RESEARCH ARTICLES

Pharmacy Students' Perceptions of a Required Senior Research Project

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Objectives. To determine pharmacy students' perceptions of a required research project in a doctor of pharmacy curriculum.

Methods. A survey instrument was administered to senior pharmacy students to determine their perceptions of the project advisor and overall project experience and their postgraduation employment plans.

Results. Two-hundred twenty-nine (81.5%) students completed a survey instrument. The majority agreed or strongly agreed that the project provided a valuable learning experience (88.2%), provided a competitive advantage for postgraduate job opportunities (73.2%), and should be a continued graduation requirement (74.2%). Respondents with plans for a residency or fellowship were more likely than those entering a community or hospital/institutional pharmacy to agree that completion of the project made them more qualified or marketable and should be continued as a graduation requirement ($p < 0.05$).

Conclusions. A required research project was perceived by pharmacy students to be a beneficial experience. Students pursuing residency or fellowship were more likely to feel the project was beneficial than students entering the workforce.

Keywords: curriculum, research, research project, survey

INTRODUCTION

In accordance with requirements set forth by the Accreditation Council for Pharmacy Education (ACPE), all US colleges and schools of pharmacy incorporate research-related coursework, such as biostatistics, drug information, literature evaluation, and research design within the core curriculum. These requirements are intended to foster graduates' understanding and appreciation of "the relevance and value of research."[1] In addition, some programs offer opportunities for students to be directly involved in the design and execution of research and the dissemination of study findings. These opportunities may include a course culminating in the submission of manuscripts to professional journals, an elective research option, or a research track within the doctor of pharmacy (PharmD) program.[2-7]

There are various reasons for incorporating research and research-related coursework into pharmacy school curricula. Exposure to the research process gives pharmacy students direct experience in the application of scientific principles and methodology. Participation in research enhances students' ability to critically analyze and interpret biomedical literature, and these skills can be applied in the clinical setting, where evidence-based medicine can improve health outcomes. Many students pursue postgraduate training opportunities (residencies, fellowships, other doctoral programs) that incorporate research as an important or predominant component of the training experience. Students with exposure to research during pharmacy school might have a competitive advantage in securing/attaining a postgraduate training position compared to peers without research experience. Indeed, a task force appointed by the American College of Clinical Pharmacy suggests that a required capstone research project is a successful strategy to incorporate into pharmacy school curricula and one that might "motivate students to pursue education and training beyond the PharmD degree."[8]

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The American Association of Colleges of Pharmacy (AACP) recognizes the benefit of research in pharmacy curricula, especially for students who plan to pursue postgraduate residency training or careers in academia.[9] Moreover, the AACP understands that research is a means to advance the profession and has advocated for the incorporation of research training in pharmacy curricula to promote among graduates an ''obligation to participate in inquiry and professional improvement.''[10]

Most faculty members regard research and research-related courses as valuable for PharmD students; however, not all feel that completing a research project should be a degree requirement. [5,6,11,12] Concerns cited by faculty members include the time that projects would require of advisors and students, insufficient resources available to support student research, and general apprehension regarding the practicality of adding a mandatory research requirement to an already rigorous professional program.[6,11,12] Survey findings regarding students' perceptions of a required research project are conflicting.[13,14] While pharmacy students at one college appreciated the importance of research, many were concerned about the time commitment necessary to complete a research project.[13] Furthermore, many did not believe that research experience would provide them with a competitive advantage with respect to postgraduate career options. In contrast, graduates of a PharmD program that had a mandatory research requirement believed they were adequately prepared and had sufficient time and faculty support to conduct their research project. The graduates also agreed that the college of pharmacy should continue to require a research project of all students.[14]

The PharmD curriculum at the University of California, San Francisco (UCSF), School of Pharmacy includes research-related didactic coursework, and all graduates are required to complete a senior research project. The research project has been a graduation requirement for all students since 2002 when 3 curricular pathways were instituted: pharmaceutical care, pharmaceutical health policy and management, and pharmaceutical sciences pathways. The majority of students (approximately 80%) are enrolled in the pharmaceutical care pathway, which emphasizes patient care and the development of clinical skills in a variety of settings during the advanced pharmacy practice experience (APPE) segment of the curriculum. While students in the pharmaceutical care pathway conduct their projects simultaneously with their APPEs, students in the pharmaceutical health policy and management and the pharmaceutical sciences pathways have scheduled blocks of time to concentrate exclusively on their research projects.

The Pharmaceutical Care Pathway Project (PCPP) is a 2-unit (ie, 80 hour) required course (Table 1) that senior pharmacy students complete individually or in teams under the guidance of paid or volunteer faculty advisors. Team projects can have a maximum of 4 students, commensurate with the amount of work involved (ie, 80 hours per student); however, a faculty oversight committee can grant exceptions for groups of up to 6 students if the scope of the project and workload warrant additional personnel. While project advisors at UCSF believe the PCCP provides a valuable learning experience,[12] the attitudes of pharmacy students completing these projects have not been evaluated systematically. The purpose of this study was to assess the perceptions of pharmacy students who had completed a required research project in our pharmaceutical care pathway.

Table 1. Goals for the UCSF Pharmaceutical Care Pathway Project

Apply the scientific method to investigate a professional or practice-oriented question.
Provide a capstone experience that allows students to integrate and apply information or concepts learned in previous courses.
Foster collaboration and teamwork.
Prepare students for future careers in pharmaceutical care.
Encourage the dissemination of project results through publications and meetings.
Provide value to clerkships and contribute to the advancement of the profession.

METHODS

All pharmacy students who completed a PCPP during 2006-2008 received an anonymous course evaluation form shortly after completion of their research project and prior to graduation. The 29-item survey instrument (available by request from the corresponding author) included 24 questions that assessed students' perceptions of the overall project experience and the project advisor(s) using a 5-point Likert scale ranging from strongly agree to strongly disagree. Students also were asked if the PCCP was completed as an individual or group project. Students who worked in teams were asked to specify the number of students on the team and whether they felt the other students had participated equally in the research process. For the latter question, response options included ''yes, all group members participated essentially equally'' or ''no, some group members did significantly more or less work than others.'' Finally all respondents were asked to specify their postgraduation plans using the following response options: residency; fellowship; community pharmacy; hospital or institutional pharmacy; other pharmacy position; master's degree program; doctoral degree program; and other. If the PCPP had been supervised by more

than 1 faculty member, the responses were tabulated only for the primary advisor in order to associate each student with only 1 survey. The primary advisor was classified as paid or volunteer, depending on their employment status with the university.

Survey responses were entered into a Microsoft Excel database for computation of simple summary statistics. The data were further examined for associations between (1) students' postgraduate plans and students' perceptions of the research project experience; (2) primary advisor's faculty status and students' perceptions of the project advisor; and (3) research group size and students' perceptions of the research project experience, the adequacy of time devoted to the project, and equal participation among group members. To analyze these associations, responses of agree and strongly agree were combined and categorized as favorable responses. Similarly, responses of disagree and strongly disagree were combined and categorized as unfavorable responses. Neutral responses were analyzed separately. The association between these predictors and the ordinal outcome variables were assessed using proportional odds logistic regression. This statistical analysis was performed by the UCSF Biostatistics Research Group using Proc Logistic in SAS 9.2 (SAS Institute Inc, Cary, NC). All study procedures were approved by the UCSF Committee on Human Research.

RESULTS

Of the 281 students who graduated from the pharmaceutical care pathway from 2006-2008, 235 (83.6%) submitted a PCPP evaluation survey instrument. Six incomplete survey instruments were excluded from analysis, yielding a final sample of 229 survey instruments (81.5% response rate). The majority of students worked in groups (n=211), with an average of 3.4 ± 0.9 students per project. Eighteen students (7.9%) worked on individual projects. Of respondents who worked in groups, 82.2% specified that all group members participated equally in the research process. However, respondents who worked in groups of 3 or 4 students were significantly less likely to agree that all members participated equally ($p < 0.05$). There were no significant differences between respondents who worked in groups and those who worked individually with respect to their perception of the overall experience and whether the amount of time they were able to spend on their research project was adequate.

Of the 224 respondents who specified postgraduate plans, approximately half intended to pursue postgraduate training in residency (115) or fellowship (1) programs. Nearly 40% planned to begin practice in community pharmacy (59; 26.3%) or hospital/institutional practice (26; 11.6%) settings. The remainder of the 224 respondents were undecided (12; 5.4%) or specified other postgraduate plans, such as establishing a consulting business, or working in a combination of community and hospital pharmacy settings (11; 4.9%).

Students expressed positive perceptions of the PCPP experience and provided favorable responses (ie, agreed or strongly agreed) to questions about the research project (Table 2). The 3 survey items receiving the highest overall agreement were that students were pleased with the selection of a project advisor (89.9%) and project topic (89.1%), and that the project was a valuable learning experience (88.2%). While only 67% of students reported that they were adequately prepared at the start of the process to conduct the project, approximately 87% believed that they could independently conduct a similar project as a result of the experience. A smaller percentage (51.3%) reported they were more likely to conduct research in the future because of this experience. A small number of students provided unfavorable responses (ie, disagreed or strongly disagreed) to statements about the research project experience. Survey items that elicited the strongest disagreement were: more likely to conduct research in the future because of the project experience (14.5%); the school should continue to require a research project for students in the pathway (10.6%); the amount of time the student was able to devote to the project was adequate (8.3%); and as a result of the project experience, students were more qualified/marketable for postgraduate job opportunities (7.0%).

Stratification of responses to other survey items based on postgraduation plans revealed significant differences among respondents (Table 3). Respondents planning to pursue a residency or fellowship were more likely to agree that by the end of the process, they had acquired enough knowledge and skills to independently conduct a similar research project compared to students with postgraduation plans to work in hospital or institutional pharmacy ($p < 0.05$). Respondents planning to pursue a residency or fellowship more often agreed that because of the project they were more likely to conduct research in the future compared to students with plans to work in community pharmacy after graduation ($p < 0.05$). Furthermore, students planning to work in community or hospital/institutional pharmacy were less likely to agree that the school should continue to require a research project for the pharmaceutical care pathway ($p < 0.05$), and that as a result of the project experience, they were more qualified/marketable for postgraduate job opportunities ($p < 0.05$).

Students reported favorable perceptions of their project advisor (Table 4). The majority of students agreed

Table 2. Student Perceptions of the Pharmaceutical Care Pathway Project Experience

Item (229)[a]	Student Response, No. (%)[b]					Mean Response (SD)
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Overall, I was pleased with my selection of a topic for my project	2 (0.9)	5 (2.2)	18 (7.9)	92 (40.2)	112 (48.9)	1.7 (0.79)
Overall, I was pleased with my selection of an advisor for my project	2 (0.9)	4 (1.8)	17 (7.5)	41 (18.0)	164 (71.9)	1.4 (0.78)
Overall, the project was a valuable learning experience	4 (1.7)	1 (0.4)	22 (9.6)	79 (34.5)	123 (53.7)	1.6 (0.82)
At the start of the process, I felt that I was adequately prepared to take on my project	0	15 (6.6)	60 (26.4)	111 (48.9)	41 (18.1)	2.2 (0.82)
By the end of the process, I felt that I had acquired enough knowledge and skills that I could independently conduct a similar research project	0	2 (0.9)	28 (12.3)	118 (51.8)	80 (35.1)	1.8 (0.68)
I am pleased with the outcome/results of my project	2 (0.9)	8 (3.5)	37 (16.3)	98 (43.2)	82 (36.1)	1.9 (0.86)
Because of my project, I am more likely to conduct research in the future	3 (1.3)	30 (13.2)	78 (34.2)	70 (30.7)	47 (20.6)	2.4 (1.0)
The amount of time I was able to spend on my project was adequate	5 (2.2)	14 (6.1)	31 (13.6)	113 (49.6)	65 (28.5)	2.0 (0.93)
The School of Pharmacy should continue to require a research project in the pharmaceutical care pathway	10 (4.4)	14 (6.2)	34 (15.1)	103 (45.8)	64 (28.4)	2.1 (1.0)
Because I conducted a project, I am more qualified/ marketable for the types of post-graduation job opportunities that I am (or will be) exploring	2 (0.9)	14 (6.1)	45 (19.7)	97 (42.5)	70 (30.7)	2.0 (0.91)

[a] Sample size for each item varied (225-229), as responses left blank were excluded.
[b] Likert scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree.

or strongly agreed that their advisor had adequate training and expertise to serve as the project advisor (93.8%), promoted ethical conduct of research (93.5%), dedicated an adequate amount of time for project oversight (88.2%), provided ongoing and constructive feedback (88.1%), developed the students' research skills (87.8%), and enhanced their critical thinking skills (87.8%).

When responses were stratified by faculty status of the primary advisor (paid or volunteer), significant differences were found (Table 5). Respondents who worked with paid faculty members were more likely to agree that the project advisor helped to develop their research skills ($p < 0.05$) than those who worked with volunteer faculty members. Similarly, students completing projects with paid faculty advisors were significantly more likely to agree that the advisor enhanced critical thinking skills, had adequate training and expertise to serve as the advisor for the project, and promoted ethical conduct of research compared to respondents completing projects with volunteer faculty members ($p < 0.05$). However, it appeared that students generally perceived their interactions with advisors favorably, regardless of the faculty status of the advisor.

DISCUSSION

A required senior research project in a PharmD curriculum was positively perceived by students, with survey respondents indicating favorable opinions of both the PCPP experience and the project advisors. Similar to the study by Murphy and Valenzuela,[14] all mean attitudinal responses regarding the research project were on the agreement side of neutral. Respondents most strongly agreed that they were satisfied with the selection of their project advisor, that they were pleased with the topic selection for their project, and that the project provided a valuable learning experience. Despite that students were not given dedicated time to complete the research project (ie, students completed the PCPP concurrently with APPEs), 78.1% of respondents agreed or strongly agreed that the amount of time they were able to devote to the project was adequate. It is possible that group projects allowed the students to divide the work and possibly better manage their time. Working in groups might allow students to conduct larger and more complex studies that are "more likely to result in publishable work."[15] In our study, working in groups did not detract from the value of the research experience. Interestingly, a group size of

Table 3. Student Perceptions of the Pharmaceutical Care Pathway Project Experience Stratified by Postgraduation Plans

Item	Postgraduation Plans (n)	Student Response, No. (%)[a] Disagree/ Strongly Disagree	Neutral	Agree/Strongly Agree	Odds Ratio[b] *(p)*
By the end of the process, I felt that I had acquired enough knowledge and skills that I could independently conduct a similar research project	Residency or fellowship (115)	0 (0.0)	12 (10.0)	103 (89.6)	
	Community (59)	1 (1.7)	6 (10.2)	52 (88.1)	0.85 (0.7467)
	Hospital/institutional pharmacy (26)	1 (3.8)	6 (23.1)	19 (73.1)	0.30 (0.0261)
Because of my project, I am more likely to conduct research in the future	Residency or fellowship (115)	14 (12.2)	31 (27.0)	70 (60.9)	
	Community (59)	12 (20.3)	25 (42.4)	21 (37.3)	0.42 (0.0049)
	Hospital/institutional pharmacy (26)	2 (7.7)	12 (46.2)	12 (46.2)	0.67 (0.3409)
The School of Pharmacy should continue to require a research project in the pharmaceutical care pathway	Residency or fellowship (114)	8 (7.0)	13 (11.4)	93 (81.6)	
	Community (57)	8 (14.0)	14 (24.6)	35 (61.4)	0.37 (0.0058)
	Hospital/institutional pharmacy (26)	3 (11.5)	7 (26.9)	16 (61.5)	0.39 (0.0405)
Because I conducted a project, I am more qualified/marketable for the types of post-graduation job opportunities that I am (or will be) exploring	Residency or fellowship (115)	4 (3.5)	12 (10.4)	99 (86.1)	
	Community (59)	6 (10.2)	19 (32.2)	34 (57.6)	0.23 (<0.0001)
	Hospital or institutional pharmacy (26)	2 (7.7)	9 (34.6)	15 (57.7)	0.24 (0.0023)

[a] Likert scale: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, and 5=strongly disagree.
[b] Odds ratio less than 1 denotes decreased likelihood of a positive response, eg, strongly agree or agree, estimated relative to reference group "residency or fellowship."

5 did not result in the students having a significantly decreased perception of equal participation among group members than a team of 2, whereas group sizes of 3 and 4 did. Perhaps the larger group (5 students) was able to split into subgroups to ensure equal participation.

By conducting a year-long project that develops skills in research, students potentially can better prepare and market themselves for postgraduate opportunities. In the current study, nearly three-quarters of the respondents agreed or strongly agreed that conducting the research project made them more qualified or marketable for post-graduation job opportunities. Our findings are comparable to those of Murphy and Valenzuela,[14] who reported the perceptions of PharmD graduates who had completed a required research project at the University of Arizona between 1992-1994. Respondents in this study believed that there was sufficient time to complete a project and that the college of pharmacy should continue to require a project of all students. This is in contrast to the results reported by Borrego and Kumar who found that students most often disagreed that there would be sufficient time to complete the project, and that a required research experience would make them more competitive after graduation.[13]

In our study, respondents pursuing a residency or fellowship were more likely to agree that completion of a research project made them more qualified or marketable for job opportunities than those planning to work in community or hospital/institutional pharmacy settings after graduation. Thus, the latter 2 groups were less likely to feel that the research project benefitted them in terms of their career plans. Students with plans to pursue a residency or fellowship might have perceived the PCPP as beneficial since residents and fellows often are required to conduct research projects.[16] Completion of the PCPP may have helped students to develop an interest in pharmacy research, or provided them with a competitive advantage in obtaining a residency or fellowship that required the conduct of pharmacy research. Not surprisingly, students with plans for a residency or fellowship were significantly more likely to indicate that because of their project they will be more likely to conduct research in the future and that the school should continue to require a research project in the pharmaceutical care pathway. It is unclear why students planning to pursue hospital/institutional pharmacy practice were less likely to agree that they acquired enough knowledge and skills to independently conduct

Table 4. Student Perceptions of the Primary Advisor of the Pharmaceutical Care Pathway Project (N = 229[a])

My project advisor...	Student Response, No. (%)[b]					Mean Response (SD)
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
helped me to develop my research skills	5 (2.2)	3 (1.3)	20 (8.7)	93 (40.6)	108 (47.2)	1.7 (0.9)
enhanced my research critical- thinking skills	4 (1.7)	2 (0.9)	22 (9.6)	82 (35.8)	119 (52.0)	1.6 (0.8)
had adequate training and expertise to serve as the advisor for my project	3 (1.3)	0 (0.0)	11 (4.8)	37 (16.2)	177 (77.6)	1.3 (0.7)
provided me with ongoing, constructive feedback throughout my project	6 (2.6)	3 (1.3)	18 (7.9)	50 (21.9)	151 (66.2)	1.5 (0.9)
promoted ethical conduct of research at all times	3 (1.3)	1 (0.4)	11 (4.8)	51 (22.3)	163 (71.2)	1.4 (0.7)
dedicated an adequate amount of time toward overseeing my project	5 (2.2)	4 (1.7)	18 (7.9)	59 (25.8)	143 (62.4)	1.6 (0.9)

[a] Sample size for each item varied (228-229) as responses left blank were excluded.
[b] Likert scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree.

a similar research project; this was not observed for students with postgraduation plans in community pharmacy.

An important component of the research project experience is the interaction between students and their project advisors. The only significant differences in student responses regarding paid and volunteer faculty advisors were for the questions pertaining to the advisor developing the students' research skills, enhancing their critical-thinking skills, having adequate training and expertise to serve as a project advisor, and promoting ethical conduct of research at all times. There was no significant difference between the types of advisors with regard to providing ongoing, constructive feedback throughout the project or dedicating adequate time towards overseeing the project. Nevertheless, a high percentage of respondents with volunteer faculty advisors (78%-90%) either agreed or strongly agreed to the survey questions about their advisors (Table 5). This suggests that volunteer faculty members, who unlike paid faculty members, are not required to conduct research, were favorably perceived in terms of their ability to guide student research projects. This positive interaction between students and advisors may have contributed to students' overall favorable perception of the PCPP experience.

The percentage of students who completed the survey was high (81.5%), and is comparable to or higher than the response rates reported in other surveys evaluating pharmacy student research experiences.[13,14,17] However, there are some limitations to our study. First, because student evaluations of the PCPP were not systematically collected prior to 2006, our data reflect perceptions of pharmaceutical care pathway graduates from 2006-2008.

Table 5. Student Perceptions of the Primary Advisor of the Pharmaceutical Care Pathway Project Stratified by Faculty Status

Item My project advisor...	Faculty Status (n)	Student Response, No. (%)[a]			Odds Ratio [b] (*p*)
		Disagree and Strongly Disagree	Neutral	Agree and Strongly Agree	
helped me to develop my research skills	Volunteer (n=101)	5 (5.0)	14 (13.9)	82 (81.2)	
	Paid (n=128)	3 (2.3)	6 (4.7)	119 (93.0)	3.03 (0.0098)
enhanced my research critical-thinking skills	Volunteer (n=101)	4 (4.0)	18 (17.8)	79 (78.2)	
	Paid (n=128)	2 (1.6)	4 (3.1)	122 (95.3)	5.56 (0.0004)
had adequate training and expertise to serve as the advisor for my project	Volunteer (n=100)	1 (1.0)	9 (9.0)	90 (90.0)	
	Paid (n=128)	2 (1.6)	2 (1.6)	124 (96.9)	3.37 (0.0453)
promoted ethical conduct of research at all times	Volunteer (n=101)	2 (2.0)	9 (8.9)	90 (89.1)	
	Paid (n=128)	2 (1.6)	2 (1.6)	124 (96.9)	3.72 (0.0284)

[a] Likert scale: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, and 5=strongly disagree.
[b] Odds ratio greater than 1 denotes increased likelihood of a positive response, eg, strongly agree or agree estimated relative to reference group "volunteer."

Perceptions of students who completed the PCPP in 2001 (ie, the first year the project was required at UCSF) may have differed from those of students completing the PCPP more recently due to the evolution of the course over time. For example, during the early years of the project, faculty members came to appreciate the scope and types of projects that are feasible for students to complete while also completing/enrolled in advanced pharmacy practice experiences. Additional curricular refinements including the development of a detailed course syllabus, clearly delineated project timelines, and advisor training may have contributed to higher overall perceptions of the required research project. Additionally, we surveyed students within a month of completing the research project. Longitudinal assessments (eg, 1-5 years postgraduation) would provide a more accurate evaluation of the impact of the PCPP on our graduates' ability to conduct similar research while in clinical practice, and any perceived competitive advantage in the workforce. Such longitudinal assessments may include pre-2006 graduates, as well as a control group composed of graduates from a college or school that does not require a research project. Finally, this study lacked independent measurement of achievement of the goals listed in Table 1 and instead relied solely on student perceptions of the experience.

CONCLUSION

UCSF pharmacy students who completed a mandatory senior research project between 2006-2008 considered the requirement to be a beneficial experience. The majority agreed that the research project provided a valuable learning experience and should be a continued requirement in the PharmD curriculum. Students planning to pursue residency or fellowship training were more likely to respond that the project benefited them by making them more qualified or marketable for postgraduation job opportunities. These students also were more likely to favor the continuation of the mandatory project than students with plans to enter community or hospital/institutional pharmacy. Students tended to perceive paid faculty advisors more favorably than volunteer faculty advisors, although all students seemed satisfied with the level of interaction with their advisor. This favorable experience with faculty advisors could have contributed to the students' overall general satisfaction with the project.

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