

Written Testing of Students in the Experiential Setting

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There is a paucity of literature regarding specific evaluation or testing procedures used in the experiential setting. The purpose of this investigation was to compare the results of paired baseline and end-rotation short-answer tests and determine the potential role of such testing in the student learning and evaluation process. The preceptor had students on rotations at this site for approximately ten years, which resulted in 86 pre/post examinations. There was significant improvement in the scores from baseline to end-rotation (10.51 ± 2.90 to 13.92 ± 2.50 , $P < 0.001$). Students expressed concerns that the evaluation exercise would be used for grading purposes despite assurances to the contrary. The preceptor was concerned that the examinations would not be useful in assessing higher level cognitive skills that were rotation objectives. Based on these findings, the written examination will be used as interactive assessment instrument, not as a replacement for more subjective grading tools.

INTRODUCTION

The experiential aspect of pharmacy students' training is a necessary and important component of the educational process. Evaluations of students in the experiential setting, whether written or verbal, are required to assess attainment of stated objectives. While published literature is available that addresses broader issues of experiential education (*e.g.*, surveys of experiential education in the United States)(1), there is a paucity of literature regarding specific evaluation or testing procedures. This is unfortunate since there are differences in students' knowledge and skills upon entering rotations, which if left undiscovered, may hinder the individualization of objectives while minimizing duplication of previous learning(2). Additionally, upon leaving the rotation, it is important to ensure that students met the rotation objectives and are prepared to move to the next site or graduate.

For several years, one preceptor at an institutional training site has performed baseline and end-rotation written testing of pharmacy students. The purpose of this investigation was to compare the results of the graded baseline and end-rotation tests and determine if such testing should replace or be used in conjunction with other aspects of the student learning and evaluation process.

METHODS

Since this teaching innovation concerns experiential training, a brief discussion of the practice site and preceptor will be discussed, along with a description of the types of rotations stu-

dents are taking at the site. The majority of the rotations are six weeks in length. In addition to mandatory rotations at community and institutional practice sites, the student is currently allowed to take three elective rotations. The specific site for this study was the university medical center, which is a tertiary care, teaching institution. The preceptor was a faculty member who had clinical responsibilities associated with the Department of Surgery at the medical center. The preceptor had students on rotations at this site for approximately ten years. During his first few years at the site, the preceptor was assigned students who were fulfilling an adult acute care required rotation requirement and students who signed up for a surgery-related pharmacy practice experience on an elective basis. Regardless of the actual title assigned to the clerkship experience, the expectations for the students at the preceptor's site are the same. Over time, the number of students requesting the site on an elective basis increased, so virtually all of the students assigned to the site in recent years are there based upon their personal requests. The absolute number of students taking the rotation also increased with time to the current level of 16 students each year.

In addition to the students assigned to this rotation, there is at least one general (first year) pharmacy resident and often a pharmacy resident specializing in critical care medicine. These residents assist the faculty preceptor in the education and evaluation of the students, although the preceptor ultimately assigns the grade for the rotation. The office of the faculty preceptor is directly attached to the residents' office so

interactions between the students, residents, and preceptor are facilitated at times besides the daily afternoon meeting.

All clerkship students are required to complete a written evaluation of each site and these results are eventually returned to the preceptors. The students consistently rank both the site and preceptor related to this project above 4.6 on a five-point scale (a "4" is defined as "agree" and a "5" is defined as "strongly agree") with higher numbers referring to increased satisfaction. Additionally, the written comments turned in by the students with rotations at the site are typically positive with few suggestions for substantive changes.

Student Audience/Level of Student. The College of Pharmacy has an entry-level, six-year, Doctor of Pharmacy program. The last year of the program is dedicated to experiential training. Therefore, all students in this evaluation were in their last educational year.

Orientation of Pharmacy Students to the Site. The first day of the rotation is spent orienting the student to the site. This includes a brief tour of the pertinent patient care units. The student is asked to describe his/her previous rotations, as well as any personal objectives (for the site and longer term). The preceptor attempts to incorporate these objectives into site-specific objectives and expectations. A detailed handout is passed out this first day that serves as the basis for this discussion. Additionally, the students are reminded to review the written materials in their clerkship manual that contains a more general description of expected core competencies and site activities.

On this first day, the preceptor discusses how evaluations will occur. There are two formal evaluations (written and verbal) of students that take place during the third and last weeks of the rotation, although verbal feedback may occur at any point in the rotation. Over the years, it was discovered that students often need reassurance that they are progressing as expected during the early stages of the rotation. The need for this reassurance typically abates after the first or second week.

Baseline and End-Rotation Testing. During the first day at the new site, students were informed of the conception of the baseline and end-evaluation examinations and why they were developed in the early years of the rotation. It was explained that the examinations were created to determine if this type of evaluation exercise would be a useful addition to the rotation in terms of serving as a baseline and end-rotation assessment tool of important rotation objectives. However, it was stressed that the examinations were not going to be graded while the student was on the rotation. Therefore, the students were informed that they need not fear prejudgments of their abilities based on their initial examination answers, or reductions in their end-rotation grades due to poor performance on the final test. On the other hand, these students were informed that they would not receive feedback as to how they performed on either examination regardless of their curiosity. Furthermore, it was explained that the preceptor would not discuss the answers to examination questions since this might encourage the preceptor to overtly or subconsciously insure that the items were covered with other students who would subsequently take the rotation. This could potentially skew the grades for individuals or classes involved in this multi-year evaluation of the written instrument. The preceptor explained to the students that he recognized how the lack of grading and discussion could lead to frustration on the part of some students who were interested in

Table I. Major topics tested on written examinations.

Pharmacokinetics
Stress ulcer prophylaxis
Pain assessment and control
Diagnosis and treatment of infections
Nutrition (including fluid and electrolytes monitoring)

their examination performance.

Examination Construction. The examinations were constructed during the second and third years of pharmacy students rotating through the site. The examinations were designed to encompass the important objectives of the rotation. The baseline and end-rotation examinations were not identical, but each had 20 short-answer questions (some with more than one part) each matched on a conceptual basis to a question on the other examination. The questions covered a wide range of important issues from the preceptor's perspective (Table I). For example, there were specific pharmacokinetic questions related to dosing of drugs that have linear or nonlinear elimination, and questions of a more general nature such as how a student would handle a question by a physician when the student is given inadequate information for an appropriate response.

It was anticipated that difficulties associated with poorly worded questions would be minimal since the tests were given on a trial basis to twelve clerkship students taking the rotation after examination construction. Each question and answer from this trial period was examined. Questions were not modified or eliminated solely because a substantial number of the students gave an incorrect answer. Such questions were examined for inappropriate wording that may have resulted in erroneous or unintended answers. At this stage, no questions were deleted entirely although several questions were substantially modified for clarification. The modified examinations were subsequently given to all students taking the rotation (an average of approximately 14 students over a six-year period).

Grading of the Examinations. The decision to collate and grade the completed examinations after several years of administration was determined by two overlapping factors. First, the number of students who had taken the examination was quite large for a single rotation and was thought to be of sufficient size to draw conclusions regarding the students' progress over the course of the rotation. Second, the subsequent classes of students taking this and other rotations had been exposed to a much greater degree of problem-based learning in the didactic curriculum compared to previous groups of students. While curricular changes are ongoing at the college of pharmacy, there were active learning strategies that were added to the first two years of coursework that were considered by the preceptor to have implications for these future students' performance on the rotation examinations. Problem-based learning strategies have been shown to enhance the average grade points of students taking elective and required clerkship rotations(3). Therefore, prior to this new group of students reaching the preceptor's rotation, it was decided to evaluate the completed examinations.

All student identifiers were taken off of the examinations by the site preceptor prior to grading. A fourth-year pharmacy student assisted the preceptor in grading the examinations that had been collected since the time the revised instrument was first given to students taking the rotation. This was done for several reasons. The fourth-year student, who was near graduation, was able to learn more about clerkship evaluation tools

Table II. Competencies not assessed by written examination

Personal accountability
Prioritization of pharmacy care
Active participation on a patient care team
Ability to evaluate published literature and apply to specific patient problems

since there is a good chance he will be precepting pharmacy students at some point in the future. Additionally, the preceptor was interested in hearing the student's perspective on the examinations' construction. For example, the student's comments might help to identify poorly worded questions that may have been missed by the trial group of twelve students. The fourth-year student did not evaluate any of his classmates examinations since the preceptor only included examinations from previous classes.

The fourth-year student was given an in-depth explanation of the questions and correct answers by the site preceptor. The student was instructed to keep a list of answers that did not appear to be correct, but were not patently wrong. Therefore, all questionable answers were referred to the preceptor for correctness. It was obvious that the student had taken these instructions seriously since he had several pages of such answers to discuss with the preceptor. The preceptor not only reviewed the questionable answers identified by the student grader, but also independently performed another review of the examinations.

Prior to grading the examinations, it was anticipated that the student grader and preceptor might not agree on the validity of a question or a response given by one of the student's taking the examinations. If these types of disagreements arose, it was decided that the question and answer would be referred to another faculty member with expertise in the area for resolution of the issue.

RESULTS

The evidence of student learning is based on the written results of the examinations, as well as subjective observations by the site preceptor and his pharmacy residents (who assist in the verbal evaluation process). Of the 86 students who did have completed written testing, there was significant improvement in the scores from baseline to end-rotation testing (10.51 ± 2.90 to 13.92 ± 2.50 , $P < 0.001$). The minimum/maximum scores for the baseline and end-rotation testing were 4.5/16.5 and 5/19, respectively.

With few exceptions, students improved their scores from baseline to end-rotation testing regardless of the baseline score. For example, nine students had baseline scores less than seven and all of these students increased their scores by at least three points on the end-rotation examination. The student who did not improve had a baseline score of 6.18 and it dropped to five on the end-rotation examination. In the latter case, the student's low scores were correlated with overall sub-optimal performance on the rotation, although it was felt that improvements had been made throughout the course of the rotation.

In conjunction with this objective data, both the site preceptor and his residents found some degree of improvement in all students taking the rotation. However, as with didactic instruction, there were substantial differences in the students' baseline skills (as well as their degree of improvement during the rotation). The preceptor attempted to correlate the students' examination scores with the more global subjective assess

ments and final rotation grades. However, conclusions from this analysis are limited since the preceptor only had final rotation grades for the last two years of the evaluation period. In general, students who had high baseline scores (*i.e.*, >10), received high grades for the rotation. For students with lower baseline scores, there was no obvious relationship between the examination scores and the subjective assessment of the student's abilities by the preceptor and residents at the site. Assuming that the student had derived some minimum baseline skills prior to entering the rotation, the preceptor was more concerned with the student's overall level of improvement than student/student comparisons.

It had been anticipated that some controversial questions and answers would be referred to an independent evaluator for resolution. The great majority of the fourth-year student's issues related to grading concerned the correctness of various students' answers. In these instances, the preceptor and fourth-year student were able to resolve such issues and the advice of a third party was not needed. There was no point of substantial disagreement between the student and preceptor after the discussion period between the two had taken place.

The fourth-year student found the discussions regarding the examinations to be useful. He gained a better understanding of the specific material under consideration, as well as insight into the overall evaluation process for clerkship students. Despite the value of the process to the fourth-year student, the preceptor has elected to be the sole evaluator of future examinations given the amount of time necessary to involve the fourth-year student in the examination grading process. Additionally, if the examinations were evaluated while the students were at the site (as is planned), there would be concerns related to the involvement of another student in the grading process.

DISCUSSION

In a survey of experiential education, baseline written testing was infrequently performed regardless of type of pharmacy degree (BS, PharmD, or combined)(1). Of BS programs 5.3 percent ($n=38$) used written pre-testing compared to 12.5 percent ($n=8$) for PharmD programs. The use of end-rotation written examinations was more frequent, 52.1 percent ($n=39$) of BS and 40 percent ($n=8$) of PharmD programs, respectively. It was not stated how many, if any, of the programs used both pre- and post-rotation testing.

In this evaluation, students had pre- and end-rotation testing in which attempts were made to test similar competencies during both examinations. Although students consistently improved their scoring from baseline to end-rotation testing, the preceptor is inclined to use the examinations primarily as interactive assessment tools in the future rather than using them to determine a predefined portion of the student's end-rotation grade. The preceptor is concerned that the latter approach would be more destructive than constructive by fostering a fearful, negative competitive attitude by the students. As a probable consequence of the extensive written examinations given to students in the didactic setting, the preceptor found that students were leery about taking the written evaluations in the experiential setting. Despite assurances by the preceptor to the contrary, many students raised questions about the use of the written instruments for grading purposes. Additionally, it was not uncommon for students to ask how they performed on the tests relative to other students even though it had been stressed that the examinations would not be

graded while the students were on rotation at the site.

Another preceptor concern about using the instrument to derive a major portion of the student's grade, relates to the level and type of skills tested by such an instrument. At best, a written examination might assess analysis or synthesis level cognitive skills using a taxonomical scale of evaluation(4), but would not evaluate higher order cognitive (e.g., evaluation or judgement) or affective (e.g., responsiveness, valuing) skills. The short-answer examinations used by this preceptor do not assess higher-order skills sufficiently. Additionally, critically important communication skills would not be assessed through written testing.

The preceptor has found that students appreciate a forthright explanation of the subjectivity involved in clerkship grading as long as there is a relatively clear delineation as to what it takes to achieve a certain level (e.g., pass vs. superior). The same might be said if the purpose and intended use of the written instrument were adequately explained, but the years of written testing required of students in the classroom setting seem raise a number of real or perceived issues that create additional problems for the preceptor who is using this approach to determine some predefined portion of the student's grade.

The final examination has the potential to be used as an objective assessment as to whether defined minimum competencies have been obtained and hence whether the student should pass the rotation. This approach would seem to have merit when dealing with the minority of students who have substantial deficiencies and should probably not move forward. At this time, the preceptor does not plan to use the final examination as the only test of minimal competencies. Justifying a no-pass evaluation for the rotation solely because the student fell below some predefined numerical grade on a test would be practically difficult, but even more difficult to justify from a pedagogical standpoint. While the student shares a substantial portion of the burden for learning the material associated with the rotation objectives, the preceptor has responsibilities as well since learning should be a collaborative process(5). In this case, the student's improvement from the baseline to final examination is as much a reflection of the instructional environment at the site as it is the student's learning abilities. However, it is anticipated that the final examination will be used as a piece of objective support of the preceptor's apparent subjective decision in borderline cases.

In the future, the preceptor intends to discuss the questions and answers with the students after taking each examination. The initial examination will be used to assess baseline competencies of the students coming into the rotation, which will allow for individualized instruction. For example, a student who is found to have deficiencies in the area of pharmacokinetics could be given patient-related problems early in the course of the rotation to help develop the requisite skills. In other words, specific steps could be taken to insure the appropriate skills were fostered near the beginning of the rotation rather than finding out weaknesses near the end of the rotation when it may be too late to improve them. While the end-rotation examination will still be used as an assessment tool, it will

be used to constructively discuss the competencies derived by the students at this point in their educational experience along with suggestions as to where more work is needed.

In recent years, the site preceptor has rewritten the goals and objectives for the rotation using a hierarchical approach to learning. Terminal and enabling objectives have been developed for the core competencies expected to be gained from the rotation. There are a number of these competencies that are difficult to test using a written examination format, but are important to assess during the course of the rotation. Table II contains an abbreviated list of some of these competencies. Assessment of these competencies must be performed in other ways (e.g., observation, discussion).

There are potential limitations associated with this evaluation of written testing at an experiential site. The preceptor constructed the examinations several months before actually implementing their use, and did not review the questions over time. However, it is possible that the instructor unintentionally may have given undue emphasis to topics during the rotation that were known to be covered in the examinations, particularly in the first few months after examination construction and testing of the instrument. While it was intended that important concepts tested by the examinations would be covered at some point in the rotation, specific examination questions and answers were not supposed to be stressed merely to improve performance on the final written examination.

Another limitation of this study involves threats to the reliability and validity of the written instrument. Steps were taken during examination construction to ensure that the important concepts were tested by questions that were well-written. Concepts that were thought to be particularly important were tested by repetition in more than one question. Also, the examinations were taken by twelve students on a pilot basis who were then queried for poorly phrased or misleading questions. Nevertheless, the creation of a new instrument is difficult and conclusions extracted from the students' responses must be considered with caution.

In summary, the use of a written testing instrument in an experimental setting provides the preceptor with objective documentation that student learning did occur in this particular clerkship setting. In conjunction with other forms of assessment, it is expected that the written testing will complement recently developed structured goals and objectives for the rotation.

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