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INNOVATIONS IN TEACHING

Designing an Assessment for an Abilities-Based Curriculum

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Objectives. Our program adopted an abilities-based curriculum and established 12 terminal educational ability-based outcomes. We developed performance-based assessments to measure students' ability to accomplish the program's outcomes.

Methods. Faculty teams defined expected outcomes and tasks for each of the 12 ability-based outcomes for the P1 and P2 years in the curriculum. These expected outcomes and tasks then became the basis for cases used in designing the performance-based assessments. Faculty members drafted 12 cases for each year and the corresponding performance criteria used in grading. All cases were validated by a national review panel. The cases were then converted into computer-based simulations for programmatic assessment at the end of the 2003 school year. All P1 and P2 students participated in the assessments. Two faculty members graded all cases. The interrater reliability between the 2 graders and the internal consistency of the assessment were measured.

Results. The overall interrater reliabilities for the P1 and P2 years were 0.94 and 0.91, respectively. The overall internal consistency reliabilities for the P1 and P2 years were 0.86 and 0.80, respectively.

Conclusions. Performance-based assessments produce reliable data that can be used to evaluate an abilities-based curriculum.

Keywords: abilities-based curriculum, curriculum, assessment

INTRODUCTION

Pharmaceutical education is focusing on clinical or patient-centered skills and activities based on the pharmaceutical care model. In order to effectively perform pharmaceutical care functions, pharmacy students must have curricular opportunities to synthesize and apply didactic information to the realm of practice, thereby providing the necessary preparation for the development of these skills.

Since emphasis is being placed on clinical skills associated with the practice of pharmacy, emphasis must also be placed on the assessment of student performance. The recently revised *Accreditation Standards and Guidelines* by the Accreditation Council for Pharmacy Education (ACPE) specifically address assessment in terms of student learning.[1] One of the standards recommends that educational programs establish methods for both the formative and summative evaluation of student achievement. These assessments should measure cognitive learning and mastery of essential practice skills, as well as the ability to communicate effectively while using data in both critical thinking and problem-solving processes. Data from these assessments indicate whether a program is providing the necessary environment for students to learn pharmaceutical care. Therefore, curricular revisions will be based on these data. For example, if the learning environment does not offer students the opportunity to practice the skills expected, performance data will be less than expected. In this example, less curricular content and more active learning may be the revisions made to the learning environment.

Currently in the United States, 89 pharmacy schools or colleges are educating more than 6,000 students. Most colleges and schools of pharmacy are grappling with what would be the best and most cost-effective means of fulfilling the ACPE guidelines pertaining to assessment. AACP is requesting that schools share their experiences, but to date, no one has devised an assessment plan that meets the guidelines and can be readily transferable from one institution to the next. Nor is there any online, Internet-based access to a repository of assessment-related information. With the ACPE *Standards 2000* requiring ongoing curricular assessment, and limited models from which to draw, pharmacy education is sorely in need of a demonstrably effective assessment program that can be readily replicated. This paper is intended to introduce one approach to the challenges presented by *Standards 2000*.

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Our purpose is to disseminate one method that matches the assessment process with an abilities-based curriculum. We will discuss the design of the assessment process, based on current literature, and present reliability data related to the assessment process of curricular years 1 and 2 using computer-based simulations.

PERFORMANCE-BASED ASSESSMENTS

Colleges and schools of pharmacy are encouraged by ACPE and the American Association of Colleges of Pharmacy (AACP) to adopt an abilities-based curriculum.[1,2] By definition, an abilities-based curriculum is one that links *outcomes* (clear statements of what the student is expected to be able to do) with an appropriate learning environment (providing the student with multiple opportunities to do the expected task) and assessment techniques that employ performance criteria (publicly shared indicators of successful performance). In reality, when asked to adopt an abilities-based curriculum, schools of pharmacy are being asked to make a shift in their educational paradigms, from a teaching-centered approach to a learning-centered approach. Currently, the problem is that no model or outcomes-based framework for making this change to a learning-centered approach has been delineated or demonstrated in pharmacy education.

When evaluating an abilities-based curriculum, one of the most appropriate types of assessment is a *performance assessment*. Performance assessment, as defined by Marzano et al[3] incorporates both *alternative assessment* and *authentic assessment*. Alternative assessment encompasses any assessment (eg, essay examinations) other than the standard, multiple-choice, timed, single examination approach. Authentic assessment requires that students *apply* knowledge and skills under "real world" conditions. Therefore, performance-based assessments require students to demonstrate or produce evidence of learning. The student must actively generate an original response rather than passively selecting one from a given list, as in multiple-choice testing.[4] Performance-based assessment may be used, in part, as a template to change educational paradigms. The traditional educational paradigm in pharmacy is linear, moving from curriculum to instruction to testing, especially for those programs that are designing new curricula for the first professional doctor of pharmacy degree. What performance-based assessments provide is a different approach to the process of assessment, curriculum, and instruction based on the concept described by Johnson.[5] In Johnson's curricular model, a school develops a scheme for planning backwards from educational outcomes. The curricular model illustrates the inherent relationship between teaching (ie, methods of instruction or the learning environment), student learning, and assessment. Assessment is viewed as an integral part of the learning process. The model differs from other models in pharmacy education in that the factor of student performance is introduced, requiring students to demonstrate what they actually know and are able to do.[6]

This conceptual model demands a shift in paradigms from a *teaching* paradigm (curriculum/instruction/testing) to a new, more student-centered *learning* paradigm. In this shift, the student becomes an active learner instead of a passive listener during a lecture. The faculty member and students work together to create a learning environment instead of acting independently. Also, assessment occurs precourse, during the course, and postcourse, instead of just at the end of the course. Such a change in paradigms requires a new form of assessment based on student performance of *knowledge-in-use*, and hence, the need for performance-based methods.[5]

Another advantage of this type of learning model using a process of planning backwards from outcomes is that it provides a framework for redesigning the curriculum, and hence instruction.[6] In other words, student performance data change the way the classroom operates. And student performance data will drive the revision of curricular content as well as the instructional methods employed in that curriculum. Students' ability to perform, therefore, will ultimately determine the learning environment.

Assessment in an Abilities Curriculum

The obvious starting point in designing an assessment plan is to define what students should *know and be able to do*, ie, define the educational outcomes.[7] Our school has defined terminal educational outcomes for graduates (see Appendix 1). These ability-based outcomes (ABOs) are based on nationally recognized competencies and should be generalizable to other pharmacy programs. Four primary performance-based assessments have been used in the health professions: written clinical simulations (more commonly termed *patient management problems*); computer-based clinical simulations; oral examinations; and standardized patients.[8]

Written clinical simulations and computer-based clinical simulations. With the advancement of computer technology, paper-based patient-management problems have evolved into computer-based simulations. Anywhere from 15 to 60 minutes may be allotted for completion of a specific case, depending on the skills being tested and the complexity of the case. Although limited use in high-stakes testing currently exists, more computer-based clinical simulations as a component of North American medical licensing examination are expected.[8]

Oral examinations. For logistical and psychometric reasons,[8] oral examinations are of limited value in a large scale evaluation of curricular effectiveness.

Standardized patients. Standardized patients (SPs) are individuals trained to present a case in a standardized, consistent manner, without variation between encounters.[8,9] Tests involving SPs generally include the Objective Structured Clinical Examination (OSCE) approach. SPs have been employed for almost 30 years in academic medicine. Such impressive data exist that SPs and the OSCE format became part of the licensure process for medicine in North America in 2004.[10]

Scoring Performance-Based Assessments

Performance-based assessments may produce a wide range of student responses in which the student uses different strategies to produce an answer. These answers also reflect different stages of student quality and proficiency. Therefore, judgment-based methods of evaluating student responses are employed. A number of evaluation methods exist that are capable of assessing student knowledge and proficiency when used with performance-based assessments.[11] Five primary types of evaluation methods are used with performance-based assessments. They include scoring rubrics, task-specific scoring guides, rating scales, checklists, and written and oral comments.

Because the solutions generated by students do not always result in the same response, evaluations based on student performances utilize judgments from a grader.[11] These judgments are guided by performance criteria that define the desired knowledge, skills, or attitude to be portrayed by the student. One such tool that may be used to guide this judgment is a rubric, a generic scoring instrument that is designed to evaluate the quality of a performance in a given outcome area by providing a continuum of product from excellent to poor. A rubric is a fixed measurement scale linked to criteria describing the characteristics for each level or point on the scale.[11] Typically, each point is anchored by examples of student behavior that define that particular level of performance on the scale (ie, behaviorally anchored rating scale). Rubrics may be holistic, in that they may be used to describe behavior in several diverse outcome areas.

Task-specific scoring guides are similar to rubrics but define performance in one particular outcome or task only.[11] These tools are also useful in judging student performance, but they generally do not provide the detailed criteria found in rubrics.[11] Checklists are the methods generally used in conjunction with computer-based clinical simulations and OSCEs. Similar to oral examinations, written and oral comments are logistically and psychometrically difficult when used in the evaluation of a curriculum.

METHODS

Because of the rich history of computer-based clinical simulations and OSCEs, these, in conjunction with behaviorally anchored rating scales and checklists, were chosen as the performance-based assessment methods for assessing our abilities-based curriculum. The first method of assessment employed was a Web-based (ie, computer-based) assessment implemented after pharmacy program years 1 and 2. These examinations consist of clinical simulations focusing on the ABOs as they apply to the program year in question.[8,12] The second performance-based assessment chosen was the OSCE approach using SPs. Only the computer-based simulations will be addressed in this paper.

Case Writing

The first step was case development based on the 12 ABOs. Selected faculty members were approached and asked to participate in the case development process. Faculty teams were formed on the basis of the 12 ABOs. Each team took one ABO; the team was comprised of faculty members from all 4 years of the curriculum. Care was taken to select faculty members who taught courses in which the ABO was listed as a primary focus of the course syllabus. The faculty teams took the terminal educational ABOs and defined the expected outcomes for student performance by each year in the curriculum. In other words, the terminal ABO (see Appendix 1) was defined by producing student performance expectations or tasks for each year in the curriculum. Twenty-four different cases (12 for P1 and 12 for P2) were authored for the computer-based clinical simulations; each computer-based clinical simulation assessment consisted of 12 case-based stations. Each station was composed of a case, directions for the student, case performance criteria, and any references deemed necessary to complete the problem or clinical task(s) required in the case.

Faculty members were instructed to use their professional/clinical experience to describe a problem or encounter that focused on the ABO level in question. This real-life problem or encounter constituted the case scenario. For each case, "Directions to the Student," a brief description of the context of the problem presented with clear directions delineating the tasks necessary for completion of the outcome that is being tested in that station was provided to ensure congruence between students' perception and actual case construct. An example of student directions for a P1-level case is provided in Appendix 2. Case writers defined the case scenario, directions for the student, performance criteria used for evaluating student performance, and identified any refer-

Table 1. P1 Student Results

Number of students	96
Maximum number of points possible	54
Mean score (±SD)	30.4 ± 7.3
Mean score as a percent	56.4%

Table 2. P2 Student Results

Number of students	96
Maximum number of points possible	57
Mean score (± SD)	27.8 ± 6.3
Mean score as a percent	48.8%

ences necessary for solving the case. The performance criteria were in the form of rating scales or checklists, a proven means of evaluating clinical skills in health professional education.[13,14] These checklists consisted of performance indicators (ie, items) or observable behaviors that can be scored by a faculty grading panel. An example of a case rating scale is provided in Appendix 2.

Validations of case content and checklists were based on a previously described method.[15] Briefly, the case content, rating scale, and directions were validated through review by a faculty validation panel. The panel was composed of 5 pharmacy faculty members from different pharmacy schools: 2 representatives from the East coast (University of Pittsburgh and Shenandoah University), 1 from the Midwest (Drake University), 1 from the West coast (University of California San Francisco), and 1 from the South (University of Houston). Further, 2 of the faculty members were employed in private pharmacy schools (Shenandoah and Drake Universities), while the remainder came from state schools. The purpose of this validation process was twofold. First, to ensure that each encounter appropriately tested the specific outcome in question (ie, construct) and that the encounter was true to the context in which it was set (ie, problem or clinical condition). Second, this panel addressed the generalizability of the cases and tests to their institution and region of the country. Comments by this panel were mailed back and then used to produce the final cases.

The P1 and P2 cases were then developed into Web-based computer simulations. These were piloted with P4 clerkship students. The students provided feedback and the assessment procedures were amended based on their comments. The Web-based assessments were given at the pharmacy school. Students rotated from station to station until all 12 stations were completed. Twenty minutes were allotted at each station.

Statistical Analyses

Inconsistency in grading is generally responsible for unacceptable reliability levels of most clinical and written examinations.[16] To address this, all student responses were scored by a two-member faculty grading panel according to the performance criteria indicated in the checklists. All raters scored all cases so that a measurement of interrater reliability could be calculated. Each item on a rating scale was scored dichotomously. The number of items varied by station, and each station was treated as an independent unit (question) of the entire performance-based assessment, as each station assessed a different outcome.

Reliability is the degree to which observations or measures are consistent and stable.[17] Evaluating the reliability of a measurement involves the process of determining how much of the variation in a set of observed scores is due to systematic differences between individuals and how much is due to other sources of variations, ie, error. Specifically, 4 different sources of variation due to error may be estimated: (1) variation in occasions of administration, (2) variation in different versions of the instrument, (3) variation in items, and (4) variation among multiple raters/judges. The reliability estimates for each of the sources of variation, respectively, are (1) test-retest reliability or coefficient of stability (2) alternate form reliability or coefficient of equivalence, (3) internal consistency as with coefficient alpha, K- R 21, etc, and (4) interrater reliability as with Cohen's Kappa, Gamma Statistic, etc.[18-20] Regarding performance-based assessment examinations, interrater reliability and internal consistency are the 2 reliability measures of importance and were the ones to be calculated with each assessment given.

RESULTS

Student performance results for the P1 and P2 years are presented in Tables 1 and 2, respectively. The interrater reliabilities per station and overall are presented in Table 3 for the P1 year and Table 4 for the P2 year. The internal consistency reliability (Cronbach's coefficient alpha) data are presented in Tables 5 and 6 for the P1 and P2 years, respectively. The P1 and P2 years represent the computer-based simulations. The overall interrater reliabilities for the P1 and P2 years were 0.94 and 0.91, respectively. The overall internal consistency reliabilities for the P1 and P2 years were 0.86 and 0.80, respectively.

DISCUSSION

Our results indicate that the performance-based assessments reliably measure the students' ability to perform the program's ABOs. We plan to repeat this process with Pharmacy Objective Structured Clinical Examinations (P-OSCEs) for curricular years 3 and 4, and then repeat the

Table 3. P1 Student Interrater Agreement

Station	Number of Items	Mean (SD)*	Mean as a Percent	Interrater Agreement
1	7	4.13 (1.37)	59.0	0.87
2	4	2.50 (1.06)	62.6	0.83
3	3	0.43 (0.78)	14.3	0.86
4	4	0.96 (0.84)	24.0	0.82
5	4	1.72 (0.94)	43.0	0.94
6	6	3.29 (1.55)	54.8	0.78
7	9	6.03 (2.41)	67.0	0.97
8	5	3.49 (1.36)	69.8	0.82
9	2	1.33 (0.58)	66.3	0.60
10	4	2.41 (1.39)	60.3	0.81
11	4	3.43 (0.99)	85.8	0.64
12	2	0.73 (0.57)	36.3	0.73
Total	**54**	**30.4 (7.27)**	**56.4**	**0.94**

*This is a mean value of the graders in which each item was scored dichotomously and valued 0/1 based on the checklist rating (yes =1; no =0).

Table 4. P2 Student Interrater Agreement

Station	Number of Items	Mean (SD)*	Mean as a Percent	Interrater Agreement
1	11	5.79(1.73)	52.7	0.86
2	5	1.29(1.29)	25.8	0.73
3	3	1.91(1.16)	63.8	1.00
4	4	1.12(1.08)	28.1	0.97
5	5	2.66(1.26)	53.2	0.97
6	5	3.25(0.80)	65.0	0.69
7	5	3.08(1.18)	61.5	0.67
8	5	2.27(1.50)	45.4	0.88
9	2	0.02(0.20)	1.0	1.00
10	3	1.22(0.93)	40.7	0.46
11	4	1.91(0.90)	47.8	0.77
12	5	2.73(1.12)	54.6	0.76
Total	**57**	**27.81(6.33)**	**48.8%**	**0.91**

*This is a mean value of the graders in which each item was scored dichotomously and valued 0/1 based on the checklist rating (yes =1; no =0).

Table 5. P1 Internal Consistency Reliability

Station	Number of items	Rater A (KR-20)	Rater B (KR-20)	Average Rating (Alpha)
1	7	0.46	0.42	0.46
2	4	0.29	0.51	0.44
3	3	0.68	0.65	0.72
4	4	0.48	0.09	0.34
5	4	0.26	0.35	0.31
6	6	0.77	0.65	0.77
7	9	0.78	0.80	0.80
8	5	0.71	0.61	0.71
9	2	0.37	0.15	0.35
10	4	0.87	0.73	0.86
11	4	0.82	0.83	0.87
12	2	-0.10	-0.09	-0.12
Total	**54**	**0.84**	**0.83**	**0.86**

Table 6. P2 Internal Consistency Reliability

Station	Number of items	Rater A (KR-20)	Rater B (KR-20)	Average Rating (Alpha)
1	11	0.49	0.45	0.50
2	5	0.37	0.48	0.46
3	3	0.72	0.72	0.72
4	4	0.53	0.54	0.55
5	5	0.37	0.37	0.38
6	5	0.38	0.32	0.39
7	5	0.57	0.46	0.60
8	5	0.73	0.67	0.73
9	2	1.00	1.00	1.00
10	3	0.78	0.70	0.80
11	4	0.44	0.31	0.41
12	5	0.45	0.42	0.46
Total	**57**	**0.80**	**0.74**	**0.80**

whole process again in order to obtain 2 years' worth of data. Once all assessment data are graded and the necessary validity and reliability data are generated, the student performance data will be used in aggregate to determine the effectiveness of the curriculum's content in terms of preparing the students to meet the program's educational ability-based outcomes. Essentially, we will *plan backwards* based on the assessment results. As identified by Arrasmith et al, the conglomeration of student performance data regarding specific programmatic outcomes may be used to monitor overall effectiveness, demonstrate school improvement, and provide student achievement accountability to all constituents.[21] Further, these data, when related back to the instructional methods in the learning environment, may be used for program planning, such as the incorporation of more active-learning strategies in the classroom. The overall educational environment may be governed based on what students *know and are able to do*.[21] Performance data can provide the necessary link between the school's mission statement, educational objectives, and learning environment, with national standards and all concerned constituents. In other words, performance data allow us to actually do what we say we do or make the necessary adjustments so we can empirically support that we are doing what we say we are doing.

Students scored roughly 50% in these performance-based assessments. One possible explanation for this is that students in the first 2 years of the curriculum are usually tested with multiple-choice examinations and not performance-based examinations. This may account for the discrepancy between expectations (ABOs are performance-based) and scores. More data and analysis are needed to further explain these low scores.

We have developed a website (http://pharmacy.creighton.edu/curr_assessment/) for dissemination purposes. We are still using this website for testing purposes so access to the site is restricted. Please contact the author for password access. As we progress, cases, student performance data, and how the data are being used for curriculum analysis will be available for viewing and downloading.

CONCLUSIONS

The use of performance-based assessments to evaluate student learning as described in this paper is only one portion of the overall programmatic assessment plan. We hope that these assessment methods continue to produce sufficiently valid and reliable data so that other pharmacy programs may incorporate the methods into their assessments of curricular effectiveness, thus lessening the burden on us all. Further, through the website we have created/hope to create a national repository of cases that may be used by all programs for both teaching and assessing ABOs. In this way, a model of assessment that links an abilities-based curriculum with student performance data will be readily available to other programs struggling with the *Standards 2000* the way we have. Performance-based assessments can serve as both formative and summative evaluation of student achievement. These assessments measure cognitive learning, mastery of essential practice skills, and the ability to communicate effectively while using data in both critical thinking and problem-solving processes.

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REFERENCES

1. American Council on Pharmaceutical Education. *Accreditation Standards and Guidelines for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree Adopted June 14, 1997*. Available at: www.acpe-accredit.org/frameset_Pubs.htm. Accessed December 10, 2003.
2. Center for the Advancement of Pharmaceutical Education Advisory Panel on Educational Outcomes. *Educational Outcomes*. Alexandria, VA: American Association of Colleges of Pharmacy; 1998.
3. Marzano RJ, Pickering D, McTighe, J. *Assessing Student Outcomes: Performance Assessment Using the Dimensions of Learning Model*. Alexandria, VA: Association for Supervision and Curriculum Development; 1993:13.
4. Khattri N, Sweet D. Assessment reform: promises and challenges. In: Kane MB, Mitchell R eds. *Implementing Performance Assessment: Promises, Problems, and Challenges*. Mahwah, NJ: Lawrence Erlbaum Assoc.; 1996:3.
5. Johnson B. *The Performance Assessment Handbook: Portfolios and Socratic Seminars Vol 1*. Princeton, NJ: Eye on Education; 1996:4.
6. Johnson B. *The Performance Assessment Handbook: Performances and Exhibitions Vol 2*. Princeton, NJ: Eye on Education; 1996:29.
7. Johnson B. *The Performance Assessment Handbook: Performances and Exhibitions Vol 2*. Princeton, NJ: Eye on Education; 1996:9.
8. Swanson DB, Norman GR, Linn RL. Performance-based assessment. Lessons from the health professions. *Educational Researcher*. 1995;24:5-11.
9. Barrows HS. An overview of the uses of standardized patients for teaching and evaluating clinical skills. *Acad Med*. 1993;68:443-51.
10. United States Medical Licensing Examination. Available at: http://www.usmle.org/. Accessed June 23, 2004.
11. McTighe J, Ferrara S. Performance-based assessment in the classroom: a planning framework. In: Blum RE, Arter JA, eds. *A Handbook for Student Performance Assessment in an Era of Restructuring*. Alexandria, VA: Association for Supervision and Curriculum Development; 1996:I-5.
12. Ryans DG. Performance tests of educational measurement. In: Lindquist EF, ed. *Educational Measurement*. Washington, DC: American Council on Education; 1951:455-95.
13. Stillman PL, et al. Clinical performance evaluation in medicine and law. In: Berk RA, ed. *Performance Assessment*. Baltimore MD: Johns Hopkins University Press; 1986:393-440.
14. Andrew BJ. The use of behavioral checklists to assess physical examination skills. *J Med Educ*. 1977;52:589-91.
15. Monaghan MS, Vanderbush RE, Gardner SF, Schneider EF, Grady AR, McKay AB. Standardized patients: an ability-based outcomes assessment for the evaluation of clinical skills in traditional and nontraditional education. *Am J Pharm Educ*. 1997;61:337-44.
16. Newble DI, Hoare J, Elmslie RG. The validity and reliability of a new examination of the clinical competence of medical students. *Med Educ*. 1981;15:46-52.
17. Rosenthal R, Rosnow RL. *Essentials of Behavioral Research: Methods and Data Analysis*. 2nd ed. New York, NY: McGraw-Hill, Inc;1991.
18. Mehrens WA, Lehmann IJ. *Measurement and Evaluation in Education and Psychology*. 4th ed. Fort Worth, TX: Holt, Rinehart and Winston, Inc;1991.
19. Nunnaly JC, Bernstein IH. *Psychometric Theory*. 3rd ed. New York, NY McGraw-Hill, Inc;1994.
20. Siegel S, Castellan NJ. *Nonparametric Statistics for the Behavioral Sciences*. 2nd ed. New York, NY: McGraw-Hill, Inc;1988.
21. Arrasmith DG, Kushman JW, Olson N. Using performance

information for improvement. Introduction. In: Blum RE, Arter JA eds. *A Handbook for Student Performance Assessment in an Era of Restructuring*. Alexandria, VA: Association for Supervision and Curriculum Development; 1996:VII-1.

Appendix 1. Ability-based educational outcomes for graduates.

Pharmaceutical Care Abilities

1. *Patient Assessment* - The student shall contribute to the database of information about the patient by: a) performing a medication history, review of systems, and physical assessment; b) recommending and interpreting laboratory tests; c) assessing medical, psychosocial, behavioral, and economic status; and d) identifying potential drug-related problems.
2. *Pharmaceutical Care Plan Development* - The student shall develop pharmaceutical care plans[a] that maximize the patients' response to drug therapy and prevent or resolve a drug-related problem(s) in order to ensure positive outcome(s). The student shall appropriately document the implementation of and outcomes related to the care plan. The pharmaceutical care plan shall include medical devices, as needed, and educational information (e.g., nutrition, lifestyle, etc.) intended to promote general health and prevent or minimize disease progression.
3. *Drug Therapy Evaluation* - The student shall assess and monitor the patient's drug therapy, including a consideration of the chemical, pharmaceutical, pharmacokinetic, and pharmacological characteristics of the administered medications.
4. *Pharmacotherapy Decision-Making* - The student shall make pharmacotherapy decisions and support those decisions based on knowledge of biomedical, pharmaceutical, administrative, and clinical sciences.[b] The student shall recommend patient use of prescription and nonprescription medications, as well as nondrug therapy.
5. *Medication Preparation, Distribution, and Administration* -The student shall compound and/or dispense drug products consistent with patient needs and in harmony with the law. The student shall demonstrate the ability to accurately interpret the prescription, select the appropriate dosage form, route and method of administration, and appropriately package and label the product. The student shall demonstrate the ability to administer medications, when appropriate.
6. *Systems Management* - The student shall use and evaluate acquisition, inventory control and distribution systems, while documenting and maintaining quality. The student shall plan, organize, direct and control pharmaceutical care systems and human, material, and financial resources, utilizing management theories and information technology.

General Education Abilities

7. *Communication Skills* - The student shall read, write, speak, listen and use multimedia to communicate effectively. The student shall counsel and educate patients, as well as communicate with other healthcare professionals.
8. *Critical Thinking* - The student shall acquire, comprehend, apply, analyze, synthesize, and evaluate information. The student shall integrate these abilities to identify, resolve, and prevent problems and make appropriate decisions. The student shall understand the research process.
9. *Professional Ethics and Responsibility* - The student shall represent the profession in an ethical manner. The student shall identify, analyze, and resolve ethical problems.
10. *Social Interaction, Citizenship, Leadership, Professionalism* - The student shall demonstrate appropriate interpersonal behaviors. The student shall provide service to the profession, as well as the community. The student shall be proactive in collaborating with other health care professionals.
11. *Life-long Learning* - The student shall continuously strive to expand his or her knowledge to maintain professional competence.
12. *Information Management* - The student shall apply technology to pharmacy practice and science. The student shall demonstrate the ability to interpret and evaluate data for the purpose of assessing the suitability, accuracy, and reliability of information from reference sources.

[a] The pharmaceutical care plan shall include subjective and objective patient information, an assessment of that information, and a plan to resolve and monitor any drug-related problems that were identified.

[b] Pharmacotherapy decisions determine what, why, when, where, and how drug therapy is provided. The making of pharmacotherapy decisions is the foremost expressions of the professional knowledge, responsibility and authority of pharmacists.

Appendix 2. P1 level case with directions to the student, prescription, and the performance criteria in the form of a checklist used to grade the case.

Directions to the Student

You are a pharmacist in the clinic pharmacy serving a medical building containing physicians from many different practices. Dr. Baker just prescribed Avandamet for a 34-Year-old woman just diagnosed with type 2 diabetes today. Please review the prescription and clarify any problems using the resources available. If you find any problems, please document them on the form provided.

The following is a list of tertiary sources; please check which would be pertinent to determine if problems exist in this case (Check all that apply)

- ❑ Briggs Drugs and Pregnancy
- ❑ Facts and Comparisons
- ❑ Micromedex
- ❑ Pharmacotherapy (old edition)
- ❑ American Hospital Formulary Service Drug Information

Using only Micromedex determine if problems exist with the following prescription.

Patient: Susan Cornwald Date: Today
Address: 853 North Golf Rd. Papillion NE 68046

Rx #65436

Avandamet 2/500

Sig: 1 BID #60

May Refill 0 Times

Dr. Baker, MD

Scoring Checklist

Information Management Checklist P1	Yes	No
1. Student identifies that Micromedex, Facts and Comparisons, and AHFS DI would all be appropriate resources to use (must get all three for credit).	O	O
2. Student determines prescription not recommended for initial use.	O	O
3. Student answers no, and recommends patient contact physician for new script.	O	O