OBJECTIVES. To assess the impact of a program to integrate introductory pharmacy practice experiences with pharmaceutical science topics by promoting active learning, self-directed learning skills, and critical-thinking skills.

Design. The Learning Bridge, a curriculum program, was created to better integrate the material first-year (P1) students learned in pharmaceutical science courses into their introductory pharmacy practice experiences. Four Learning Bridge assignments required students to interact with their preceptors and answer questions relating to the pharmaceutical science material concurrently covered in their didactic courses.

Assessment. Surveys of students and preceptors were conducted to measure the effectiveness of the Learning Bridge process. Feedback indicated the Learning Bridge promoted students’ interaction with their preceptors as well as development of active learning, self-directed learning, and critical-thinking skills. Students also indicated that the Learning Bridge assignments increased their learning, knowledge of drug information, and comprehension of relevant data in package inserts.

Conclusion. The Learning Bridge process integrated the didactic and experiential components of the curriculum, enhancing student learning in both areas, and offered students educational opportunities to interact more with their preceptors.

Keywords: student learning, introductory pharmacy practice experience, pharmaceutical sciences
No. 14 that, “The pharmacy practice experiences must integrate, apply, reinforce, and advance the knowledge, skills, attitudes, and values developed through the other components of the curriculum.”11 In addition, ACPE guideline 14.4 states that, “The introductory pharmacy practice experiences should begin early in the curriculum, be interfaced with didactic course work that provides an introduction to the profession, and continue in a progressive manner leading to entry into the advanced pharmacy practice experiences.”11 These statements emphasize that integration between didactic and experiential components of the PharmD curriculum should be a well-defined and well-structured curricular activity.

The American Association of Colleges of Pharmacy’s Center for the Advancement of Pharmaceutical Care (CAPE) encourages faculty members and pharmacy institutions to enrich their curricular outcomes to prepare pharmacists for their evolving important role in pharmaceutical care. 12 The Pacific University School of Pharmacy is a learner-centered environment that delivers a unique modified block curriculum in which one block is taught at a time, with each block varying in length depending on the topic being presented. Within this 3-year curriculum students are encouraged to be active and integrative learners.13 The school’s IPPEs begin the second week of the first year (IPPE 1) and continue throughout the second year (IPPE 2 and IPPE 3), with students spending an 8-hour day at their assigned pharmacy once every other week. Students are assigned to a single IPPE preceptor during their first year, in which their tasks are legally limited to the functions of a pharmacy technician.

Theoretically, beginning IPPEs early in the curriculum would allow students the opportunity to correlate and apply didactic classroom materials with practice experiences throughout their first year. However, assessments of P1 students conducted at the conclusion of the 2007-2008 academic year indicated that students did not perceive a strong connection between the didactic curriculum and the activities performed in IPPE 1. Therefore, we designed the Learning Bridge, a method to build a curricular connection between the didactic pharmaceutical sciences and the activities performed in IPPE 1. The desired outcomes for the Learning Bridge program were to promote active learning and integration of didactic and experiential materials; increase the educational productivity of IPPEs for students; and assess the impact of Learning Bridge activities on student learning.

**DESIGN**

A significant portion of the P1 didactic curriculum is comprised of basic biomedical and pharmaceutical sciences. Although clinical correlate cases and activities are incorporated regularly into the P1 curriculum, a hands-on activity where students could apply their knowledge to answer a pharmacy site-related question within the experiential setting might be expected to strengthen the learning of concurrent didactic materials. Learning Bridge assignments were therefore designed to positively impact learning in both the experiential and didactic realms.

An integrated team composed of pharmaceutical science, pharmacy practice, and social administrative faculty members, as well as the academic coordinator for experiential education and the coordinator for academic affairs and assessment, developed recommendations for the design, implementation, evaluation, and feedback process for the Learning Bridge assignments, as well as the responsibilities of all parties involved (Table 1). In addition to student learning, preceptor-student communication and interaction also were of particular interest to us. Therefore, the Learning Bridge process was designed such that students were strongly encouraged to work on the assignments at their pharmacy sites on the IPPE days, and preceptors were asked to provide time at the site for Learning Bridge completion and discussion. The curriculum emphasized active learning and critical-thinking skills; an emphasis supported by ACPE.14 Likewise, the Learning Bridge assignments were intended to promote students’ active learning and critical-thinking skills. The final Learning Bridge design incorporates 3 components of Fink’s Taxonomy: foundational knowledge, application, and integration into student learning.15,16

The Learning Bridge process was pilot tested in fall 2008 with 4 assignments (Table 2). P1 students were oriented to the Learning Bridge process, criteria, and expectations. In addition, the academic coordinator for experiential education introduced preceptors to the Learning Bridge process and criteria through the Education Management System, and emphasized the importance of providing student support. Prior to each biweekly IPPE day, the faculty member in charge of the concurrent didactic block generated a Learning Bridge assignment using the general guidelines listed in Table 3. An example assignment can be found in Appendix 1. The Learning Bridge questions were carefully chosen to reflect the didactic material and to be feasible for students to complete at a pharmacy practice site in approximately 1 hour. In addition to answering the Learning Bridge questions, students were required to review at least 1 drug package insert relevant to the Learning Bridge assignment and obtain their preceptor’s signature on this document. Pharmaceutical science and pharmacy practice faculty reviewed the assignments, as did the academic coordinator for experiential education, to ensure the quality and feasibility of each Learning Bridge assignment. The assignment was distributed...
electronically to P1 students and preceptors 1 day prior to the IPPE day on which it was to be completed. Blackboard (Blackboard, Inc., Washington, DC) was used for posting Learning Bridge assignments for students, and for collecting and grading student responses, while communication with preceptors occurred via e-mail.

A two-step process was used to “close the loop” for each Learning Bridge assignment. First, the faculty member used the online Blackboard tool to review each individual student response, assign a grade of “pass” or “no pass,” and provide individual feedback. Second, during an in-class 20-minute wrap-up session, the faculty member presented general feedback to the group as a whole, facilitated discussion, and answered any student concerns or questions in regard to the assignment. Approval was sought and granted by the Pacific University Institutional Research Board for the completion of this study.

EVALUATION AND ASSESSMENT
The effectiveness of the Learning Bridge process as an integrative learning tool was assessed at the conclusion of the fall semester after the 4 pilot assignments had been completed. We had intentionally omitted Learning Bridge assignments from the first, second, and last IPPE days of the fall semester in order that these IPPE days could serve as a negative control for IPPE days that included Learning Bridge assignments. Two surveys were conducted to measure the intended outcomes. First, an anonymous survey of students, administered electronically via Blackboard, evaluated their perceptions of their learning during the Learning Bridge process. The second survey was used to obtain preceptors’ input and opinions about the role the Learning Bridge process played in student learning and to gauge what improvement was necessary to maximize the effectiveness of the entire Learning Bridge process. Students and preceptors were given 1 week to complete the survey instruments. Approval was sought and granted by the Pacific University Institutional Research Board for the completion of this study.

**Table 1. Learning Bridge Design, Roles, and Responsibilities**

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| **Faculty Member in Charge**| Didactic block coordinator coordinates the development of an assignment for students to complete during a given IPPE day covering material currently being taught didactically in the block.  
  * Answer key is supplied to the preceptor before the IPPE day |
| **Evaluation of Learning Bridge Assignments** |  
  * Allocate assignment grade as “Pass” or “No Pass” according to the predefined key.  
  * Document grade in electronic system.  
  * Provide individual electronic feedback to students  
  * Present general feedback to students following assessment of student performance in the Learning Bridge assignments. Invite other interested faculty to participate in this activity. |
| **Students** |  
  * Communicate the Learning Bridge requirements to preceptor and organize a timeframe to complete the assignment.  
  * Complete any preparatory work prior to attending the IPPE  
  * Actively engage in the assignment and link to the didactic materials  
  * Discuss the assignment with preceptor or designee  
  * Complete assignment and turn in by designated day/time |
| **IPPE Coordinator** |  
  * Learning Bridge dissemination and coordination with preceptors  
  * Electronic postings of assignments and preceptor key |
| **Preceptor** |  
  * Provide student time to work on assignments  
  * Be prepared to discuss the assignment with the student during the IPPE day |

**Table 2. Description of Learning Bridge Pilot Study Assignments**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antifungal medication and the role of antibiotics on translation</td>
<td>Critical thinking/application questions</td>
</tr>
<tr>
<td>Proton pump inhibitors, the effect of Ca$^{2+}$ and Mg$^{2+}$ on drug absorption, and the negative impact of NSAIDs</td>
<td>Critical thinking/application questions</td>
</tr>
<tr>
<td>Obesity, hyperlipidemia and type II diabetes</td>
<td>Critical thinking/case study</td>
</tr>
<tr>
<td>The importance of nutrition and vitamins and their impact on patient care</td>
<td>Critical thinking/application questions</td>
</tr>
</tbody>
</table>
The student and preceptor surveys were organized into sections based on the 3 desired outcomes: the Learning Bridge process promotes active learning; increases the educational productivity of IPPE days for students; and promotes student learning and integration of didactic and experiential materials (Table 4). Definitions for critical-thinking skills, self-directed learning, and active learning were included in the survey instrument.

Quantitative responses were based on a Likert scale ranging from strongly agree to strongly disagree. Strongly agree and agree responses for each item were combined, with a combined percentage equal to or greater than 75% of respondents indicating a significant level of agreement on that statement. The student survey instrument also included the following qualitative questions:

1. Which of the 4 Learning Bridge topics represented your best work and why?
2. Describe at least 2 ways that the Learning Bridge assignments made your IPPE days more productive.
3. Please provide your suggestions for Learning Bridge improvement.

The results of the student and preceptor surveys provided evidence of student learning (Tables 5 and 6). The majority of preceptors and students (86%-88%) agreed that Learning Bridge assignments promoted critical-thinking, self-directed learning, and active-learning skills. Both students (85%) and preceptors (85%) stated that student drug information knowledge was increased by Learning Bridge assignments. Additionally, in a comprehensive examination at the end of the P1 year, 15 questions were based on the 13 Learning Bridge assignments carried out during the year. The mean score ± SD for these questions was 90% ± 11%. Students agreed that the requirement to study drug package inserts increased their drug knowledge (78%), and most preceptors indicated that their students made progress in interpreting relevant package insert data over the course of the semester (82%). Eighty-five percent of students indicated that the Learning Bridge process assisted them in learning didactic materials. Qualitative feedback was generally positive, with students indicating the Learning Bridge assignments “helped me to learn and understand and remember lectures much more” and “were very useful to synthesize and integrate didactic materials.”

As students were expected to perform many pharmacy practice tasks during their IPPE day, we were interested to know how much time, on average, the Learning Bridge assignment took to complete at their sites. Seventy-eight percent of students spent 0-90 minutes completing their Learning Bridge assignments, 10% spent 90 minutes to 2 hours, and 12% spent more than 2 hours. Students spent approximately 20% of a given IPPE day on the Learning Bridge assignment (a total of 6 Learning Bridge hours/56 IPPE hours in 1 semester). Similarly, we asked preceptors about the time they invested working with their students on a Learning Bridge assignment on a given IPPE day. Sixty-eight percent of preceptors spent 0-30 minutes, and 21% spent 31-60 minutes. A few preceptors commented that the Learning Bridge time commitment needed to be reduced.

Seventy-five percent of students believed that the Learning Bridge process facilitated preceptor-student...
communication at their sites, whereas 88% of preceptors stated that the Learning Bridge assignments encouraged them and their students to communicate and to review and identify steps needed to find accurate information for the assignments. Eighty-nine percent of students believed the Learning Bridge assignments made their IPPE days more productive in terms of learning both didactic and experiential materials. Specific student comments pertaining to how the Learning Bridge process made the IPPE day more productive included: “allowed my preceptor and me to engage in a way that facilitated active learning and conceptual applications”; “provided another opportunity to hear the opinion and knowledge of my preceptor”; and “helped to provide me with more of a focus as to what I needed to accomplish that day.”

Students were asked to review their responses to each of the 4 Learning Bridge assignments, identify which topic(s) demonstrated their “best work,” and explain their choice. More than 60% identified the last 2 Learning Bridge assignments as their best work (Table 2). Approximately 97% of students received a grade of pass on each of the 4 Learning Bridge assignments.

### DISCUSSION

Students learn better when they are actively engaged in their learning. Active learning enhances a student’s ability to think in an independent and critical manner and is an important aspect of the Learning Bridge process. The majority of students and preceptors believed the Learning Bridge assignments promoted students’ active learning at the pharmacy site. We believe that the success of this activity in promoting active learning is based on the students’ prior understanding of the relevant didactic material, their inherent interest in applying this understanding to the pharmacy practice environment, and the role of preceptors as mentors in helping students to identify next steps and critically evaluate options.

### Table 5. Student Responses to Quantitative Questions in a Survey Regarding the Learning Bridge (N = 94)

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Strongly Agree and Agree</th>
<th>Neutral</th>
<th>Strongly Disagree and Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Learning Bridge assignments promote your critical-thinking skills.</td>
<td>88</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2. The Learning Bridge assignments promote your self-directed learning skills.</td>
<td>88</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>3. The Learning Bridge assignments promote your active learning.</td>
<td>86</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>4. In working with the Learning Bridge assignments and comparing, analyzing, and selecting the right drugs, you believe you have improved your knowledge base of drug information.</td>
<td>85</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>5. The Learning Bridge assignments facilitate your learning of the didactic materials.</td>
<td>85</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>6. On average the Learning Bridge assignment requirement to review package inserts gave you new information that made you more knowledgeable about drugs.</td>
<td>78</td>
<td>14</td>
<td>8</td>
</tr>
</tbody>
</table>

### Table 6. Preceptor Responses Quantitative Survey Questions Regarding the Learning Bridge (N = 34)

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>Strongly Agree and Agree</th>
<th>Neutral</th>
<th>Strongly Disagree and Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In your opinion as preceptor, do the Learning Bridge assignments encourage your student to critically interpret and evaluate a concept or a problem in order to synthesize or find an accurate answer to a question.</td>
<td>88</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>2. The Learning Bridge assignments increased students’ self-directed learning skill.</td>
<td>88</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>3. The Learning Bridge assignments increased students’ active learning?</td>
<td>88</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>4. You believe your student has improved their knowledge base of drug information based on the Learning Bridge assignments.</td>
<td>85</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>5. You believe your student has made progress in interpreting relevant data in the package inserts.</td>
<td>82</td>
<td>18</td>
<td>0</td>
</tr>
</tbody>
</table>
Promoting self-directed learning skills is a challenging process for faculty members and students. However, observation of student self-directed learning assists faculty in assessing what students have learned. In a self-directed learning process, the student is encouraged to use his/her own knowledge, explore the available resources, and make an informed judgment when selecting the answer to a question. The learning that students acquire from Learning Bridge assignments completed in a pharmacy practice setting expands on what they have gained from traditional classroom activities. In traditional classroom learning, students learn by focusing on facts and ideas from teachers, lecture notes, and peers. In Learning Bridge assignments, students bring this acquired knowledge into a pharmacy practice site and pursue additional knowledge by independently focusing on the actual drug information available at a pharmacy practice site. The vast majority of students and preceptors indicated that they believed the Learning Bridge assignment encouraged students to be self-guided in their learning.

A student comment commonly seen in experiential evaluations is “my preceptor did not spend enough time with me at my pharmacy practice site.” This comment may reflect a lack of interaction between each party, perhaps not so much due to workload, but to lack of direction or specific expectation as to what exactly would be most helpful to discuss with the student. We believe a well-written Learning Bridge assignment can encourage (and motivate) a student to proactively discuss and share his/her ideas for doing the assignment, thereby increasing interaction and communication between the student and preceptor. A strong majority of our students and preceptors believed that discussion of Learning Bridge assignments facilitated student-preceptor communication.

Reviewing and understanding information in a package insert can be a challenging task for students, particularly for P1 students with limited exposure to the pharmacy field. One of the Learning Bridge process goals, which turned out to be one of the significant student learning experiences in our study, was to encourage students to review and interpret drug package inserts and discuss their findings with their preceptors. This activity gave students a chance to practice skills introduced during their drug information block. Indeed, preceptors’ direct observation of their students led to the conclusion that their students made progress in interpreting relevant data in the package inserts as a result of the Learning Bridge process (Table 6). These results could explain why students felt their knowledge about drug information increased as a result of the Learning Bridge assignments (Table 5).

The survey instruments also pointed out ways in which the Learning Bridge process could be improved. The third Learning Bridge was preferred by students because it was presented in a case format. These self-reflection results assisted faculty members in generating more effective Learning Bridge assignments using a case format for the remainder of the academic year. As there are other tasks that both students and preceptors need to do at the practice site, we also collected information on the time spent on Learning Bridge assignments. Based on student and preceptor survey comments and the high level of passing grades awarded on the assignments, the amount of time spent at the site appears to be sufficient to thoroughly address the material, yet not prohibitively time-consuming for most preceptors. A few preceptors felt the Learning Bridge time commitment ideally should be reduced. Future studies will determine an optimal duration for the Learning Bridge activity.

Although our goal was to see if the Learning Bridge process could increase educational productivity, we were only able to obtain qualitative data supporting the achievement of this goal from the survey instruments administered. Ideally, we would like to determine whether the Learning Bridge assignments helped students retain information. Learning Bridge questions were included in the comprehensive end-of-year examination, and the majority of students scored highly on these questions. However, without having a control group from which to draw a comparison, it is not possible to separate the learning retention that occurred as a result of completing the Learning Bridge assignments from that which occurred from a myriad of other learning opportunities afforded during the year.

In order to increase the validity of survey results, it is critical to identify how well the sample represents the targeted population in the study. Due to the anonymity of the preceptor survey, we were unable to associate preceptor responses with any other specific preceptor factor (years of experience, gender, etc). On the other hand, all IPPE preceptors who were surveyed were in community pharmacy practice in the Portland, OR, metropolitan area.

There were a few barriers to employing the Learning Bridge process as designed. First, not all pharmacy sites filled all of the medications that students were asked to work with. For instance, a few students who were assigned to compounding pharmacies encountered difficulty finding relevant package inserts. Second, a few students (approximately 5%) completed the entire Learning Bridge assignment outside of their pharmacy practice site. These students may have completed their work at home because of a real or perceived lack of time during practice site hours. Third, the preceptor respondent rate (36%) was significantly lower than the student respondent rate (100%). We did not send paper copies of the survey
instrument to preceptors, and that may have been a more accessible format, particularly for those without Internet access at their practice site. Fourth, establishing and facilitating a student learning tool such as the Learning Bridge required extra time and effort on the part of the faculty. Faculty members’ interest in and focus on writing successful Learning Bridge assignments was facilitated in several ways: (1) it was clearly explained that integration of didactic material with experiential activities would increase students’ appreciation of the value of the didactic section (faculty members always want to feel their material is appreciated); (2) Learning Bridge assignments were kept reasonably short (4-5 questions each); and (3) some structure was provided for assignment creation (Table 3). The outcomes of increased student learning and the opportunity for students to promote self-directed learning skills and active-learning and critical-thinking skills justify the time and energy it takes to apply this learning tool.

After reviewing the favorable pilot data, the Learning Bridge was continued throughout the 2008-2009 P1 year for 13 case-based or critical thinking assignments. Two improvements were implemented in the spring semester 2009: more case-based assignments were developed, and a key for each assignment was provided to preceptors to facilitate their interaction with their student. The Learning Bridge is now incorporated into the core of our program curriculum, with ongoing assessment and preceptor development.

**SUMMARY**

Learning Bridge assignments integrated didactic and experiential portions of the curriculum to facilitate student learning and have offered students educational opportunities to interact more with their preceptors. A significant number of students and preceptors perceived that student critical-thinking, active learning, and self-directed learning skills were promoted by the Learning Bridge assignments. The Learning Bridge pilot results were sufficiently encouraging to incorporate the Learning Bridge process into our core curriculum, with ongoing data collection and analysis to assess the educational impact.

**ACKNOWLEDGMENTS**

The authors would like to thank P1 preceptors and students (class of 2011) who diligently participated in this study. In addition, our sincere thanks go to Stephanie Morrison, Becky Shipman and Professors Joe Bonnarens, Jeff Fortner, Brad Fujisaki, Naushad Ghilzai, John Harrelson, Mike Millard, Vedavalli Pokala, and Susan Stein who contributed to the success of the Learning Bridge process.

**REFERENCES**

Appendix 1. Example of a Learning Bridge Assignment

**Learning Bridge Assignment No. 4: The importance of nutrition and vitamins and their impact on patient care**

Related didactic unit: Dietary Nutrition with Clinical Correlates. Didactic materials covered biochemistry and roles of micronutrients, dietary guidelines, pathological conditions caused by vitamin deficiency, and nutrient-nutrient and nutrient-drug interactions. The following questions were included in the Learning Bridge assignment.

1. Use the pharmacy computer to look up one vitamin A-, vitamin D- or vitamin B12-related drug that is carried by your pharmacy (examples: tretinoin/Retin-A, isotretinoin/Accutane, calcidiol/Calderol, calcitriol/Calcijex, B12 (injection), B12 nasal spray/Calomist or B12 nasal gel/Nascobal).
   a. Use the computer or consult with members of the pharmacy team to determine roughly how often this drug is sold by your pharmacy.
   b. Use a drug information database to describe briefly the disease state(s) it is useful for treating (reference the database in your answer).
   c. If you find that one or more of these drugs is not available in your pharmacy, please note that as well.

2. Talk to your preceptor about ways that nutrition impacts patient care in your pharmacy, and highlight two disease states or drugs (OTC or prescription) that elicit the most nutrition-related concerns in your pharmacy.

3. Obtain a package insert for one of the following: (1) warfarin/Coumadin, (2) oral levofloxacin/Levoquin, or (3) Orlistat/Xenical. Use this package insert to answer the following questions:
   a. What vitamin or mineral is affected by, or affects, this drug? Note your answer in your written work and also highlight the relevant section on the package insert.
   b. Describe the mechanism of the unfavorable drug-nutrient interaction, and be sure to mention if drug activity and/or vitamin activity are/is compromised by the interaction (be concise – two or three sentences should be sufficient).
   c. What suggestions are given in the package insert for getting the recommended daily amount of this vitamin or mineral and/or still having effective drug activity? Highlight any information given in the package insert, and also provide your own written assessment of how you might counsel a patient taking such a drug on how to get adequate nutrition while not interfering with the drug’s absorption or activity. Use what you have learned in class to answer this question, and again, limit your response to a few sentences.

4. Talk about your answer to 3c with your preceptor or another member of the pharmacy team, and describe what he or she mentions to patients prescribed this drug about nutrition, if anything. If nutrition information is not normally part of his or her counseling on this drug, describe why. If you are rotating in a compounding pharmacy this question is not required.