INSTRUCTIONAL DESIGN AND ASSESSMENT

Longitudinal Student Self-Assessment in an Introductory Pharmacy Practice Experience Course

Vincent C. Dennis, PharmD

College of Pharmacy, The University of Oklahoma

Objective. To evaluate changes in student self-assessment responses within and between classes related to *Pharmacy Practicum II*, a second-year introductory pharmacy practice experience (IPPE) course.
Methods. Students completed a self-assessment of their achievement of learning objectives before and after the IPPE course using a 5-point response scale and the practice context of community pharmacy. Analyses included precourse and postcourse comparisons within classes for 3 consecutive years, and a postcourse comparison between classes for learning objectives associated with course changes.
Results. Mean student self-assessment scores increased for all learning objectives, suggesting an increase in student-perceived independence. Larger increases were observed when multiple learning activities were employed and/or other courses contributed to learning. Course changes related to 2 learning objectives did not appear to significantly influence postcourse scores in a consistent manner.
Conclusions. Student self-assessments at the end of the second professional year described the changes in students' perceived independence. This process may be useful to characterize the level of student-perceived independence related to learning objectives and assess the influence of course changes on self-assessment scores.

Keywords: introductory pharmacy practice experience, assessment, community pharmacy

INTRODUCTION

The inclusion of an introductory pharmacy practice experience (IPPE) or "early experiential" program within accreditation standards adopted in 1997 for first professional pharmacy degree programs[1] required colleges and schools of pharmacy to create such experiences where few had previously existed. In addition, evaluation of student performance with this curricular component is necessary to assure attainment of course objectives. Considerations for creating an IPPE have been published,[2] but the evaluation of student learning is somewhat limited by a lack of experience in delivering this type of program in pharmacy education.

The University of Oklahoma admitted the first class of pharmacy students into a revised first professional pharmacy degree program in the fall of 1998. The revised curriculum includes an IPPE course in both the first and second professional years (P1 and P2, respectively) of the 4-year program. Each course spans 2 semesters and ensures that the student gains 120 contact hours of experience, including classroom time, written

Corresponding Author: Vincent C. Dennis, PharmD. Address: The University of Oklahoma College of Pharmacy, 1110 N. Stonewall, P.O. Box 26901, CPB 231, Oklahoma City, OK 73190. Tel: 405-271-6878, ext. 47372. Fax: 405-271-6430. E-mail: vincent-dennis@ouhsc.edu.

assignments, and experiential practice site visits. The IPPE course in the first professional year has a general focus on exposure and professionalization of students through a combination of required professional meetings and experiences in a multitude of practice settings, with general learning objectives directed at becoming familiar with the pharmacy profession. The P2 IPPE course (*Pharmacy Practicum II*, Table 1) focuses on development/refinement and application of knowledge and early practice skills, with specific learning objectives that are more easily quantifiable in comparison to the IPPE course in P1.

With the newness of the IPPE course in our curriculum, additional evaluative methods were considered in order to provide information about student-perceived learning during the P2 year. Consistent with the ideal of self-directed learning, student self-assessment was implemented as one method of providing additional information regarding perceived learning in the *Pharmacy Practicum II* course, as well as learning in specific areas of the second professional year. The purpose of this paper is to describe our experience with a pharmacy student self-assessment related to an IPPE course in the second year of the curriculum (*Pharmacy Practicum II*). Specific objectives include (1) evaluation of the changes in student self-assessment responses for

Table 1. Course Content and Activities* for Pharmacy Practicum II (Fall 1999 to Spring 2002)

Learning Objective	Topic	Learning Activities				
		Site Visits	Lecture	Class Discussion	Small Group	Written
1	Interpreting medication orders	X				
2	Verification of an accurate prescription order	X				
3	Pharmacy law	X				
4	Product selection/substitution	X				
5	Prescription preparation/product selection	X				
6	Filling a prescription	X				
7	Compounding, including calculations	X				
8	Peer counseling on cardiovascular disease pathophysiology				X	
9	Peer counseling on cardiovascular agent pharmacology				X	
10	Product information and prescribing	X	X	X		X
10,14	Therapeutic class summary (cardiovascular agents)			X	X	X
11	Medical acronyms and abbreviations	X		X		
11,12	Introduction to case studies/progress notes†	X	X*	X*		
12	Using appropriate sources of information	X				
10,13,14,15	Therapeutic alternatives (drug selection)	X		X	X	X
16	Medication errors and prevention	X	X			X
17	Adverse drug reactions and reporting‡		X	X†		X†
18	Decision-making and bias		X	X		
18	Peer review of written drug information				X	
19	Self-assessment			X		X

*Activities for the course consisted of 1 hour of in-class contact per week (lecture, class discussion, small group activities, written assignments) and experiential site visits: 80 hours of site visit contact accumulated over 2 semesters with a minimum of 8 - 10 hours in both community and institutional practice sites and a minimum of 8 - 10 hours in a third practice type (specialty, clinical, or other).
†topic and learning activities added Fall 2000 and refined Fall 2001
‡learning activity changed from written to in-class discussion assignment (Fall 2000)

knowledge, skills, and attitudes in the context of community pharmacy practice following the *Pharmacy Practicum II* course and concomitant coursework during the second professional year, (2) observation of the influence that longitudinal course changes in *Pharmacy Practicum II* may have on student self-assessment scores, and (3) comparison of longitudinal pre- and post-course student self-assessment scores for 3 consecutive P2 classes (1999-2000, 2000-2001, and 2001-2002) enrolled in *Pharmacy Practicum II*.

METHODS

Given that *Pharmacy Practicum II* runs parallel to other core knowledge/skill courses (Table 2), learning objectives from the CAPE outcomes[3] that focus on application of learned material across the second year of the curriculum were selected or modified and utilized (Table 3). Structure and content of *Pharmacy Practicum II* is broad and includes both a classroom and experiential component (Table 1). Performance in the course is graded as satisfactory or unsatisfactory based on students' adherence to specific guidelines for assignments and completion of experiential site visits within specifications.

In addition to lectures, *Pharmacy Practicum II* learning activities included both class and small-group discussions and a number of written assignments (Table 1). During class discussions, students presented their perspectives on course topics, providing further elaboration on the subject matter. Small group activities consisted of 6 to 10 students discussing course material, problem solving, or peer counseling, with time allotted at the end of a class session for informal presentation of group information. Written assignments were 1 to 3 pages in length and designed to meet specific course learning objectives. Written assignments were used as the basis

Table 2. Second Professional Year (P2) Courses

Fall Semester
- *Biological Principles of Drug Action* (8 weeks)
- *Pharmaceutical Care Module I* (8 weeks)
- *Drug Information Systems*
- *Pharmaceutical Biotechnology*
- *Pharmacoeconomics I*
- *Pharmacokinetics*
- *Pharmacy Practicum II*

Spring Semester
- *Patient Assessment*
- *Pharmacoeconomics II*
- *Pharmaceutical Care Module II* (Cardiovascular)
- *Pharmaceutical Care Module III* (Respiratory and Renal)
- *Pharmaceutical Care Module IV* (Neurology)
- *Pharmacy Practicum II*

Table 3. Course Learning Objectives for *Pharmacy Practicum II*

1 Receive and correctly interpret medication orders obtained in oral, written, and/or electronic form.
2 Verify the proper dosage, dosage form, and accuracy of the prescription or medication order.
3 Assure the prescription or medication order conforms to all state and federal regulations.
4 Comply with legal requirements regarding product selection, substitution, and documentation.
5 Prepare the prescription or medication order for the patient by evaluating and selecting the proper product.
6 Fill, label, double-check and file the prescription or medication order according to established regulations and/or guidelines.
7 Compound the prescription or medication order as required, including provision of pharmacy calculations (liquids or topical non-sterile dosage forms).
8 Describe the relevant pathophysiology of a specific disease.
9 Describe the biochemical and/or pharmacological mechanisms of action for a given medication.
10 Collect accurate and comprehensive drug information from appropriate resources.
11 Identify appropriate information in profiles or medical records that will impact medication-related decisions, such as dosage calculations and/or schedule of administration.
12 Use appropriate sources of information as available and applicable to a specific situation.
13 Identify characteristics of the product(s) under consideration that may impact cost and/or therapeutic outcomes.
14 Determine the availability of therapeutic alternatives to the prescribed product.
15 Determine the availability of generically equivalent products for brand name products.
16 Identify appropriate actions to minimize the occurrence of medication errors.
17 Complete a standard instrument used within an adverse drug reaction reporting system.
18 Display professional behavior when interacting with patients, colleagues, other health care practitioners, preceptor and support personnel.
19 Display self-directed learning by conducting self-assessment, acting on identified strengths and weaknesses, and pursuing knowledge independently.

for 2 of the small-group discussion activities prior to submitting the papers for grading.

Course objectives were provided to preceptors participating in the experiential portion of the *Pharmacy Practicum II*. The preceptors volunteered their time so that students could visit various pharmacy practice sites outside of class time. Students signed up for visits at a central location within the College and schedules for student site visits were regularly faxed to participating practice sites. Students were responsible for meeting the experiential hour requirements for the course, but limitations were not placed on students pursuing additional employment experiences outside the curriculum during the second year. However, employment histories were not collected from students, so which students obtained additional experience through employment was not known.Although the curriculum for the *Pharmacy Practicum II* course was specifically created to meet the learning objectives for the course, concomitant courses in the second year (Table 2) were also expected to contribute to student learning for many of the objectives. With the exception of the pharmacy calculation problems that are covered in Pharmaceutical Care Modules I through IV, *Pharmacy Practicum II* course objectives 1 through 7 (aspects of filling a prescription) and objective 16 (medication errors) were not expected to be covered significantly in or influenced by other courses during the second professional year.

For this intervention study, second-year students were given an orientation to the *Pharmacy Practicum II* course and learning objectives (Table 3) during the first 2 weeks of the fall semester. Using the practice context of community pharmacy practice, students were required to complete a self-assessment of their current knowledge of the learning objectives they would be required to achieve in *Pharmacy Practicum II* (Table 4). The self-assessment was based on a 5-point scale that was created to describe a student's confidence in his/her ability to independently accomplish a specific learning objective without intervention from a faculty member/preceptor. At the end of the spring semester, students were required

Table 4. Student Self-Assessment Scale

Rank	Interpretation
1	I would always require intervention; could not generally accomplish the objective
2	I would consistently require intervention; could rarely accomplish the objective
3	I would occasionally require intervention; could sometimes accomplish the objective
4	I would rarely require intervention; could generally accomplish the objective
5	I would never require intervention; could always accomplish the objective

Table 5. Pre- and Postcourse Comparison of Self-Assessment Scores Within a Class (1999-2000 year), N= 62 students

Objective	Precourse Mean (SD)	Postcourse Mean (SD)	P
1	3.49 (0.96)	4.00 (0.75)	< 0.001
2	3.29 (1.06)	3.95 (0.76)	< 0.001
3	3.16 (1.26)	3.50 (1.02)	0.006
4	2.89 (1.19)	3.55 (1.05)	< 0.001
5	3.60 (1.25)	4.05 (0.97)	0.001
6	3.85 (1.04)	4.31 (0.71)	< 0.001
7*	3.11 (1.04)	3.39 (0.96)	0.055
8	1.98 (0.78)	3.03 (0.65)	< 0.001
9	1.87 (0.71)	2.98 (0.61)	< 0.001
10	3.34 (0.92)	4.10 (0.74)	< 0.001
11	2.50 (0.99)	3.18 (0.74)	< 0.001
12	3.21 (0.94)	3.79 (0.79)	< 0.001
13	2.40 (1.06)	3.27 (0.87)	< 0.001
14	2.27 (0.91)	3.24 (0.84)	< 0.001
15	3.34 (1.19)	3.94 (0.79)	< 0.001
16	3.21 (1.12)	3.92 (0.82)	< 0.001
17	1.82 (0.92)	3.65 (0.93)	< 0.001
18	4.35 (0.85)	4.65 (0.58)	0.002
19	3.81 (0.81)	4.34 (0.70)	< 0.001

*No significant difference postcourse
SD = standard deviation
Refer to Table 4 for scale values.

Table 6. Precourse and Postcourse Comparison of Self-Assessment Scores Within a Class (2000-2001), N= 65 students

Objective	Precourse Mean (SD)	Postcourse Mean (SD)	P
1	3.89 (0.66)	4.12 (0.67)	0.010
2*	3.62 (0.90)	3.78 (0.86)	0.100
3*	3.43 (1.06)	3.66 (0.94)	0.096
4	3.31 (1.07)	3.58 (0.95)	0.043
5*	3.88 (1.07)	4.09 (0.84)	0.118
6	4.23 (0.68)	4.43 (0.64)	0.031
7	3.06 (0.83)	3.42 (0.88)	0.010
8	1.77 (0.70)	3.03 (0.71)	< 0.001
9	1.92 (0.67)	3.05 (0.78)	< 0.001
10	3.40 (0.84)	4.11 (0.69)	< 0.001
11	2.65 (0.93)	3.35 (0.78)	< 0.001
12	3.37 (0.84)	3.95 (0.69)	< 0.001
13	2.49 (0.94)	3.31 (0.77)	< 0.001
14	2.43 (1.03)	3.44 (0.83)	< 0.001
15	3.40 (1.06)	3.98 (0.80)	< 0.001
16	3.26 (1.11)	3.85 (0.80)	< 0.001
17	2.09 (0.93)	3.32 (0.92)	< 0.001
18*	4.72 (0.48)	4.77 (0.49)	0.471
19*	4.24 (0.82)	4.42 (0.63)	0.055

*No significant difference postcourse
SD = standard deviation
Refer to Table 4 for scale values.

to complete an identical self-assessment activity in class. Numeric student responses were longitudinally loaded into Microsoft *Excel*. Pre- and postcourse self-assessment scores within a class were analyzed for 3 consecutive years of delivery (1999-2000, 2000-2001, and 2001-2002). Data were also analyzed for differences between the classes for learning objectives that underwent significant course changes between consecutive years of delivery (objectives 11 and 17). Differences within classes were analyzed using *SPSS* (version 11.0, Chicago, Ill) by paired-samples t-test, with a $p < 0.05$ considered representative of significant differences. Differences between

classes for objectives 11 and 17 were analyzed using *SPSS* (version 11.0, Chicago, Ill) by one-way analysis of variance (ANOVA) with post hoc analysis using the Bonferroni correction; a $p < 0.05$ was considered representative of significant differences.

RESULTS

Completed self-assessments were obtained from 98%, 97%, and 95% of the student classes (62 of 63, 65 of 67, and 69 of 73 students, respectively).

Mean student scores on the second self-assessment increased for all learning objectives for students in all 3 study years; statistical analysis revealed the majority of changes within all 3 study years were statistically significant (Tables 5, 6, and 7). The increases in mean student self-assessment scores are summarized according to magnitude of change (< 0.5 point, 0.5 – 0.99 point, or > 1.0 point) and listed in Table 8.

No statistical analysis was performed on the precourse comparisons between consecutive years (Table 9) due to lack of known variables aside from course year of delivery. For postcourse comparisons of the 2 learning objectives for which class activities changed substantially between consecutive years of course delivery (objectives 11 and 17), the only significant difference found

Table 7. Pre- and Postcourse Comparison of Self-Assessment Scores Within a Class (2001-2002), N = 69 students

Objective	Precourse Mean (SD)	Postcourse Mean (SD)	*P* Value
1*	3.86 (0.60)	4.00 (0.62)	0.084
2	3.48 (0.76)	3.88 (0.76)	< 0.001
3*	3.36 (0.95)	3.58 (0.86)	0.071
4	3.14 (1.02)	3.49 (0.98)	0.005
5	3.78 (0.89)	4.23 (0.67)	< 0.001
6*	4.25 (0.65)	4.29 (0.64)	0.634
7	3.06 (1.04)	3.51 (0.82)	< 0.001
8	1.91 (0.64)	3.20 (0.61)	< 0.001
9	1.91 (0.59)	3.10 (0.67)	< 0.001
10	3.04 (0.83)	4.09 (0.76)	< 0.001
11	2.39 (0.99)	3.49 (0.76)	< 0.001
12	2.65 (0.97)	3.90 (0.75)	< 0.001
13	2.04 (0.81)	3.33 (0.78)	< 0.001
14	2.32 (0.76)	3.28 (0.80)	< 0.001
15	3.17 (0.91)	3.80 (0.76)	< 0.001
16	3.25 (0.91)	3.93 (0.73)	< 0.001
17	2.09 (0.72)	3.25 (0.85)	0.017
18	4.52 (0.61)	4.70 (0.55)	< 0.001
19	4.12 (0.74)	4.52 (0.58)	< 0.001

*No significant difference postcourse

SD = standard deviation

Refer to Table 4 for scale values.

was between the 1999-2000 and 2001-2002 course years for objective 17 (Table 10).

DISCUSSION

Changes in Postcourse Scores Within Study Years

An increase in a mean self-assessment score for a given learning objective can be viewed in terms of student-perceived progression toward independence, as a maximum scale rank of 5 is defined as the ability to independently accomplish an objective 100% of the time. Although an increase in mean score was uniformly seen on the postcourse assessment for students in all years studied, the magnitude of change varied by a small degree (< 0.5 point) for some objectives and greatly (> 1 point) for others (Table 8). The first objective of this study was to evaluate the changes in self-assessment responses postcourse, with known influences including the *Pharmacy Practicum II* course (classroom and experiential learning activities), as well as concomitant coursework in the second curricular year (Tables 1 and 2, respectively).

During all 3 study years, no significant change in mean student self-assessment scores or only a small change (mean score increase < 0.5 point) regardless of

significance was observed for objectives 3 (pharmacy law), 5 (prescription preparation/product selection), 6 (filling a prescription), 7 (compounding, including pharmacy calculations), and 18 (professional behavior), as shown in Table 8. Experiential site visits associated with *Pharmacy Practicum II* were expected to largely contribute to student learning and an improved sense of independence for these particular objectives during the second year, because all are primarily practice-based and other concomitant courses do not necessarily focus on these areas during the same time period. In fact, students do not take the pharmacy law course until the fall semester of their third professional year, so according to self-assessment scores, second-year students gained only minimal independence in this area, apparently derived from experiential activities. Another factor likely accounting for smaller changes in these objectives were the relatively high initial precourse rankings for all years (mean scores > 3 or 4), denoting a perceived high level of baseline independence and leaving less room for improvement (Table 9).

During the 2000-2001 and 2001-2002 study years (Tables 6 and 7, respectively), small improvements in student-perceived independence (mean score increases < 0.5 point) were seen for objectives 1 (interpreting medication orders), 2 (verification of an accurate prescription order), 4 (product selection/substitution), and 19 (self-directed learning). Learning related to these specific objectives was again expected to be primarily experiential, based on practice site visits, although self-directed learning was a focus topic in the *Pharmacy Practicum II* classroom activities. Interestingly, mean self-assessment scores for the same 4 objectives increased to a larger degree (0.5 – 0.99) during the 1999-2000 study year (Table 5). This larger increase cannot be explained except to note that students in this particular year had lower precourse self-assessment scores (Table 9), while their mean postcourse scores were comparable with those of students in the other 2 study years (Table 10).

In general, larger improvements in mean student self-assessment scores were seen when multiple learning activities were employed to accomplish a given objective during the *Pharmacy Practicum II* course (see Table 1 for learning activities according to course objectives). Moderate improvements in student-perceived independence (mean score increases 0.5 – 0.99) were seen for objectives 15 (determining generic availability) and 16 (minimizing medication errors) during all 3 study years (Table 8 for summary; Tables 5, 6, and 7 for year-specific data). Learning related to these 2 objectives was accomplished through a written assignment associated

Table 8. Summary of the Mean Increase in Student Self-Assessment Scores by Learning Objective and Course Year

Course Year	Mean Increase According to Learning Objective (1 - 19)		
	< 0.5 point	0.5 - 0.99 point	> 1.0 point
1999-00	3,5,6,7*,18	1,2,4,10,11,12,13,15,16,19	8,9,14,17
2000-01	1,2*,3*,4,5*,6,7,18*,19*	10,11,12,13,14,15,16	8,9,17
2001-02	1*,2,3*,4,5,6*,7,18,19	14,15,16	8,9,10,11,12,13,17

*No significant difference postcourse

Table 9. Precourse Comparisons of Self-Assessment Scores Between Classes (Fall 1999 to Fall 2001)

	1999-00	2000-01	2001-02
Objective	Mean (SD)	Mean (SD)	Mean (SD)
1	3.49 (0.96)	3.89 (0.66)	3.86 (0.60)
2	3.29 (1.06)	3.62 (0.90)	3.48 (0.76)
3	3.16 (1.26)	3.43 (1.06)	3.36 (0.95)
4	2.89 (1.19)	3.31 (1.07)	3.14 (1.02)
5	3.60 (1.25)	3.88 (1.07)	3.78 (0.89)
6	3.85 (1.04)	4.23 (0.68)	4.25 (0.65)
7	3.11 (1.04)	3.06 (0.83)	3.06 (1.04)
8	1.98 (0.78)	1.77 (0.70)	1.91 (0.64)
9	1.87 (0.71)	1.92 (0.67)	1.91 (0.59)
10	3.34 (0.92)	3.40 (0.84)	3.04 (0.83)
11	2.50 (0.99)	2.65 (0.93)	2.39 (0.99)
12	3.21 (0.94)	3.37 (0.84)	2.65 (0.97)
13	2.40 (1.06)	2.49 (0.94)	2.04 (0.81)
14	2.27 (0.91)	2.43 (1.03)	2.32 (0.76)
15	3.34 (1.19)	3.40 (1.06)	3.17 (0.91)
16	3.21 (1.12)	3.26 (1.11)	3.25 (0.91)
17	1.82 (0.92)	2.09 (0.93)	2.09 (0.72)
18	4.35 (0.85)	4.72 (0.48)	4.52 (0.61)
19	3.81 (0.81)	4.24 (0.82)	4.12 (0.74)

SD = standard deviation
Refer to Table 4 for scale values.

Table 10. Postcourse Comparisons of Self-Assessment Scores Between Classes (Spring 2000 to Spring 2002)

	1999-00	2000-01	2001-02
Objective	Mean (SD)	Mean (SD)	Mean (SD)
1	4.00 (0.75)	4.12 (0.67)	4.00 (0.62)
2	3.95 (0.76)	3.78 (0.86)	3.88 (0.76)
3	3.50 (1.02)	3.66 (0.94)	3.58 (0.86)
4	3.55 (1.05)	3.58 (0.95)	3.49 (0.98)
5	4.05 (0.97)	4.09 (0.84)	4.23 (0.67)
6	4.31 (0.71)	4.43 (0.64)	4.29 (0.64)
7	3.39 (0.96)	3.42 (0.88)	3.51 (0.82)
8	3.03 (0.65)	3.03 (0.71)	3.20 (0.61)
9	2.98 (0.61)	3.05 (0.78)	3.10 (0.67)
10	4.10 (0.74)	4.11 (0.69)	4.09 (0.76)
11*	3.18 (0.74)	3.35 (0.78)	3.49 (0.76)
12	3.79 (0.79)	3.95 (0.69)	3.90 (0.75)
13	3.27 (0.87)	3.31 (0.77)	3.33 (0.78)
14	3.24 (0.84)	3.44 (0.83)	3.28 (0.80)
15	3.94 (0.79)	3.98 (0.80)	3.80 (0.76)
16	3.92 (0.82)	3.85 (0.80)	3.93 (0.73)
17†	3.65 (0.93)	3.32 (0.92)	3.25 (0.85)
18	4.65 (0.58)	4.77 (0.49)	4.70 (0.55)
19	4.34 (0.70)	4.42 (0.63)	4.52 (0.58)

* significance of the difference between 1999-00 mean score and 2000-01 mean score, $p = 0.576$; between 1999-00 and 2001-02, $p = 0.056$; between 2000-01 and 2001-02, $p = 0.873$
† significance of the difference between 1999-00 mean score and 2000-01 mean score, $p = 0.133$; 1999-00 and 2001-02, $p = 0.036$; and between 2000-01 and. 2001-02, $p = 1.000$

SD = standard deviation
Refer to Table 4 for scale values.

with experiential site visits, a classroom lecture and/or class/small-group discussion (Table 1). During the 1999-2000 and 2000-2001 study years (Tables 5 and 6, respectively), moderate improvements were also seen for objectives 10 (collecting drug information), 11 (identifying important information in patient records), 12 (using appropriate sources of information), and 13 (product characteristics impacting cost or outcomes), while larger improvements (mean score increases > 1.0) were seen for these same objectives during the 2001-2002 study year (refer to Table 8 for a summary and to Tables 5, 6, and 7 for year-specific data). Learning related to all of these objectives (10 - 13) was planned through at least 2 separate learning activities (Table 1). The greater increase in mean self-assessment scores during the 2001-2002 year (Table 7) did coincide with the addition of an introduction to case studies/progress notes primarily

intended to improve learning related to objective 11; the course change will be addressed later in this report. Objective 14 (therapeutic alternatives) also showed a moderate increase in mean student self-assessment scores (0.5 – 0.99 point) during the 2000-2001 and 2001-2002 course years, respectively (Tables 6 and 7), with a larger increase (> 1.0 point) during the 1999-2000 course year (Table 5). This was also a learning objective that involved multiple learning activities within *Pharmacy Practicum II* (Table 1), as well as concomitant subject matter from the Pharmaceutical Care Modules during the fall and spring semesters (Table 2).

The largest improvements in mean self-assessment scores (> 1.0 point) were seen for objectives 8 (describing pathophysiology), 9 (describing pharmacology), and 17 (adverse drug reaction reporting), and occurred in all 3 study years (refer to Table 8 for summary; Tables 5, 6, and 7 for year-specific data). Precourse mean student self-assessment scores were low for these objectives because related subject matter is not introduced until the second curricular year. Although multiple learning activities for these objectives were planned for *Pharmacy Practicum II* (Table 1), there was also significant overlap in concomitant coursework during the second year (Table 2). For example, multiple courses (Biological *Principles of Drug Action and Pharmaceutical Care* Modules I through IV) cover subject matter on pharmacology and pathophysiology (objectives 8 and 9), while the *Drug Information Systems* course introduces adverse drug reaction reporting (objective 17) during the fall semester of the second professional year. This duplication and/or overlap between courses is known and desirable given the nature of the subject matter, the limited class time available for *Pharmacy Practicum II* (only 1 hour per week), and the opportunity to reinforce related classroom subject matter with experiential site visits (80 hours over 2 semesters).

Precourse Comparisons Between Classes (Fall 1999 to 2001)

Although differences can be observed in precourse self-assessment scores between 3 consecutive classes (Table 9), further useful analysis could not be accomplished due to limited information about potential precourse variables. Underlying reasons for differences could certainly be multiple, including variance in the amount of students' work experience at the time they entered their second professional year, and even changes in the first professional year courses that took place over the 3 consecutive years of the study. But such specific information was not captured and therefore cannot be considered. The collection and analysis of additional precourse information could perhaps better explain future differences observed.

Postcourse Comparisons Between Classes (Spring 2000 to 2002)

Postcourse comparison of the 3 consecutive student classes is limited because variables other than course changes in *Pharmacy Practicum II* between years are largely unknown. Analysis was completed for objectives 11 and 17, as substantial course changes in *Pharmacy Practicum II* occurred in relation to these specific learning objectives between years of delivery (Table 1).

The apparent trend toward an increase in mean student-perceived independence during the 2001-2002 year compared with 1999-2000 and 2000-2001 for objective 11 was thought to possibly be related to a course change in *Pharmacy Practicum II* (Table 10). Whereas the learning activities for this objective were initially expected to be largely experiential, a new class topic was added early in the fall semester of 2000 due to general faculty feedback that students were unprepared in this area when beginning *Pharmaceutical Care* Module I late in the fall semester. The new class topic added to *Pharmacy Practicum II* in the fall of 2000 (2000-2001 academic year) consisted of a limited body of patient information via case study, with class discussion about how to identify and utilize significant findings. The case study was further refined the following year (2001-2002), to include full history and physical examination information via progress notes and a requirement that students "work up" the case according to specific guidelines and be prepared to discuss the case in class. The improvement in student-perceived independence at identifying patient information in records (objective 11) correlates well with the timeframe in which the case study/progress note activity was introduced in *Pharmacy Practicum II*, though the statistical analysis showed no significant difference related to the course change (Table 10). Other variables outside *Pharmacy Practicum II* could have also influenced postcourse student rankings for objective 11; case studies in the *Pharmaceutical Care Modules* commonly utilize simulated patient records for case discussion and could also account for this observation.

The apparent trend toward a decrease in mean student-perceived independence postcourse for objective 17 (adverse drug reaction reporting) during the 2000-2001 and 2001-2002 years compared to scores for that objective in 1999-2000 was also thought possibly related to a course change in *Pharmacy Practicum II* (Table 1). During the fall of 1999, students were initially required to evaluate a case study and submit a written report related to an adverse drug reaction. This written activity was changed to an in-class discussion activity beginning in the fall of 2000 to facilitate better understanding of how to complete a report. The change from a written assignment to a discussion activity correlates well with the timeframe during which mean student self-assessment scores declined for both the 2000-2001 and 2001-2002 course years in comparison to 1999-2000 (Table 10), though the change was only significant when comparing the 1999-2000 class with the 2001-2002 class. The decline in student-perceived independence postcourse could be the result of less student effort/preparation

when not required to submit a written adverse drug reaction report, resulting in a lower student ranking of their independence in this area, but other factors cannot be excluded.

Limitations and General Discussion of Self-Assessment

Determining the degree of influence that the *Pharmacy Practicum II* course alone had on student-perceived independence in accomplishing course learning objectives was not possible, as both the known and unknown influences of concomitant coursework and experiential learning outside the curriculum (for those students who also worked as paid interns) could have contributed to the increase in mean scores seen postcourse. This realization was expected given that selection of course objectives took into account the general knowledge, skills, and attitudes that should be acquired during the second professional year, whether through the *Pharmacy Practicum II* course or the curriculum as a whole. The differences in postcourse scores between consecutive years were thought to possibly correlate with course changes for objectives 11 and 17 (Tables 1 and 10), but this was not consistently supported by statistical analysis and there could have been other influencing factors.

There is also the issue of whether the course objectives for *Pharmacy Practicum II* , which were used in the student assessment scale (Table 4), provided valid information on which to base judgments, as formal testing was not performed on these items. Also, an external measure (eg, preceptor assessment) was not used for comparison or correlation with student self-assessment scores, leaving student-perceived rankings as the only observed measures. So although the results provide interesting information for consideration, comparable interest is found in potential applications of self-assessment in pharmacy education.

Since self-directed learning is a common goal in pharmacy education and given that self-assessment provides a logical venue for initial and follow-up monitoring at the individual student level, it seems that efforts toward this end are worthwhile. The use and limitations of self-assessment in health professions and higher education have been reviewed,[4] and applications to pharmacy education have also been recently reported.[5-7] The use of self-efficacy measurements has been proposed for evaluating both experiential rotations and curricular changes,[5] and student perceptions of preparedness have been applied in a longitudinal manner to provide information related to curricular assessment.[6] Student responses related to competencies before and after a third-year IPPE course have also been used to provide information about student learning in relation to a single course.[7]

The experiences and information gained through the use of student self-assessment in the *Pharmacy Practicum II* IPPE course within our curriculum provides a further application of self-assessment in pharmacy education. The value of the process of self-assessment in the *Pharmacy Practicum II* course has been anecdotally positive from student comments provided via a written assignment done after the precourse self-assessment, in which students select areas of perceived weakness and elaborate on means for improving and provide a plan for knowing when they have made progress. The potential introspection gained through self-assessment is appealing and desirable given the ultimate goal of producing practitioners who are self-directed in their learning.

CONCLUSIONS

Student self-assessment in our *Pharmacy Practicum II* IPPE course provided data describing the longitudinal change in student-perceived independence during the second professional year, including the magnitude of change in specific knowledge, skills, and attitudes according to course learning objectives. Student self-assessment was also useful in the interpretation of course changes and the possible effect on student-perceived independence accomplishing specific learning objectives in subsequent years of course delivery. The *Pharmacy Practicum II* IPPE course and concomitant coursework during the second curricular year could be among influencing factors accounting for change in student self-assessment scores within a given year, but other influencing variables cannot be absolutely excluded.

Applications of student self-assessment in pharmacy education should continue to be reviewed and tested as additional means of evaluative data and with cognizance of self-directed learning as a goal while students matriculate through our curricula. The use of external measures of actual student performance relative to the course objectives, as well as defining the target level of postcourse student-perceived independence for course-learning objectives are ideas for future consideration in the *Pharmacy Practicum II* IPPE course. Further study of influencing variables such as student work history will also be considered.

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