

INSTRUCTIONAL DESIGN AND ASSESSMENT

A Capstone Advanced Pharmacy Practice Experience in Research

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Submitted June 11, 2010; accepted August 23, 2010; published December 15, 2010.

Objective. To implement a required capstone experience in research for pharmacy students, assess course outcomes, and solicit mentors' and students' opinions regarding the structure and efficacy of the course.

Design. Fourth-year pharmacy students chose a research project, selected a mentor, and completed a 5-week capstone advanced pharmacy practice experience (APPE), during which they wrote a research paper and presented their research at a poster session.

Assessment. Eighty students completed the capstone experience in 2008-2009 and 56 faculty and non-faculty pharmacists served as mentors. Based on their responses on a course evaluation, the students' experience with their mentor and course instructor were positive. Thirty-one mentors completed a survey on which they indicated their overall support of the capstone project, but wanted their role to be better defined and felt the students needed to have additional training in statistics, survey question design, and the IRB process before completing the APPE.

Conclusion. The capstone APPE was perceived by students and mentors as a positive learning experience that allowed the student to take information from the curriculum and apply it to a real-world situation. Additional research is needed to determine whether pharmacy students will use the research skills acquired in their future careers.

Keywords: advanced pharmacy practice experience, research, curriculum

INTRODUCTION

In higher education, a capstone experience is a culminating experience in which students are expected to apply knowledge gained from the curriculum to a personal or academic experience, where the focus is on synthesis and integration rather than acquiring new knowledge and skills.^{1,2} Capstone experiences can be organized as: (1) an interdisciplinary course; (2) a discipline-based course that pulls together learning from the program of study; or (3) a course or series of activities that permit students to demonstrate their applied knowledge relative to an external requirement or competence.² However they are structured, the pedagogical approaches necessary for student enjoyment and success depend on the presence of several factors: collaborative learning, self-directed learning, problem-based learning, and other learner-centered instructional strategies that encourage critical-thinking, integration, reflection, and synthesis.² Thus, the activities or assignments in the capstone experience should require students to apply the knowledge gained in the course

lecture portion of the curriculum to a real-world situation using higher-order thinking skills.

Many disciplines use capstone experiences or senior projects to assess student learning across the curriculum, eg, sociology,^{3,4} engineering,⁵ and accounting.⁶ Additionally, many colleges and universities have adopted the capstone or senior assignment as part of their institution's assessment program.⁷ The methods used to assess students' work are discipline-specific and range from basic to rigorous. Basic methods include requiring students to present their work publicly as an exhibit, performance, or poster that is judged in some way. An example of a rigorous approach involves systematically analyzing projects for evidence of program quality and using this information to make curricular changes.⁷ Whichever method is used should provide useful insight into the strengths and weaknesses of the curriculum.

Since 1988, 3 studies have described the role of research in doctor of pharmacy (PharmD) programs across the United States.⁸⁻¹⁰ These studies looked at the percentage of programs that required research coursework and a research project that included data collection, analysis, and a written report with or without a presentation. They found that the percentage of programs that required coursework in research methods essentially remained the

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same from 1988 (50%) to 1997 (54%) to 2007 (53%). The percentage that required a course in drug information/literature evaluation rose from 78% in 1988, to 98% in 1997, and then decreased to 94% in 2007. The percentage that required an extensive research project was 22% in 1988, dropped to 14% in 1997, and rose to 15% in 2007.

Since 1992, Southern Illinois University Edwardsville has required all undergraduates to complete a senior assignment that demonstrates educational competency within the academic major.¹¹ This requirement arises from the university's belief that the ability to integrate a general education perspective into one's academic discipline is an essential mark of a university-educated person.¹² The university's Senior Assignment program was ranked as a national model for learning assessment by the Association of American Colleges and Universities in January 2007.¹³ For 4 consecutive years, Southern Illinois University Edwardsville has been recognized by *US News and World Report, America's Best College Rankings*, as among the top 17 in the nation in the senior capstone experience category for its comprehensive program measuring the competency of graduating seniors.¹⁴

Within broad limits, the structure of the senior assignment is defined by each of the schools within the university. The broad limits are defined as: (1) each student must demonstrate a grasp of general education as well as the major discipline itself; (2) the assessment must be high stakes to assure motivation; and (3) the departmental faculty members must view and assess the results.¹⁵

The designers of the curriculum (a committee consisting of the founding dean, 3 administrators, and 3 faculty members) at Southern Illinois University Edwardsville School of Pharmacy integrated the Accreditation Council on Pharmaceutical Education (ACPE) Standards 2007,¹⁶ the Center for the Advancement of Pharmaceutical Education (CAPE) outcomes,¹⁷ and the university requirement for a senior assignment to create the capstone experience. Specifically, ACPE Guidelines Standard 13.3 states that the curriculum should address issues that include a number of topics, such as communications, professionalism, critical-thinking, and problem-solving. Guideline 15 states that the school must develop and carry out assessment activities to collect information about the attainment of desired student-learning outcomes.¹⁶

The curriculum designers decided that the capstone experience should be a 5-week APPE in research that required students to create and implement a research project using knowledge and skills from the class lecture portion of the curriculum, and then applying higher-order thinking skills of analysis and synthesis. The capstone experience was designed as a 3-credit-hour APPE rather than a 6-credit-hour APPE because (1) the scope of the capstone

project was intended to be relatively small with few variables and most students would be able to complete it in 120 hours; and (2) with the required 3-hour capstone experience, the total numbers of hours completed by our students would be 1520, compared to the 1440 total experiential hours required by ACPE guidelines.¹⁶ The purpose of this paper is to describe the capstone research experience developed by Southern Illinois University Edwardsville School of Pharmacy, and to report the results from a student course evaluation and a mentor's course survey after the first year.

DESIGN

The required capstone experience consisted of a 1-credit-hour APPE preparation course, a 3-credit-hour APPE, a written paper, and a poster presentation. The experience began with the APPE preparation class in the spring of the third year (P3). The class introduced students to the types of APPEs they would complete and what would be expected of them, including in the capstone experience. Class topics for the capstone portion included a review of research design, statistical methods, literature search strategies, survey questions, and elements of a research paper.

In the fourth year (P4), students completed the requirements for the capstone experience, which included a declaration for their capstone project, completion of the 5-week capstone module, a written paper which followed the *International Committee of Medical Journal Editors Uniform Requirements for Manuscripts Submitted to Biomedical Journals*,¹⁸ and a poster. The students began by identifying the project and a mentor, who could be a preceptor, faculty member, employer, or other interested pharmacist. General project categories included bench research (eg, using the scientific method in a laboratory to test a hypothesis), business (eg, creating a business plan for an immunization program in a community pharmacy), clinical services (eg, using retrospective patient data to revise an existing hospital protocol), educational services (eg, surveying colleges and schools of pharmacy regarding their service-learning activities), and other pharmacy-related topics (eg, using computer technology to enhance patient care). The next step was for the student to complete a project declaration for approval by both the mentor and the capstone coordinator. If applicable, the student also had to submit the project for approval by the Southern Illinois University Edwardsville Institutional Review Board (IRB) and the APPE site's IRB when required.

The student was assigned to a 5-week capstone block as part of the APPE scheduling process. Of the 8 modules available, capstone modules could not be scheduled for

modules 1 and 2 because students needed exposure to clinical practice through other APPEs before starting their research project. Module 8 also was excluded because it coincided with the due dates for the final paper and poster. Thus, approximately 15 students were assigned to each of the remaining 5 modules, which began in late July through early February.

Once a mentor was identified and the project was approved by the capstone coordinator, the student began work on the project. Students were required to communicate weekly (in person, by telephone, or e-mail) with the mentor, and document a minimum of 120 hours of work on the project during the 5-week module. During the 5-week capstone APPE, the student gathered background information, collected data, analyzed the data, and wrote a rough draft of the project. The rough draft first was submitted to the mentor for review and comment, and then revised and submitted to the capstone coordinator, who evaluated and graded the project. The rough draft had to be submitted by the end of the 5-week module. If necessary, students continued to work on the project after the 5-week period, but the additional hours of capstone work could not be completed during other APPEs or employment.

A grading rubric was developed to assess students' communication skills, ability to synthesize information, and time management skills. The communication element covered parameters such as grammar and spelling. The synthesis element covered the structure of the paper and whether the student followed a scientific research model; included an adequate literature search strategy; applied appropriate methods to gather the data, used appropriate statistical methods to obtain the results; and reached an appropriate conclusion based on the outcomes of the study. Time management was assessed based simply on whether the draft was turned in on time, which was by the end of the 5-week capstone module.

The capstone coordinator returned the graded rough draft to the student for review and revision. The final paper first was submitted to the mentor for feedback, and then revised and submitted by the beginning of April to the capstone coordinator, who evaluated and graded the paper. A rubric similar to the one used for grading the rough draft was created to grade the final paper, and focused on communication, synthesis of information, and reference format. The main differences between the rubrics were the extent to which the papers were analyzed for spelling/grammar errors, appropriate depth of background information, formulation of an appropriate conclusion from the data, and appropriate use of references to achieve a passing score.

The last requirement was to create a poster for the project and present it at the first annual Pharmacy Poster

Day on campus. In preparation for poster day, invitations were sent to all pharmacy faculty members and administration, university faculty members and administration, all mentors who assisted students with projects, and other interested pharmacists from the community. To receive their final grade for the capstone experience, all students were required to have a poster and be present at the poster exhibit and able to answer questions about their project from faculty members. A poster grading rubric was developed and used by the capstone coordinator to grade the posters. This rubric focused on communication (spelling and grammar and poster appearance) and the effectiveness of the required elements (background, methods, results, and conclusion sections).

A poster contest also was held in which the posters were judged on the following criteria: (1) content: clearly defined objectives, appropriate methodology, analysis of data and conclusions drawn from the results of the study; (2) appearance: overall clarity and design of the poster; (3) presentation: ability of the author to answer questions about their project. One poster received the best poster award and 3 posters received honorable mentions.

The capstone experience was graded based on 2 components: the P3 preparation class, which was assigned a pass/fail grade; and the capstone APPE, which was assigned a letter grade. Points were awarded based on the following: 10% project declaration, 20% rough draft, 20% poster, 40% final paper, and 10% communication with mentor and capstone coordinator. As stated, rubrics were created to grade the project declaration, rough draft, poster, and final paper. Communication with the mentor was recorded on a time log during the course, and communication with the capstone coordinator was tracked from e-mail messages. All written material and rubrics used were returned to the student after grading was complete.

EVALUATION AND ASSESSMENT

There were 80 students in the inaugural class at SIUE School of Pharmacy. Seventy-six posters were presented on poster day, which included 4 projects that were group projects (maximum of 2 students in any 1 group). The projects were grouped into categories based on the method used to complete the project and included 6 bench research projects, 13 business plans, 20 survey-based projects, 31 guideline or drug utilization reviews, and 6 classified as other. Table 1 provides the demographics of the mentors for the capstone projects for 2008 and 2009.

The mentors were invited to participate in a course assessment survey using SurveyMonkey (SurveyMonkey, Palo Alto, California) in February 2009. At the time of the survey, the program was only in its ninth month and students had not completed their posters. The primary focus

Table 1. Demographics of Pharmacist Mentors Who Participated in a Capstone Research Project for Doctor of Pharmacy Students

Demographic	Mentors (n = 80)	Project Location (n = 47)
Faculty	33	
Pharmacy Practice Department	26	
Pharmacy Science Department	7	
Non-faculty	47	
Preceptors	37	
Employers	9	
Other	1	
Project locations		(Non-faculty)
Belleville, IL		8
Central IL ^a		12
Edwardsville, IL		4
Springfield, IL		9
St. Louis, MS		11
Other states (IA, SC, SD)		3

^a 100 mile radius of Champaign, IL

of the survey was to obtain the mentors' feedback on the experience up to that point in the program. Suggestions for improvements to the program for the following year were solicited. Fifty-six faculty and non-faculty members served as mentors (20 faculty members served as mentors on 2 projects). All 56 mentors were e-mailed and invited to complete the survey instrument; 2 e-mails were returned as undeliverable. Thirty-one individuals completed the survey instrument for a response rate of 57.4%. The survey instrument contained 6 items requiring Likert-scale responses and 3 items requiring written responses. Responses to the items can be seen in Tables 2 and 3. In their written responses to items 7-9, mentors indicated they wanted a more defined role in the capstone project, felt the students needed an additional refresher (to that provided in the APPE preparation class) in the areas of statistics, survey question design, and the IRB process, and wanted more consistency in the depth of student projects.

Students were asked to complete a 20-item course evaluation for the capstone experience at the start of pre-commencement activities in May prior to graduation. Thirteen items required Likert-scale responses and 6 required short-answer responses. Eighty survey instruments were distributed, and 77 returned for a response rate of 96.3%. Three of the returned survey instruments were incomplete. Tables 4 and 5 summarize the results from the course evaluation. The short-answer questions provided suggestions for changes to the capstone experience,

Table 2. Responses of Mentors Who Participated in a Capstone Research Project for Doctor of Pharmacy Students

Survey Question	Response, No. (%)^a
Please define your relationship to the SIUE School of Pharmacy.	
Faculty	12 (39)
Preceptor	11 (35)
Employer to mentee	5 (16)
Other	3 (10)
The 120 hours of time allotted to the capstone project was:	
Not enough	5 (16)
Appropriate	24 (77)
Too much	2 (7)
The biggest challenge presented during the capstone experience process was:	
Answered	26 (84)
Skipped	5 (16)
If you could make one improvement in the capstone process, what would that be?	
Answered	22 (71)
Skipped	9 (29)
Any other general comments about the capstone project or experience you would like to share?	
Answered	16 (52)
Skipped	15 (48)

^a n = 31

which included: posting a list on Blackboard Academic Suite (Blackboard, Inc, Washington, DC) of mentors and projects available for students who needed assistance finding a project and/or mentor; providing the logistics for poster day; explaining the IRB process better; explaining capstone expectations in greater detail; possibly offering the experience as an elective so that students would have a choice of completing the research project or another elective.

DISCUSSION

The strength of the capstone experience is that it requires students to use knowledge and skills from the course lecture portion of the curriculum and apply them to a pharmacy-related research project using the higher-order thinking skills of analysis and synthesis. One example is the business plan presented by 1 of the students. In the Health Systems or Community Management course, students learned the importance of the various components of a business plan. As a capstone project, the student created a simplified business plan to determine if offering immunizations in the pharmacy during influenza season would be a successful venture for the pharmacy.

Other examples of students using the knowledge and skills from the didactic portion of the curriculum can be

Table 3. Likert-scale Responses to Survey Questions from Capstone Mentors

Survey Question	Response (n=31)					Mean	Median
	SA (1)	A (2)	N (3)	D (4)	SD (5)		
I could use the results from the capstone project to benefit my facility/research.	9	17	3	0	2	2.0	2
The student met with me on a regular basis and kept me informed throughout the process.	9	15	4	2	1	2.1	2
The student submitted their written work to me (ie, project declaration, rough draft) for feedback in a timely manner.	8	12	6	3	2	2.3	2
I would be willing to work with another student on a capstone project.	11	15	4	0	1	1.9	2

Abbreviations: SA = strongly agree; A = agree; N = neutral; D = disagree; SD = strongly disagree.

seen in those projects using retrospective chart review. The scientific method is introduced to students in the general chemistry and biology courses in the prepharmacy curriculum and applied to pharmacy in the drug literature and evaluation and the pharmaceuticals classes

in the P1 year. The scientific method is applied again to patient information in the therapeutic sequence in the P2 and P3 years. In their capstone projects, students defined a question, reviewed the literature, collected data, and drew a conclusion based on results of the study. Examples

Table 4. Doctor of Pharmacy Students Likert-scale Responses on a Course Evaluation for the Capstone Experience

Survey Question	Response ^a					Mean	Median
	SA (1)	A (2)	N (3)	D (4)	SD (5)		
1. The capstone preparation class prepared me for the capstone experience.	4	25	26	21	1	2.7	3
2. The materials available on Blackboard provided clear direction on what was expected for the capstone experience.	10	39	19	8	1	2.4	2
3. My mentor provided guidance and direction for the capstone project.	30	31	9	5	2	2.0	2
4. My mentor for the capstone project provided feedback on the rough draft.	36	21	9	9	2	2.0	2
5. My mentor for the capstone project provided feedback on my poster before printing.	25	18	15	12	6	2.4	2
6. My mentor for the capstone project answered my questions in a timely manner.	37	25	6	7	1	1.8	2
7. The instructor for the capstone experience provided guidance and direction.	20	43	9	4	0	2.0	2
8. The instructor for the capstone experience provided feedback on my rough draft.	34	37	5	1	0	1.7	2
9. The instructor for the capstone experience answered my questions in a timely manner.	32	40	3	2	0	1.7	2
10. The capstone project required too much work for a 3-credit hour course.	13	29	21	12	2	2.5	2
11. The minimum of 120 hours for the capstone project was accurate.	9	34	21	8	5	2.6	2
12. Creating a capstone poster was a waste of time.	2	18	20	30	7	3.3	3
13. I found creating the capstone project was one way to apply material learned in the classroom to a real life situation.	5	30	19	17	6	2.9	3

Abbreviations: SA = strongly agree; A = agree; N = neutral; D = disagree; SD = strongly disagree

^a n = 77 except for questions 5-7 where n = 76

Table 5. Doctor of Pharmacy Students Responses on a Course Evaluation for the Capstone Experience, N = 77

Survey Question	Response, No. (%)	
14. Was the information gathered from the capstone project used by the mentor at the facility? If yes, please specify how the information was used by the mentor and/or facility.	No	40 (52)
	Yes	35 (45)
	No Answer	2 (3)
15. Was your capstone poster submitted to a pharmacy meeting? If yes, specify which one.	No	69 (90)
	Yes	7 (9)
	No answer	1 (1)
16. Has or is your capstone paper being submitted for publication? If so, where.	No	68 (88)
	Yes	6 (8)
	No answer	3 (4)
17. If there was ONE thing you could change about the capstone experience what would it be and how would you change it?	Answered question	51 (66)
	Skipped question	26 (34)
18. What suggestions do you have about Poster Day?	Answered question	48 (62)
	Skipped question	29 (38)
19. If asked about your capstone experience from a P3 student, what advice would you share with this student?	Answered question	55 (71)
	Skipped question	22 (29)
20. General comments about the capstone experience	Answered question	34 (44)
	Skipped question	43 (56)

of these projects included: comparing use of the antinausea wrist band with traditional antiemetics for chemotherapy in children; comparing high doses versus standard doses of clindamycin in a large teaching hospital; compliance with the national patient safety goal for anticoagulation therapy in a critical access hospital; using antibiotics appropriately to treat methicillin-resistant staphylococcus aureus (MRSA) infection in a community hospital; and updating the fall prevention policy to include a pharmacy medication review in a long-term care facility.

One weakness of the capstone experience was that it was a new course, so its value was not entirely clear. Mentors agreed with the statement on the survey instrument that they could use the results of the research to benefit their research/facility (mean = 2.0). On the other hand, students' mean response to the statement that the capstone poster creation was a waste of time (mean = 3.3), and that the project was applicable to real-life situations (mean = 2.9) were more neutral. The timing for project completion was viewed as both a positive and a negative. To the mentors, students were given enough time during the 5-week APPE to complete the project, but due to several factors (eg, IRB timetables, patient data not accessible, poor time management, and mentor's other duties), students had to finish the rough draft, final paper, and poster after the APPE was complete, requiring them to work on it during evening, weekend, and other hours outside of APPEs and work. Students, on the other hand, agreed (mean 2.56 on question 11) that 120 hours was enough time to finish the project.

Several comments from the mentors in the general comments section (7 out of 16 responses on question 9) indicated that they perceived this exposure to research as being of value to the student's future career. In the student comment section (question 20), several commented (7 out of 33 who made a comment) that the project was stressful and put in the curriculum only to "fulfill the SIUE's senior project requirement." A research project is planned that will track whether the graduates' perceptions about the capstone experience change over time.

Another weakness of the study was that mentors were not asked the amount of time that they spent meeting with the students and reviewing their work. However, in the survey, mentors indicated that they felt serving in this capacity was time well spent and that they were willing to devote time to this effort.

The course achieved the general outcome of having all students present their research in a professional poster on poster day. All 80 students produced a poster (including 4 groups of 2 students each) and were present to answer questions. In addition, several posters were presented at state and national meetings. To date, 2 of the capstone papers have been accepted for publication in peer-reviewed journals.

A perceived benefit of the capstone experience was that several of the projects appeared to have been implemented at the mentor's practice site. For question 14 on the student evaluation, 35 out of 77 students (45%) indicated that the information from their project was used at the site where they had completed their capstone APPE.

Specific comments given by students about information used at sites included: development and implementation of an immunization program in a community pharmacy; update of an existing hospital protocol for using anticoagulation in the institution; development of a reference tool for a long-term care facility when using nonprescription products for patients on medical insurance plans; and distribution of information to patients at a community pharmacy for the safe disposal of outdated prescriptions. Several changes were suggested on the course evaluation and survey instrument for the capstone experience and will be addressed in planning for future capstone experiences.

CONCLUSION

The capstone experience was perceived by the students and mentors to be a positive learning experience that allowed the student to take information from the curriculum and apply it to a real-world situation using the higher-order thinking skills of analysis and synthesis. Changes will be made to the structure of the course for both students and mentors. Whether pharmacy students will use the skills acquired in the capstone research experience in future research remains to be seen and will be examined in a future study.

REFERENCES

1. Wagenaar TC. The capstone course. *Teach Sociol.* 1993;21(3):209-214.
2. Rowles CJ, Koch DC, Hundley SP, Hamilton SJ. Toward a model for capstone experiences: mountaintops, magnets and mandates. *Assess Update.* 2004;16(1):1-15.
3. Steele JL. The laden cart: the senior capstone course. *Teach Sociol.* 1993;21(3):242-245.
4. Dickinson J. The senior seminar at Rider College. *Teach Sociol.* 1993;21(3):215-218.
5. Howe S. Where are we now? Statistics on capstone courses nationwide. *Advances in Engineering Educ.* 2010;2(1):1-27.
6. Jervis KJ, Hartley CA. Learning to design and teach an accounting capstone. *Issues Account Educ.* 2005;20(4):311-339.
7. Berhelde CW. Doing less work, collecting better data: using capstone courses to assess learning. *Peer Rev.* 2007;9(2):27-30.
8. Kirking DM. The role of research in PharmD education. *Am J Pharm Educ.* 1988;52(2):131-134.
9. Murphy JE, Peralta L, Kirking DM. Research experiences and research-related coursework in the education of Doctors of Pharmacy. *Pharmacotherapy.* 1999;19(2):213-220.
10. Murphy JE, Slack MK, Boesen KP, Kirking DM. Research-related coursework and research experiences in doctor of pharmacy programs. *Am J Pharm Educ.* 2007;71(6):113-124.
11. Sill D. The senior assignment: applying learning to complex problems. *Peer Rev.* 2007;9(2):17-19.
12. Southern Illinois University Edwardsville. Edwardsville. Office of the Registrar. Undergraduate Catalog;2010:68. <http://www.siu.edu/registrar/pdf/siue-undergraduate-catalog.pdf>. Accessed September 1, 2010.
13. Association of American Colleges and Universities. *College Learning for the New Global Century: A Report from the National Leadership Council for Liberal Education and America's Promise.* Washington, DC: Association of American Colleges and Universities. 2007.
14. Southern Illinois University Edwardsville. Edwardsville. SIUE News. August 2009. <http://www.siu.edu/news/archives/ArchivesAUG2009.shtml>. Accessed September 1, 2010.
15. Southern Illinois University Edwardsville. Office of Assessment. <http://www.siu.edu/innovation/assessment/seniorassignment/>. Accessed September 1, 2010.
16. Accreditation Council for Pharmacy Education: Accreditation Standards and Guidelines for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree. http://www.acpe-accredit.org/pdf/ACPE_Revised_PharmD_Standards_Adopted_Jan152006.pdf. Accessed September 1, 2010.
17. American Association of Colleges of Pharmacy Center for the Advancement of Pharmaceutical Education: Educational Outcomes 2004. <http://www.aacp.org/resources/education/Documents/CAPE2004.pdf>. Accessed September 1, 2010.
18. International Committee of Medical Journal Editors, Preparing a Manuscript. http://www.icmje.org/manuscript_1prepare.html. Accessed September 1, 2010.