.0127	0.1
Raters within Students (R:S)	238	0.0266	0.0167	2.2
Students by Items (SI)	99	0.1662	0.0326	13.4
IR:S, e	714	0.5526	0.0292	45.9
Subject-matter contribution				
Students (S)	33	0.5374	0.1413	43.3
Items (I)	3	0.0000	0.0043	0.0
Raters within Students (R:S)	238	0.0350	0.0171	2.8
Students by Items (SI)	99	0.1254	0.0274	10.1
IR:S, e	714	0.5427	0.0286	43.7

Table IV. G-coefficients and standard errors of measurement (SEM) for the total score and for separate factors

Factor	G-coefficient	SEM
– Peer evaluation of effort	0.895	0.2515
– Peer evaluation of community interaction	0.887	0.2097
– Peer evaluation of leadership	0.881	0.2471
– Peer evaluation of subject-matter contribution	0.910	0.2300
Total	0.970	0.1139

lower than 0.07, and (3) the goodness-of-fit index and the adjusted goodness-of-fit index, that takes into account the number of degrees of freedom, is higher than 0.80 (Saris and Stronkhorst, 1984). The model described in the analysis section differed

Table V. Correlation between different factors of peer assessment

	Effort	Interaction	Leadership
Effort			
Interaction	0.769		
Leadership	0.606	0.609	
Subject-matter	0.889	0.709	0.616

All coefficients are significantly different from zero; p < 0.001.

significantly from the data (Chi-square = 472.14, df = 203, p = 0.00; Chi-square/df = 2.33). The root mean square residual was 0.053, the goodness-of-fit-index and the adjusted goodness-of-fit-index were respectively, 0.79 and 0.74. These results suggest that the conditions specified by Saris and Stronkhorst (1984) are not met, although the actual findings do not deviate far from the minimally acceptable level. A second validity study was undertaken to test the assumption that the apparent lack of fit of the four-factor model to the data might be caused by the fact that there are actually two second-order latent factors underlying the four first-order latent factors. It was assumed that Leadership and Community-interaction would be explained by a second-order factor we would call "Social interaction skills." Effort and Subject-matter input are typical "Content related skills." This model fitted the data very well: Chi-square = 0.779, df = 1, p = 0.37, Chi-square/df = 0.779, with a goodness-of-fit index of 1.00.

Acceptability. The acceptability interview, revealed that the method was quite acceptable to students. A large majority felt that the instrument measured important characteristics of future physicians. In addition, the students thought that having to judge peers did not interfere with group-related activities. The students proposed the faculty to include peer evaluation in the array of assessment procedures routinely applied at the University of Gezira.

Discussion

The results of the present study suggest that students are generally able to rate each other reliably, in particular when all items were taken together to generate one index for community-related skills. The G-coefficient for this index indicates that the findings can be generalized to both other students under similar circumstances and other items measuring the same concepts. The variability among the objects of interest, the students, was sufficiently large compared to other sources of variation to warrant the conclusion that the instrument, taken as a whole, and its subscales reliably discriminate between subjects of different levels of competence.

We were somewhat surprised to see that the subscales in the domains measured were equally able to differentiate between students. We expected that cultural influences would moderate the way Sudanese students perceive each other's inter-

personal skills. In the Arab culture, dominant in the area in which the present study was done, there is a strong emphasis on equality in interpersonal matters. Every member of a group is considered to be contributing to the groups well-being to the same extent and leadership is considered more a collective than an individual good. Therefore, one would expect the interaction subscales to have lower generalizability.

In addition, the students involved did not have much experience with evaluating their peers on the attributes in question. It is expected that students will be better able to judge their peers reliably only if they have sufficient opportunities to observe and rate their colleagues. Calhoun et al. (1990), for instance, showed that senior medical students become more "expert-like" in their peer evaluations in the course of a clerkship.

On the other hand students *do* accumulate other experiences apart from this particular posting that allow them to judge their peers, since students live together in dormitories and participate in voluntary community-based activities almost every other weekend. This may add to the explanation why these students were reasonably good at judging each other.

It may be useful to note here that the reliability findings in the present study are comparable with most peer-rating studies, and comparable with the best three studies discussed in a recent review by Goldman (1992). In addition, it seems that the measurement procedure fulfills the three criteria for successful use of peer assessment suggested by Kane and Lawler (1978) mentioned in the introduction to this article. It is, however, clear that attempts should be made to improve on the reliabilities of the Community-interaction and Leadership scales, if only because they are by no means conceptually less important than the Effort and Subject-matter-contributions subscales. One way of doing this is increasing the number of items measuring the factors in question.

The validity of the model turned adequate only after the original latent four-factor model was adapted. Assuming that two second-order latent factors operate under the four latent factors, resulted in an good fit of the data. It seems indeed that an interaction-related latent factor and a content-related latent factor can validly account for differences in perceived behavior. Process and content appear in this study in new disguises.

Acceptability of the method by students, is a prerequisite for including it in the arsenal of approaches available assessors. In addition, peer assessment should not interfere with group activities and should not influence the atmosphere in the student team. Team work and group cohesion are vital in community-based education. Interestingly, studies conducted to test the acceptability of the method show contradictory findings. Fenn et al. (1993), Epstein (1993), Morales-Saminigo (1993), Hassan (1993) and Erickson (1990) found the method to be quite acceptable to students. On the other hand, studies in a residency program (Jennet et al., 1990) report that students find the method unacceptable. At the University of Gezira, the students initiated in fact the application of this instrument. They felt that giving

equal grades for all group members was not fair. As a result, the idea of using peer evaluation evolved during discussions between tutors and students.

In conclusion, this study can be considered a first, reasonably successful, attempt to measure important skills needed for work in the community setting, that cannot be measured otherwise. The rating scale developed has high reliability and good validity and its development may be considered a first effort in a field that is still in its infancy.

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