Outcome Assessment in a PharmD Program: The Texas Tech Experience

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Systematic assessment and evaluation of professional pharmacy programs are mandated by the American Council on Pharmaceutical Education. Therefore, U.S. schools and colleges of pharmacy are developing programs to assess student mastery of curricular outcomes. Beginning with its inaugural class in the fall of 1996, Texas Tech School of Pharmacy began an annual assessment program, which has undergone significant changes since then. Currently, an Outcome Assessment Committee with faculty, administration, and student representatives and an Outcome Assessment Office with Associate Dean for Curriculum, Students, and Outcomes Assessment are responsible for the program. In the 2000-2001 academic year, the program assessed student learning in six abilities: (*i*) use of basic science in the practice of pharmacy; (*ii*) problem prevention and solving; (*iii*) dispensing pharmaceuticals; (*iv*) providing patient-specific pharmaceutical care; (*v*) moral reasoning and ethical and legal judgment; and (*vi*) management sciences. Different steps in the annual assessment program included: (*i*) selection of curricular abilities to be assessed; (*ii*) development of the assessment tool; (*iii*) assignment of minimum competencies and cutscores using the modified Angoff method; *(iv)* administration of the assessment; and *(v)* analysis and distribution of reports to both students and faculty. Although several issues remain to be resolved, surveys indicate that both students and faculty believe that the assessment program is a valuable tool for identification of student strengths and weaknesses and for curricular evaluations. Faculty and students are, however, almost evenly divided as to the use of assessment data for student progression. A step-by-step description of the program evolution, along with its shortcomings and future directions, is presented with the hope that it may be of some value to other institutions currently developing similar programs.

INTRODUCTION

Because of a general demand by the public for educational accountability, the need for educational program assessment has dramatically increased in recent years(1). This demand has led to specific requirements and standards set by various agencies responsible for accrediting educational institutions.

In pharmacy education, ability-based curricular outcomes have been proposed for entry-level programs(2), and one of the requirements for accreditation of these programs is a systematic assessment of the achievement of these outcomes by students(3). Standard No. 3 of the Accreditation Standards and Guidelines of the American Council on Pharmaceutical Education (ACPE) requires that colleges and schools of pharmacy continuously assess the achievement of their educational goals and objectives through a variety of methods, use the data for evaluation of the program, and modify the program accordingly(3). Therefore, programmatic assessment has become one of the most important priorities and challenges for pharmacy

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Table I. Tech's Top Ten curricular ability sets

Communication
Use of basic science in the practice of pharmacy
Problem prevention and solving
Dispensing pharmaceuticals
Providing patient-specific pharmaceutical care
Providing pharmaceutical care to large populations
Moral reasoning, ethical, and legal judgment
Management Sciences
Advancing the profession and promotion of good health
Personal growth

educators and administrators during recent years. Consequently, it is not surprising that a recent survey(4) found that 49 percent of the U.S. pharmacy schools have formed assessment committees, in addition to the traditional curriculum committees, to deal with this issue. Additionally, the American Association of Colleges of Pharmacy (AACP) has considered outcome assessment as a priority by providing models(5,6) and organizing workshops and seminars for pharmacy schools.

Similar to most other higher education institutions, pharmacy programs have traditionally concentrated on the assessment of student achievement in individual courses, as opposed to more global assessment of the programs. Additionally, colleges and schools of pharmacy have used data from standardized licensure examinations, alumni and graduate surveys, and preceptor and employer evaluations to support the achievement of their overall educational goals and/or revise their curricula. In an article prepared for AACP, Winslade(6) recently described in detail an assessment model for student achievement in PharmD programs. It was stated that an ideal model would allow for both comparison of student achievement with national standards and also with that of students in other schools/colleges of pharmacy. In addition to serving as a quality assurance program, such assessments may also be useful for detection of curricular deficiencies and remediation purposes. However, such comprehensive quality assurance programs are currently nonexistent in most, if not all, of the schools/colleges of pharmacy.

Although pharmacy education appears to be behind medicine in the area of assessment of student achievement, pharmacy educators and professional organizations generally believe in the importance of such measures. Therefore, it is not unexpected to see that various schools have started to develop assessment programs. For example, one school reported(7) that an annual examination administered to the fourth year graduating students correlated with final grade point average, suggesting convergent validity of the assessment. A second school reported(8) an attempt to integrate the available assessment tools currently used in their program to identify areas of concern for further probing. The purpose of this article is to describe the efforts of Texas Tech School of Pharmacy in the development and application of an annual assessment program as one of the tools for the assessment of student achievement in an ability-based curriculum.

OUTCOME ASSESSMENT PROGRAM DEVELOPMENT

Texas Tech University School of Pharmacy accepted its first class of PharmD students in the fall of 1996. From the first year, the school established an Outcome Assessment Committee (OAC) to oversee the annual assessment process, which has evolved during the last five years. The committee consists of four faculty representatives (two from each of the two departments of Pharmaceutical Sciences and Pharmacy Practice) appointed by the Dean, both department chairs, Associate Dean for Curriculum, Students, and Outcomes Assessment, and two students nominated by the Pharmacy Student Senate. The committee chair is elected from the faculty representatives. The committee is responsible for coordination of all of the activities related to the programmatic assessment. In the latest annual assessment program, which was administered during the 2000-2001 academic year, the process involved the following steps:

1. Selection of curricular abilities to be included in the annual assessment
2. Development of the assessment tool
3. Assignment of minimum competencies and cut-scores
4. Administration of the assessment
5. Preparation and distribution of reports

These steps are discussed in more detail in the following sections.

Curricular Abilities To Be Assessed

The faculty at Texas Tech has adopted 10 curricular ability sets (Tech's Top Ten) as a basis for curriculum development and assessment (Table I). Additionally, each of these abilities has been defined in specific terms for each level of the curriculum (P1, P2, P3, and P4). Tech's Top Ten and its subsets are made public and communicated with students through the school's web site. The first two annual assessments, administered in the 1996-1997 and 1997-1998 academic years, attempted to assess all abilities in Tech's Top Ten (Table I). However, the faculty did not believe that these assessments yielded useful information. In a subsequent retreat on the subject, the faculty decided to start with assessing a limited number of Tech's Top Ten abilities and gradually increase the assessed abilities over the years. To that end, the third year of the program (1998-1999) assessed only three abilities including: (*i*) the Use of Basic Science in the Practice of Pharmacy (BS); (*ii*) Providing Patient-Specific Pharmaceutical Car (PC); and (*iii*) Problem Prevention and Solving (PS). In the 1999-2000 academic year, a fourth ability, (*iv*) Dispensing Pharmaceuticals (DP), was also included in the annual assessment program; and in the latest annual assessment (2000-2001), two other abilities, (*v*) Moral Reasoning and Ethical and Legal Judgment (MEL), and (*vi*) Management Sciences (MS) were added (for a total of six abilities).

Each of Tech's Top Ten abilities is defined in specific statements for all the four years of the program. Because assessment of all the specific terms for each selected ability would result in an unreasonably long assessment tool, only three specific statements describing abilities expected for each level (year) of the curriculum are assessed every year. The abilities and corresponding statements at each level to be assessed each year are selected by the Outcome Assessment Committee after receiving input from faculty. As an example, the statements selected for Basic Sciences ability in 2000-2001 assessment are listed in Table II.

Development of Assessment Tool

During the first two years of annual assessment, the assessment tool included written essay questions along with

Table II. Statements for different year levels for the basic sciences ability selected for assessment in the 2000-2001 academic year[a]

P1 Level
1. Define the nature, location, and function of a selected component of the human anatomy.
2. Describe six routes of medication administration.
3. Perform a selected pharmaceutical dosage calculation.

P2 Level
1. Describe the pathophysiology of a selected disease.
2. Describe the mechanism of action of a selected drug.
3. Perform pharmacokinetic calculations.

P3 Level
1. Define the probable adverse effects of a new drug given its pharmacologic classification.
2. Describe the probable action of a new drug given its drug family and prototype.
3. Detect potential drug interactions in a patient care setting.

P4 Level
1. Monitor drug therapy for a selected patient.
2. Adjust drug therapy for a selected patient.
3. Manage adverse drug reactions for a selected patient.

[a]A complete list of statements for this and other Tech's Top Ten abilities may be found at our web site (http://pharmacy.ama.tluhsc.edu/).

simulated patient cases, developed by faculty. These assessment tools, although theoretically sound, proved impractical and of limited value for a new and developing program; the faculty were simply overwhelmed by trying to accomplish too much in a short period of time. There were also concerns over the reliability of such a testing methodology. A faculty retreat in 1998 resulted in adoption of an assessment format consisting of mainly multiple-choice questions with only four answer options, with the possibility of adding other more sophisticated and complementary assessment tools as the faculty gained more experience. Consequently, the assessment tool has been a multiple-choice annual exam during the last three years of the program.

Specifically, the Outcome Assessment Committee divides faculty, based on their expertise, into different ability assessment groups that correspond with the skill sets being tested. For example for the 2000-2001 assessment, the faculty were divided into six groups to write questions for the annual assessment of Basic Sciences, Pharmaceutical Care, Dispensing Pharmaceuticals, Problem Solving, Management Sciences, and Moral Reasoning and Ethical and Legal Judgment abilities. A seventh group of faculty and residents were assigned the task of examination item quality control and determining cut-scores after the initial development of the questions (see the following section). One or more members of the Outcome Assessment Committee took responsibility for coordinating faculty activity in each of the above groups. The plan was to have faculty write four to five questions for each of the statements under every year level of each ability (Table II). However, only three of these questions would be included in the final assessment tool. This would allow for elimination of any question deemed not suitable during the revision and leveling process and possible extra questions which would be included in a question database for use in subsequent years. Considering six abilities, four different year levels for each ability, and three statements for each level (Table II), questions were needed to assess a total of 72 statements. Requiring four to five questions for each statement translated into a total of 288 to 360 questions. A total of 65 faculty and residents were assigned to writing questions. Therefore, the Outcome Assessment Committee asked each faculty to write a total of five questions for five different statements in their ability groups. Assignment of statements and years to individual faculty within each ability group was at the discretion of the group leader who was an Outcome Assessment Committee member. The initial revision of the questions was conducted within each of the ability groups. The questions were then collected from all six ability groups and compiled into a single document, which was reviewed by Outcome Assessment Committee members who selected a minimum of three questions for each of the 72 statements (216 questions), with the remaining questions serving as backups. The selected questions were then sent to the leveling/cut-score group for further analysis.

Assignment of Minimum Competencies and Cut-Scores

Until the latest assessment in the 2000-2001 academic year, the student performances in annual assessments were reported based on absolute scores they achieved in different categories. Therefore, each student's performance only could be considered in comparison with the performance of the other students in the same year (*e.g.,* student scores relative to the mean and range of scores and percentiles). This type of information allowed only ranking of students in terms of their performance in the overall assessment and in each ability. However, no information could be obtained regarding the competence of students in any specific ability. Additionally, the performance of students in different categories could not be compared. This was because the degree of difficulty of the questions was not known. Therefore, a higher average score in one ability could not be automatically translated into a higher degree of ability mastery of students in this category; it could simply mean that the questions in this category were less difficult that those in other categories. Consequently, the Outcome Assessment Committee decided to develop a strategy to set minimum competence levels (cut-scores) for different abilities for each level of the curriculum for the 2000-2001 annual assessment using a modification(9) of the Angoff method(10) as briefly explained below.

The modified Angoff method, as developed at Texas Tech(9), is based on the likelihood of a "minimally-competent" student answering a question correctly. In other words, for each question, the percentage of a group of just minimally competent students who will answer a question correctly must be determined. In determining this percentage, the probability of students arriving at a correct answer by guessing should also be considered. For example, in the Texas Tech case with multiple-choice questions consisting of four options, the value would be 25 percent if it is determined that none of the minimally competent

Dear XXXX: Below is a preliminary report on the annual assessment conducted on Jan. 20, 2000. Please contact your advisor if you need help in interpretation of the results. Thank you for taking part in this important assessment.

P1 (P2, P3, or P4)-Specific Questions															All Questions		
Composite[1]			PS[2]			DP[2]			BS[2]			PC[2]			(P1-P4)		
Score	Range	Mean	Score	Range	Mean	Score	Range	Mean	Score	Range	Mean	Score	Range	Mean	Score	Range[3]	Mean[3]
36	18-39	29.9	10	4-11	7.86	6	3-10	6.42	8	2-11	6.02	12	3.-12	9.64	101	58-119[3]	043

[1]Composite = All Abilities; [2]PS = Problem Solving and Prevention, DP = Dispensing Pharmaceuticals, BS = Basic Sciences, PC - Pharmaceutical

Fig. I. An example of a report sent to individual students for the 1999-2000 academic year assessment. The example is for a P1 student. However, students in other years also received similar reports with the italic text changing based on their class standing.

students would know the correct answer to the question. The values are determined for each question individually by a panel of judges. Nine faculty and residents were selected by the Outcome Assessment Committee to achieve this task - a task termed question leveling. Each member of the group assigned a score to each question. The scores were then made public, and members discussed their reason(s) for the assigned scores. At the end of discussion, the members scored the question for a second time, and, after deleting the highest and the lowest scores, the remaining scores were averaged and used for that question. Cut-score averages were then determined by taking the average of scores for individual questions for each level (P1 to P4) of each ability. The average cut-score values were then used as a priori for determination of minimum competence for each level and ability. In other words, students who scored equal to or higher than a specific cut-score were considered "minimally competent" in the ability that corresponded to that cut-score. In addition to development of cut-scores, the question-leveling process served as another layer of quality control for questions. During this process, the expert panel was asked to examine questions for editorial and scientific soundness and agreement with the stated abilities. Consequently, some questions were revised for clarity and others, which were not consistent with the stated abilities, were replaced with other questions from the question pool.

Administration of the Assessment Tool

There are several methods of assessment administration. The two common methods are progress testing and standardized testing(6). In progress testing, an instrument assessing final levels of competencies is administered to all students who are at different levels, and the students progress is monitored as they move through different years of education. In standardized testing, students at different levels of curriculum are assessed using different instruments related to the competencies for those specific levels. Except for the 2000-2001 academic year, one assessment tool consisting of all the questions for all the years was administered to all students regardless of their class standing (progress testing). This process, however, resulted in some problems in interpreting the results for students in lower levels of the curriculum. Additionally, student surveys indicated that students other than P4's (especially P1 and P2's) were frustrated by a relatively large number of questions that they were not familiar with. Therefore, the Outcome Assessment Committee decided to administer class-specific assessment tools (standardized testing) during the 2000-2001 academic year. Consequently, P4 students received all the 216 questions in the assessment (three questions for each of the three statements for each of the four years for each of the six abilities). However, other classes received only questions designed for their levels and levels below them in the curriculum (162, 108, and 54 questions for P3's, P2's, and P1's, respectively). The annual assessment was administered as a day-long process early in the spring semester. Whereas P1 and P2 students were assessed during the morning of the assessment day, the assessment for P3's and P4's were extended to afternoon.

The planned format for the future years is the same as that for the 2000-2001 assessment. However, it is planned that at least for the next few years new questions be solicited from faculty until a question database with substantial numbers of questions and appropriate psychometric indices is developed. It is anticipated that at that time, several equivalent tests may be developed for administration at different years with only minor revisions for the future.

Preparation and Distribution of Reports

During the first two years of assessment, faculty graded the essay questions and videotaped performances of students in response to simulated patient cases. However, because of lack of confidence of faculty in the assessment tools and the interpretation of the results, these results were not distributed to the students. In the third year of assessment (1998-1999), the results of a multiple-choice tool assessing three areas of Basic Sciences, Problem Solving, and Pharmaceutical Care were analyzed by the Outcome Assessment Committee members, and the committee decided to report to students only their overall class standing in three categories (first 25 percent, middle 50 percent, and lower 25 percent) for each class. In the fourth year of the program (1999-2000 academic year), the results of a tool assessing four abilities of Basic Sciences, Problem Solving, Pharmaceutical Care, and Dispensing Pharmaceuticals were reported to students in more detail (Figure 1). As shown in Figure 1, the students' absolute score and range and mean scores for their classes were reported for all the questions (P1-P4) as well as class-specific composite and ability-specific questions. However, as mentioned previously, still these results could not be used for determination of competence; only the performance of students relative to their classmates could be inferred. In addition to distributing results to students, aggregate results were also reported to the faculty for this year.

The 2000-2001 annual assessment report to students, shown in Figure 2, was by far the most comprehensive in the history of Texas Tech assessment program. This was due to the availability of cut-scores (Competence Standard, Figure 2) obtained using the modified Angoff method(9) for this year. Therefore, for the first time, the ability of students to meet specific

Name: XXX				Advisor: XXX			
	Your score	Competence standard	Class mean	Class range	Your percentile	Your Z-score	Unmet abilities
Problem Prevention and Solving							
Overall	63.9	71	73.7	55.6 - 86.1	11	-1.4	PS
P1 Questions	78	77	86.1	55.6- 100			
P2 Questions	78	70	71.2	33.3 - 88.9			
P3 Questions	67	69	72.6	44.4 - 88.9			PS P3
P4 Questions	33	70	64.7	0 - 88.9			PS P4
Dispensing Pharmaceuticals							
Overall	83.3	78	82.2	58.3 - 94.4	52	+0.2	
P1 Questions	89	89	94.0	55.6- 100			
P2 Questions	67	76	73.9	44.4- 100			DP P2
P3 Questions	78	67	67.9	22.2- 100			
P4 Questions	100	81	92.7	11.1 -100			
Providing Patient-Specific Pharmaceutical Care							
Overall	97.2	78	78.4	66.7 - 97.2	99	+2.9	
P1 Questions	100	86	82.1	44.4- 100			
P2 Questions	100	88	91.0	66.7- 100			
P3 Questions	100	77	73.5	44.4 - 100			
P4 Questions	89	60	66.9	22.2 - 99.9			
Use of Basic Science in the Practice of Pharmacy							
Overall	52.8	60	57.7	38.9 - 75.0	28	-0.6	BS
P1 Questions	67	63	70.7	44.4- 100			
P2 Questions	67	57	57.9	22.2 - 88.9			
P3 Questions	44	57	45.5	11.1 -77.8			BS P3
P4 Questions	33	63	56.8	11.1 -88.9			BS P4
Management							
Overall	91.7	72	85.9	72.2- 100	81	+0.9	
P1 Questions	100	75	87.2	66.7- 100			
P2 Questions	100	85	95.3	77.8- 100			
P3 Questions	89	49	78.6	55.6- 100			
P4 Questions	78	78	82.5	33.3- 100			
Moral Reasoning, Ethical, and Legal Judgment							
Overall	86.1	79	81.7	55.6 - 94.4	72	+0.6	
P1 Questions	100	84	91.2	66.7- 100			
P2 Questions	78	83	74.8	55.6- 100			
P3 Questions	89	75	79.3	44.4 – 100			
P4 Questions	78	76	81.6	22.2 – 100			
OVERALL							
Overall	79.2	73	76.6	60.6 - 83.8	66	+0.6	

Fig. 2. An example of a report sent to a P4 student for the 2000-2001 academic year assessment. Students in other years received data related to their own and previous years only.

competencies was reported in addition to other psychometric data regarding their performance (Figure 2). As demonstrated in Figure 2, the report contained detailed information about the overall performance of students in addition to data for the six individual abilities. Further, student performance in each ability was broken down into performance in questions related to their own class standing and those questions designed for the assessment of their under-classmates (Figure 2). Also listed in the back of the report page (not shown in Figure 2) were all the ability statements for individual ability categories and years (for an example of statements, see Table II) so that students with unmet abilities would know the areas in which they were deemed deficient. Students received their report along with an interpretation from their academic advisors after advisor training sessions were conducted by the office of the Associate Dean for Curriculum, Students, and Outcomes Assessment.

The aggregate results of the 2000-2001 annual assessment (Figures 3-9), in addition to the number and percentage of students who did not meet overall or individual competencies (Table III), were reported to the faculty. As demonstrated in Figure 3, when all the questions were considered, the minimum composite scores for P1, P2, and P3 students were all above the overall competence standards (cut-scores), resulting in no students being designated as not meeting minimum composite competency for these years. However, the minimum overall score for the P4 class was lower than the competence standard set for the class (Figure 3), resulting in seven students designated as not meeting the overall competence standard (Table III).

Figures 4-9 show performance data for the six abilities of Problem Solving, Dispensing Pharmaceuticals, Pharmaceutical Care, Basic Sciences, Management Sciences, and Moral Reasoning and Ethical and Legal Judgment, respectively. For each ability (Figures 4-9), the competence standards generally increased from P1 to P4 levels, indicating higher expectations of faculty/resident judges from students in the later years of the program. Although, in most cases, the higher standards for later years were not matched with higher mean scores for these students, there was a trend for an increase in the minimum scores with an advance in the program (Figuress 4-9). Additionally, although all P1, P2, and P3 students met the overall

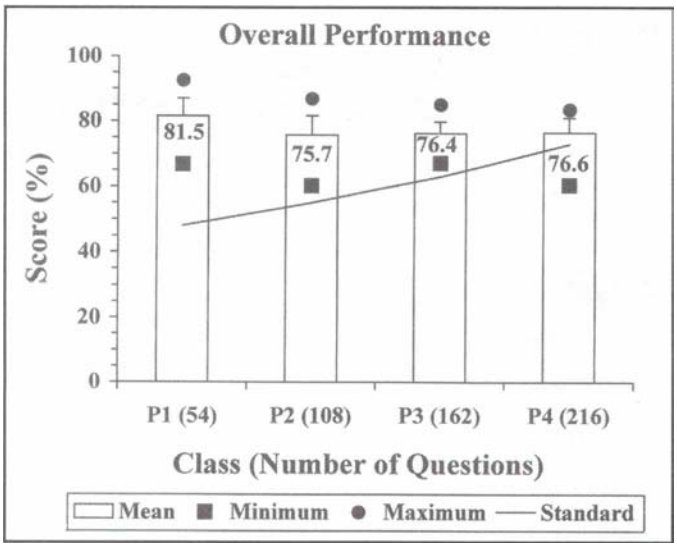

Fig. 3. Performance of P1-P4 students for all the abilities in the 2000-2001 Annual Assessment.

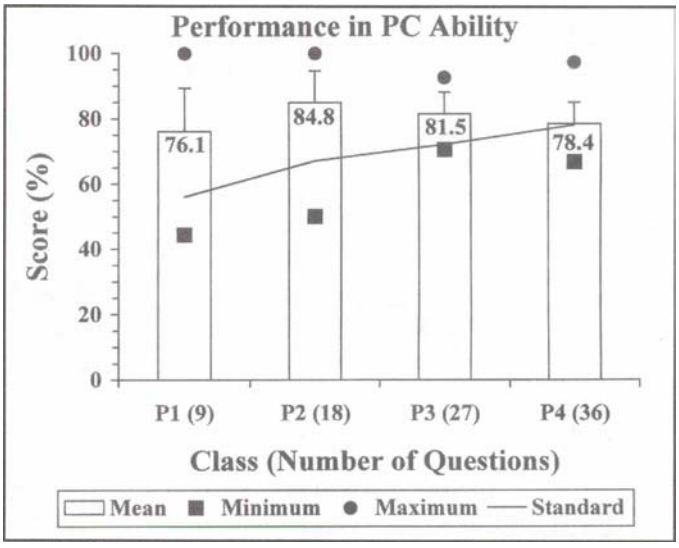

Fig. 6. Performance of P1-P4 students for Providing Patient-Specific Pharmaceutical Care (PC) ability in the 2000-2001 Annual Assessment.

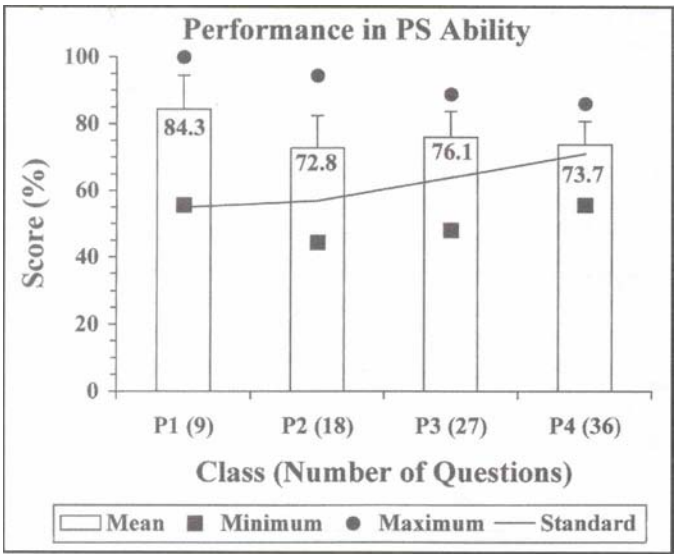

Fig. 4. Performance of P1-P4 students for Problem Prevention and Solving (PS) ability in the 2000-2001 Annual Assessment.

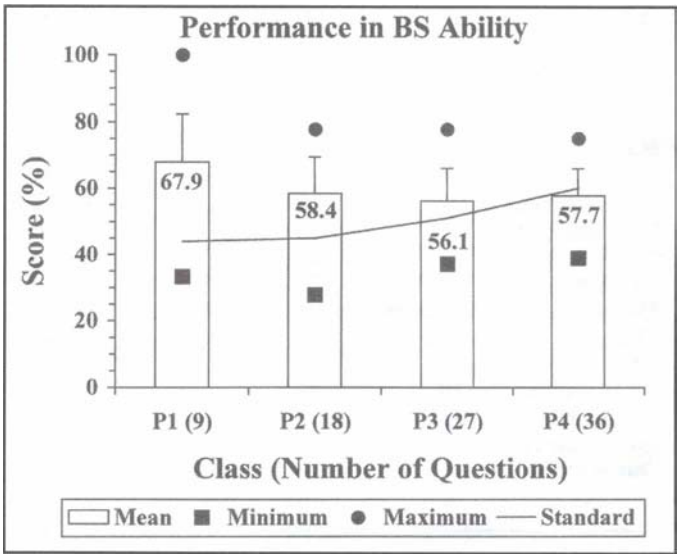

Fig. 7. Performance of P1-P4 students for Use of Basic Sciences in the Practice of Pharmacy (BS) ability in the 2000-2001 Annual Assessment.

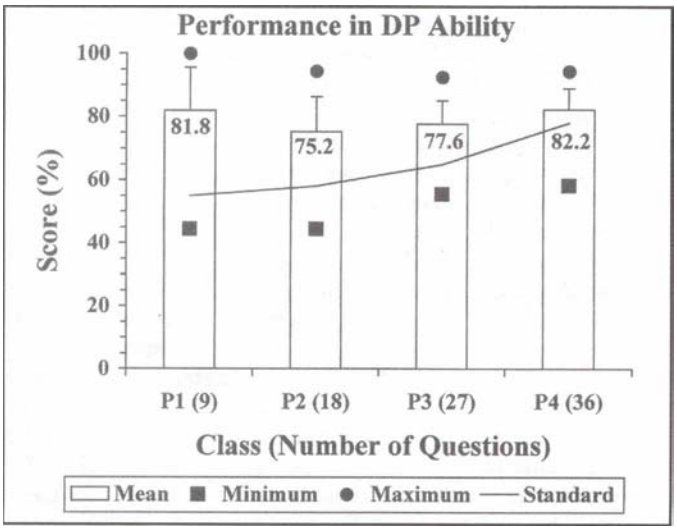

Fig. 5. Performance of P1-P4 students for Dispensing Pharmaceuticals (DP) ability in the 2000-2001 Annual Assessment.

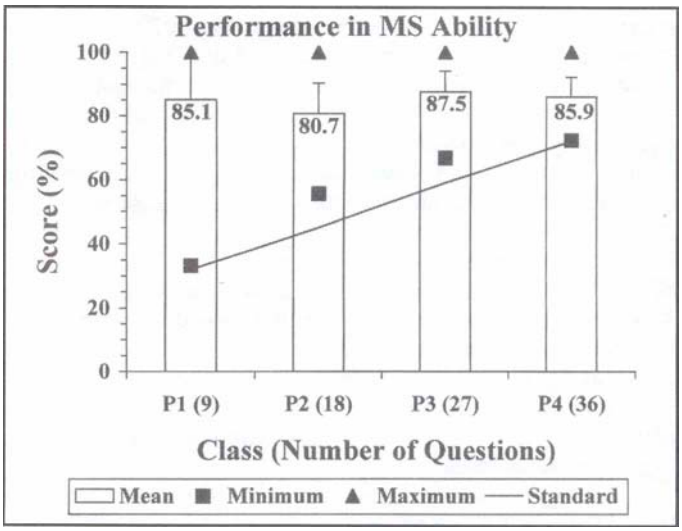

Fig. 8. Performance of P1-P4 students for Management Sciences (MS) ability in the 2000-2001 Annual Assessment

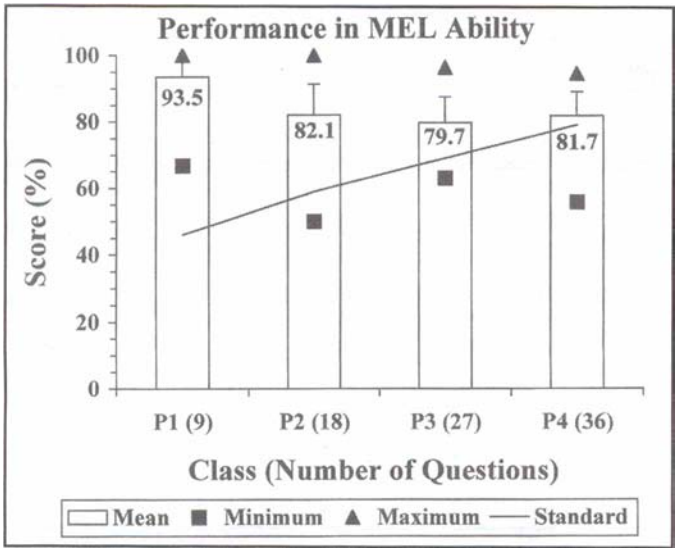

Fig. 9. Performance of P1-P4 for Moral Reasoning, Ethical, and Legal Judgment (MEL) ability in the 2000-2001 Annual Assessment.

all competencies (Figure 3, Table III), all the classes had some students who did not meet minimal competency expectation for one or more of the individual ability sets (Figures 4-9, Table III). Generally, the failure rates appeared to be substantially higher for the P4 class, compared with other levels (Table III). Furthermore, student performance appeared to be the best in Management Sciences (no failure) and worst in Basic Sciences (63 percent of P4's did not meet the competency expectation) abilities (Figures 4-9, Table III).

Theoretically, the failure of students to meet one or more of the abilities could be due to a deficiency in curriculum content or delivery and/or a weakness of the student. Although clear criteria have yet to be established for the distinction between these possibilities, some inferences may be made from the current results. If the performance of students as a group in a particular ability is much higher than the cut scores, a reasonable conclusion would be that there is no curricular deficiency in this area. Therefore, failure of individual students most likely is due to the student weakness. However, if the performance of the group is low, relative to cut scores, a deficiency in curricular content and/or delivery may be suspected. Nevertheless, this issue cannot be clearly addressed using the current data and needs further analysis and probing.

Validity and Reliability of the Assessment.

Validity and reliability are two important criteria for selection of assessment formats(6). Validity of an assessment indicates the degree of convergence between what the assessment claims to measure and what is actually assessed. As a direct measure of ensuring validity in our 2000-2001 assessment, questions were quality controlled through several layers of evaluation and examination by subgroup question writing leaders, the Outcome Assessment Committee, and the question-leveling expert panel. Further, the validity of the assessment was tested using an indirect method that showed a significant ($P < 0.001$) correlation (0.427) between the annual assessment scores and the pharmacy grade point averages. The latter method has been used by others(7) in documenting the validity of similar assessments. Reliability, on the other hand, is a measure of reproducibility of the assessment results for each student(6). In other words, it indicates how reproducible the assessment score of a student is if the assessment is administered multiple times under different conditions. For the overall assessment administered in January 2001, the reliability coefficient was 0.745, indicating a high degree of test reliability.

Table III. Number (percentage) of students who did not meet competencies[a]

	P1 (n = 80)	P2 (n = 85)	P3 (n = 52)	P4 (n = 52)
Overall	0 (0)	0 (0)	0 (0)	7 (13)
PS	0 (0)	5 (6)	4 (8)	17 (33)
DP	3 (4)	6 (7)	1 (2)	7 (13)
PC	1 (0)	1 (1)	5 (10)	23 (44)
RS	1 (0)	16 (19)	14 (27)	33 (63)
MS	0 (0)	0 (0)	0 (0)	0 (0)
MEL	0 (0)	2 (2)	5(10)	16 (31)

[a]PS: problem prevention and solving; DP: dispensing pharmaceuticals; PC: providing patient specific pharmaceutical care; BS: use of basic sciences in the practice of pharmacy ; MS: management sciences; MEL: moral reasoning and ethical and legal judgment.

OUTCOME ASSESSMENT PROGRAM EVALUATION

During its development and evolution, the outcome assessment program at Texas Tech has been formally evaluated by students and faculty at different times. These evaluations have been in addition to informal input from faculty and students. For brevity, only the evaluation data obtained in the latest annual assessment period (2000-2001) are presented below.

Student Evaluation

During the 2000-2001 assessment, students were surveyed two times regarding the annual assessment program – once after finishing taking the assessment tool in January 2001, and the second time during the last day of classes in the spring semester after they had a chance to receive their results from their advisors. The results of the first student evaluations are presented in Table IV. The questions in this evaluation mostly dealt with the format and logistics of the assessment. As demonstrated in Table IV, an overwhelming majority of students indicated that they did not prepare for the assessment (question 1). Additionally, only less than three percent of students guessed answers to most of the questions (question 2). This is in contrast to student evaluations in most of the previous years (data not shown) when the instrument tools were the same for all the years, forcing students at lower levels to guess on most of the questions. Generally, students agreed that the number of questions in the assessment (question 3), the time allowed for the completion of the assessment (question 4), and the assessment format (question 5 and 6) were appropriate for this year (Table IV). Additionally, the majority of students disagreed with changing the format of the assessment to have one assessment tool for all the years (question 7, Table IV), the format used in the past annual assessments.

The results of the second student evaluation, which was conducted after the assessment results were distributed, are presented in Table V. For this survey, the results were analyzed for individual classes (curricular levels), in addition to all students. The differences between the classes in their responses to each question were also statistically tested using an unpaired student t-test (two-tailed) at a Bonferonni-adjusted significance level of 0.0083 (0.05 divided by six, which is the number of possible comparisons among the four class years). The statistical analysis indicated that except for question 9, the

Table IV. Student response to a survey at the completion of annual assessment (n= 216)

Question	Percent response: Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean ± SD
1. I prepared for the assessment by studying prior to the assessment day.	0.9	1.4	6.5	21.8	69.4	1.4 ± 0.8
2. I guessed the answers to most of the questions.	0.9	1.9	12.0	57.4	27.8	1.9 ± 0.7
3. The number of questions for the assessment was appropriate.	19.9	57.9	16.2	5.1	0.9	3.9 ± 0.8
4. The allotted time was sufficient for the completion of the assessment.	62.5	36.1	0.5	0.9	0.0	4.6 ± 0.6
5. The format of the assessment (multiple choice questions) was appropriate.	53.2	41.7	4.2	0.9	0.0	4.5 ± 0.6
6. More case-based questions should be included in the assessment.	6.0	27.3	47.7	15.3	3.7	3.2 ± 0.9
7. I prefer to take the questions for all the years, rather than taking questions specific to my class.	11.6	12.1	17.2	27.4	31.6	2.4 ± 1.4

5= Strongly agree; 1= strongly disagree.

responds of the P4 class were significantly different from one or more of other classes for all the questions, with the P4 class having a more negative view of the annual assessment program in general (Table V). The more negative attitude of P4 students towards annual assessment may be due to the fact that this class experienced a number of significant changes during the evolution of the annual exam. Overall, it appears that most students believe that the annual assessment program is useful to both students (question 1) and the school (question 2) for identification of weaknesses and strengths of individual students and the curriculum. Additionally, approximately 70 percent of students (strongly) agreed that they were well informed about the process for obtaining the results of their annual assessment (question 3). Students responded generally positively to the timeliness of the distribution of the results (question 4), their advisors' efforts to explain the results to them (question 5), their understanding of the results (question 6), and the policy to dispute the results through the advisors (question 7). However, for all these issues, the responses of the P4 class were consistently more negative (Table V, questions 3-7). When they were asked about the use of the data from the annual assessment for student progression decisions (question 8), students responses were more negative and more consistent across the years, compared with their responses to other questions (Table V). However, most students, even the P4 class, (strongly) agreed that the 2000-2001 assessment was an improvement over those for previous years (question 9).

Faculty Evaluation

The faculty were also asked to evaluate the 2000-2001 annual assessment program after the results were distributed to them. The results of a survey with eight questions are tabulated in Table VI. Six of the questions in the faculty survey (questions 1, 2, 5-8) were similar to those posed to students in their second survey (Table V). For these questions, unpaired student *t*-test (two-tailed) was used to compare the results between the faculty and all students. Similar to students ($P = 0.704$), most of the faculty agreed that the annual assessment is a useful tool for identification of strengths and weaknesses of students (question 1). Although faculty also agreed that the annual assessment is useful for identification of problems in the curriculum, the response of faculty to this question (Table VI, question 2) was less favorable ($P = 0.0056$) than that of students (Table V, question 2). Additionally, a majority of faculty (strongly) agreed that they were clear about their roles in the program (question 3) and that they received appropriate help from the Outcome Assessment Committee or the Outcome Assessment Office (question 4). Similar to students ($P > 0.05$, faculty vs. all students), a majority faculty thought that the results of the assessment were available in a timely manner (question 5), the policy of distribution of results through advisors was appropriate (question 6), and the 2000-2001 assessment was an improvement over previous years (question 8). However, faculty (question 7, Table VI) were more receptive than students (question 8, Table V) to the idea of using the annual assessment results in student progression decisions ($P = 0.0014$).

REFLECTIONS AND FUTURE DIRECTIONS

During recent years, pharmacy educators and organizations have become aware of the importance of evaluation and assessment of their professional programs(4,5,11), with the recent issue of the *Journal* reporting three articles(7,8,6) in this area. However, this awareness has not been paralleled by a significant progress in development and implementation of comprehensive programs in a majority of schools(4,11). This may be due to the fact that implementation of a comprehensive and well-developed program without any previous experience is almost impossible. Therefore, schools or colleges of pharmacy need to start a program with modest and achievable goals and add, delete, and/or revise different components of the program as experience is gained.

The assessment program at Texas Tech has undergone substantial changes since its inception five years ago and will continue to evolve in the future. The program by no means is comprehensive or free from errors and/or shortcomings at this time. However, progress is made with every year of experience. Therefore, several issues have been identified by the Outcome Assessment Committee and are being considered by the faculty, which may require changes to our program.

One issue for consideration is whether to use a different tool for the Problem Solving ability. Currently, the same format (multiple-choice) is used for all the abilities. However, during a recent workshop(12), the Outcome Assessment Committee members learned that our tool might not have been appropriate for a true measurement of this ability. This is because an incorrect

Table V. Student response to a survey after distribution of annual assessment results

Question	Year[a]	Percent response: Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	Mean ±SD
1. The Annual Assessment is a useful tool for students to identify areas of strength and weakness.	All	13.0	47.4	17.5	15.6	6.5	3.4 ± 1.1
	PI	17.9	53.6	17.9	8.9	1.8	3.8 ± 0.9[b]
	P2	12.2	49.0	14.3	18.4	6.1	3.4 ± 1.1
	P3	8.3	41.7	20.8	20.8	8.3	3.2 ± 1.1
	P4	8.0	36.0	20.0	20.0	16.0	3.0 ± 1.3[b]
2. The Annual Assessment is a useful tool for the school to identify problems with the curriculum.	All	20.1	50.0	15.6	9.7	4.5	3.7 ± 1.0
	PI	28.6	48.2	16.1	5.4	1.8	4.0 ± 0.9[b]
	P2	12.2	57.1	10.2	16.3	4.1	3.6 ± 1.0
	P3	25.0	45.8	20.8	8.3	0.0	3.9 ±0.9
	P4	12.0	44.0	20.0	8.0	16.0	3.3 ± 1.3[b]
3. I was well informed by the school about the process for obtaining my assessment results.	All	22.7	46.8	12.3	13.0	5.2	3.7 ± 1.1
	PI	30.4	48.2	10.7	8.9	1.8	4.0 ±].0[b]
	P2	16.3	59.2	14.3	8.2	2.0	3.8 ± 0.9[c]
	P3	29.2	41.7	12.5	8.3	8.3	3.8 ± 1.2
	P4	12.0	24.0	12.0	36.0	16.0	2.8 ± 1.3[b,c]
4. The results of this year's assessment were available to faculty and students in a timely manner.	All	16.2	49.4	15.6	13.0	5.8	3.6 ± 1.1
	PI	19.6	48.2	17.9	10.7	3.6	3.7 ± 1.0[b]
	P2	16.3	59.2	12.2	10.2	2.0	3.8 ± 0.9[c]
	P3	20.8	54.2	12.5	8.3	4.2	3.8 ± 1.0[d]
	P4	4.0	28.0	20.0	28.0	20.0	2.7 ± 1.2[b,c,d]
5. My advisor took time. to explain the results to me adequately	All	42.7	34.4	8.4	4.6	9.9	4.0 ± 1.3
	PI	55.1	28.6	8.2	4.1	4.1	4.3 ± 1.1[b]
	P2	37.0	43.5	13.0	2.2	4.3	4.1 ± 1.0°
	P3	45.0	35.0	5.0	5.0	10.0	4.0 ± 1.3
	P4	18.8	25.0	0.0	12.5	43.8	2.6 ± 1.7[b,c]
6. I understand the results of my annual assessment.	All	28.4	50.7	6.0	7.5	7.5	3.8 ± 1.1
	PI	42.9	46.9	4.1	4.1	2.0	4.2 ± 0.9[b]
	P2	27.7	59.6	4.3	4.3	4.3	4.0 ± 0.9[c]
	P3	19.0	57.1	14.3	4.8	4.8	3.8 ± 1.0[d]
	P4	0.0	29.4	5.9	29.4	35.3	2.3 ± 1.3[b,c,d]
7. I agree with this year's policy to distribute the results to students through their advisors.	All	23.0	38.8	19.1	7.9	11.2	3.6 ± 1.2
	PI	30.4	37.5	19.6	7.1	5.4	3.8 ± 1.1[b]
	P2	26.5	42.9	16.3	6.1	8.2	3.7 ± 1.2[c]
	P3	21.7	52.2	13.0	8.7	4.3	3.8 ± 1.0[d]
	P4	0.0	20.8	29.2	12.5	37.5	2.3 ± 1.2[b,c,d]
8. The results of Annual Assessment should be used for making a decision on academic progression to the next year.	All	5.8	18.8	16.9	25.3	33.1	2.4 ± 1.3
	PI	5.4	32.1	19.6	19.6	23.2	2.8 ± 1.3[b,e]
	P2	8.2	14.3	18.4	34.7	24.5	2.5 ± 1.2
	P3	4.2	12.5	8.3	20.8	54.2	1.9±1.2[e]
	P4	4.0	4.0	16.0	24.0	52.0	1.8± 1.1[b]
9. Overall, this year's assessment process was an improvement over previous year(s).	All	30.2	30.2	24.4	9.3	5.8	3.7 ± 1.2
	PI						
	P2	32.4	43.2	10.8	10.8	2.7	3.9 ± 1.1
	P3	29.2	29.2	37.5	0.0	4.2	3.8 ± 1.0
	P4	28.0	12.0	32.0	16.0	12.0	3.3 ±1.4

5 = Strongly agree; 1 = strongly disagree
[a]n - 154 (All), 56 (PI), 49 (P2), 24 (P3), and 25 (P4).
[b]Significant difference between PI and P4.
[c]Significant difference between P2 and P4.
[d]Significant difference between P3 and P4.
[e]Significant difference between PI and P3.

Table VI. Faculty response to a survey after distribution of annual assessment results (n=43)

Question	Percent response: Strongly Agree	Agree	Neutral	Disagree	Strongly disagree	Mean ± SD
1. The Annual Assessment is a useful tool for students to identify areas of strength and weakness.	7.0	51.2	27.9	9.3	4.7	3.5 ± 0.9
2. The Annual Assessment is a useful tool for the school to identify problems with the curriculum.	7.0	39.5	27.9	18.6	7.0	3.2 ± 1.1
3. I was clear about my role in this year's assessment process (*e.g.*, writing questions, leveling questions, or explaining results to students).	31.0	40.5	14.3	4.8	9.5	3.8 ± 1.2
4. The Outcome Assessment Office/Committee provided adequate help for faculty throughout this year's process.	22.5	32.5	27.5	12.5	5.0	3.6 ± 1.1
5. The results of this year's assessment were available to faculty and students in a timely manner.	35.7	28.6	21.4	2.4	11.9	3.7 ± 1.3
6. I agree with this year's policy to distribute the results to students through their advisors.	42.9	28.6	16.7	7.1	4.8	4.0 ± 1.2
7. In the future, the results of Annual Assessment should be used for making a decision on academic progression to the next year.	11.6	32.6	25.6	16.3	14.0	3.1 ± 1.2
8. Overall, this year's assessment process was an improvement over previous year(s).	47.1	26.5	17.6	2.9	5.9	4.1 ± 1.2

5 = Strongly agree; 1 = strongly disagree.

answer to a Problem Solving question could have been due to a lack of knowledge, rather than a lack of problem solving ability. In a very recent and thorough article on the subject of assessment, Winslade(6) also commented on the limitations of most written examinations for assessment of problem-solving ability. Consequently, the Outcome Assessment Committee and faculty are considering different test formats, as suggested by Winslade(6), for this ability.

A second question is whether Tech's Top Ten (Table I) and specific statements related to them should be modified to reduce the number of abilities and/or statements by combining, revising, and/or eliminating some of them. This is because assessing all the Tech's Top Ten at all the curricular levels and statements will require a multiple-day process, which is logistically difficult. Additionally, some of the abilities, such as providing patient-specific pharmaceutical care and providing pharmaceutical care to large populations (Table I), are very closely related with some overlapping specific statements. The faculty are currently reviewing this issue.

Another improvement that is planned for implementation in the future is development of remediation strategies for students who do not meet specific abilities. In the 2000-2001 assessment, students were informed only of the specific abilities and statements that they did not meet. However, these deficiencies were not linked to specific courses or remediation materials. One approach to deal with this issue is mapping of the curriculum to relate each specific ability statement to individual courses. Remediation materials may then be obtained from these courses and delivered to students through mechanisms such as online, self-paced studies with faculty assistance, if needed.

A major issue that faculty have yet to decide is whether to use the annual assessment data for student progression. Whereas students are generally against this idea (Table V), the faculty are almost evenly divided as to the use of assessment data for student progression (Table VI). Faculty proponents of the idea state that students do not take the assessment seriously if there are no consequences for their poor performance. Consequently, the assessment results may be of less value for programmatic assessment and changes in the curriculum. Opponents, on the other hand, state that they do not have full confidence in our assessment for use in decisions on student progression. This is the most contentious issue among those cited here and is currently being debated by the Outcome Assessment Committee and faculty.

Our latest version of the assessment, which is described here, has been administered only once. Therefore, so far no curricular changes have occurred based on these results. However, plans are underway for an interaction between the Curricular Affairs and the Outcome Assessment Committees to identify areas of curricular concern based on the annual assessment results. This will be achieved by mapping the curriculum and relating specific abilities tested in the annual assessment to individual courses.

CONCLUSIONS

A student-centered annual assessment program can serve two important functions. It can serve as a means of identification of a student's strengths and weaknesses in professional and academic abilities as well as serving as an integral component of curricular evaluation. At Texas Tech, an annual assessment program yielding results that can be reported in terms of competency attainment has been developed by the faculty. This system, though highly structured, has been assembled, item by item, by 100 percent of the faculty. In this manner, the faculty has been enfranchised without any apparent or expressed sentiment of evaluative threat. The faculty have developed the ability statements, defined which abilities are most important to test, developed the questions that test these abilities, quality controlled each question, and set the minimal competence standard for each question, and, consequently, for each ability set and for the overall annual assessment. The students have benefited by virtue of the reinforced self-assurance of their strengths and the definition of their weaknesses. And, faculty advisors have been assisted in their advising functions secondary to receiving an annual report on long-term mastery of

abilities by the students they mentor. The program is continuously evolving and several modifications are planned for the future.

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