

RESEARCH ARTICLES

Research-related Coursework and Research Experiences in Doctor of Pharmacy Programs

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Objectives. To evaluate the research-related coursework and research experiences in doctor of pharmacy programs and compare the findings to those of 2 previous studies.

Methods. A questionnaire was mailed to 88 colleges and schools of pharmacy in the United States and Puerto Rico. The survey instrument sought information on formal research-related coursework; required and elective research experiences; and perceptions of student-conducted research.

Results. Seventy-nine colleges and schools completed the questionnaire for a response rate of 88%. Most colleges (>90%) required students to study/complete courses in biostatistics and drug information/literature evaluation; approximately half required research methods coursework. Twenty-five percent required some form of project and requirements were not influenced by class size. Students could often work in teams to complete projects. Respondents generally thought participation in research had some value for motivated students.

Conclusions. This study demonstrates the variability in extent of research-related coursework and research experiences in PharmD programs across the country.

Keywords: research education, education, pharmacy research

INTRODUCTION

Defining a problem, systematically gathering and interpreting data, and reporting the results are the essence of research. Whether a pharmacist personally conducts research or critically evaluates the research results of others for application to evidence-based practice, he or she can benefit from understanding the process. Research-related coursework and the development of research skills can enhance the professional vitality of pharmacists and help ensure that they will be better prepared for lifelong learning and capable of dealing with changes in science and practice. Furthermore, advancement of the profession itself could benefit from research done to document the value of pharmacists in providing patient care.^{1,2}

There are a variety of reasons for providing an orientation to research in the doctor of pharmacy curricula. For example, some graduates will go on to careers in academia or research, while the ever-increasing sophistication of clinical practice requires pharmacists to interpret, use,

and communicate published research findings. Early exposure to research-related coursework and research experiences may serve to interest students in research or at least get them to a level of comfort with conducting or evaluating certain types of projects. Another potential benefit is formative training for those students who will go into residency programs where a project is required and the conduct of pharmacy practice research is an elective outcome.³ Conducting research during residency training is strongly recommended by the American Association of Colleges of Pharmacy (AACP) to help develop future faculty.⁴

The core of training in PharmD programs must be focused on patient care and drug-specific knowledge and skills, leaving only a limited amount of time for teaching research skills.⁵ Unfortunately, as a result, much pharmacy research is conducted and published by individuals not trained extensively in research methods. Thus, there is a need to at least introduce research to students in professional programs. The introduction could range from requiring all students to conduct a full research project, to providing elective research opportunities,^{6,7} to developing research tracks within the PharmD program,⁸ to participating in the research of faculty members. The Accreditation Council on Pharmaceutical Education

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(ACPE) accreditation standards for the doctor of pharmacy degree address the need for graduates to understand research processes and identify the need for coursework in biostatistics, drug information, literature evaluation, and research design.⁹ The standards further promote the availability of electives in research (guideline 14.5) and that graduates should understand “the relevance and value of research” (guideline 23.4).

Studying research-related coursework without actual opportunities to conduct a research project may have limited impact if the profession is committed to promoting new research in pharmacy. Obviously, there are costs associated with offering such educational opportunities and the research development outcomes would generally not be expected to be equal to those of more advanced research education and training.

Professional organizations have addressed the issue of research in pharmacy. For example, the American Society of Health-System Pharmacists (ASHP) has a statement addressing the pharmacist’s obligation for participation in research.¹⁰ The American College of Clinical Pharmacy’s (ACCP) mission includes “providing . . . resources that enable pharmacists to achieve excellence in . . . research; . . . that catalyze change and advance drug therapy.”¹¹ The commitment of these organizations to research by their members clearly indicates a need for fairly broad training in research principles among pharmacists.

Kirking first published a study in 1988 describing the role of research in the education of doctors of pharmacy.¹² At that time, there was considerable variation in the extent of research-related courses and experiences among different types of PharmD degree programs (post-BS PharmD, entry-level PharmD, etc). A follow-up study in 1997 (published in 1999) found that most colleges required coursework in research methodology, biostatistics, and drug information and literature evaluation.¹³ Students had opportunities to conduct research as an elective in 41% of the responding programs, but only 12.9% required an extensive project with data collection, analysis, and write-up.

Much changed in the years between the original Kirking study and the first follow-up study. The same can be said for the interval between the 1997 study and 2007. Many new colleges have been created, many colleges have increased class size to meet the demand for pharmacists, and there is a considerable shortage of faculty members.¹⁴ All colleges now exclusively offer the PharmD degree as the first professional degree, and the mission of the pharmacist has continued to evolve, with greater emphasis placed on providing evidence-based pharmaceutical care. Knowledge of the current status of re-

search-related efforts in colleges of pharmacy would be of value in understanding the preparation of new pharmacists for roles that require greater understanding of the literature and research processes.

The purpose of this study was to provide the first evaluation of the role of research-related coursework and research experiences in entry-level PharmD programs in the United States since the conversion to the PharmD as the first-professional degree for all colleges. Further, we wanted to compare our results to those found earlier.^{12,13}

METHODS

A questionnaire patterned after the one used by Murphy and colleagues in 1997 was used for this study.¹³ That questionnaire was revised by the current research team to reflect the focus on first professional degree doctorate of pharmacy programs. It was pretested by a group of 5 faculty from other colleges and revised slightly. The revised questionnaire was mailed in May 2006 to the 88 colleges and schools of pharmacy established in the United States at that time, including Puerto Rico. Associate and affiliate colleges and schools that were in candidate status or in early planning at the time were not surveyed. The institutions were identified from *The Roster of Faculty and Professional Staff* of the American Association of Colleges of Pharmacy.¹⁵ Deans of the institutions were asked by e-mail for the name of an appropriate person to participate in the survey. If a dean did not respond, a second questionnaire was sent to the head of the pharmacy practice or pharmacy administration department, or to a person known to be an appropriate alternate. In order to enhance response to the survey, an e-mail reminder was sent to all nonrespondents on May 30, 2006. A revised list was prepared of colleges that still did not respond and an electronic version of the survey instrument was e-mailed to an appropriate individual on June 9, 2006, with a request to respond. Finally, beginning August 3, 2006, personal calls were placed to those still not responding.

The questionnaire requested information in 4 areas: formal research-related coursework; required student research experiences; other research-related courses or activities; and perceptions of student-conducted research.

In the section on formal research-related coursework, respondents were asked whether the 3 specific courses or coursework areas of (1) research methods, (2) statistics, and (3) drug information/literature evaluation (DI/LE) were required (during the pharmacy program or prepharmacy) or optional, and the number of credit hours assigned to each. Respondents were asked to estimate the number of credit hours assigned to the topic (eg,

statistics) when the coursework was part of another course. Quarter credit hours were converted to semester credit hours for analysis, with 1 quarter hour equaling two thirds of a semester hour.

In the section on required student research experiences, data were collected on experience completing required (if available) projects. Data collected included: type of grading; requirement for, and faculty status of student project advisors; extent of project requirements (from developing a proposal, through data collection and analysis, to writing a formal research paper and presenting study results); whether financial support was available; the number of students that could work on a single project; how projects were reviewed; and types of data collection methods used by students and whether there were any restrictions on the type of methods that could be used. For the purposes of the study, a research project was defined in the questionnaire as “posing research questions and devising methods to obtain suitable solutions, with or without actual data collection and analysis.” To be consistent with the previous study, project proposals were included within the definition of research projects; however, proposals represent limited experiential research activities for students. Respondents were told that “review papers on therapeutic or other topics should not be considered research, nor should simple service as an assistant to a faculty member on one of their projects.” A complete research project experience was assumed if the student(s) developed a project proposal and/or submitted a project outline to a human subjects committee, collected and analyzed data, and then either prepared a written report or presented the results. It was thought that writing up the results or presenting the results both required somewhat similar skills. Again, some colleges might require all of these.

In the section of the questionnaire entitled other research-related courses or activities, data on elective research experiences offered by the college were collected. For colleges that only provided elective research opportunities, respondents were asked to estimate the percentage of students who had completed a project by graduation.

Finally, in the section on perceptions of student-conducted research, open-ended comments were solicited on the value of having PharmD students conduct research projects as a requirement or as an elective opportunity. Respondents were also asked to comment on recent or foreseeable changes in the curriculum related to research project offerings in their institution.

Data on class sizes of the individual colleges were obtained from the table listing total PharmD enrollment by college for fall 2005 on AACP’s website. Data were entered into a spreadsheet and analyzed using Microsoft

Excel 2002 (Redmond, Wash). Descriptive analyses (mean, standard deviation, and frequency count) were used to describe the data collected. Analysis of variance and *t* tests were used to determine statistical significance, which was assumed at $p \leq 0.05$. This study was approved by the Human Subjects Committee at the University of Arizona.

RESULTS

Seventy-nine questionnaires were returned for an 88% response rate. Table 1 shows the total of research-related coursework offerings among the colleges. Most colleges required some coursework in statistics (72; 91%) and drug information/literature evaluation (74; 94%), but just slightly over half (42; 53%) required research methods. Programs that required student research experiences (20; 25%) were somewhat more likely to require research methods coursework (15 of 20 [75%] vs. 27 of 59 [45.7%]) and to require more hours (2.1 ± 1.3 vs. 1.6 ± 0.7 and 1.5 ± 1.0 for the required, elective, and no student research experiences, respectively). Five (11%) programs, all in the elective research options group ($n = 45$), did not offer any statistical or research methods coursework.

As shown in Table 2, most colleges of pharmacy (45; 57%) offered elective research experiences, while 20 (25%) required some form of research projects and 14 (18%) did not provide research opportunities. Of the 20

Table 1. Research-Related Coursework ($n = 79$)*

Content Area	No. (%)	Hours, Mean (SD) [†]
Research Methods		
Required	42 (53)	1.7 (1.0)
Required (prepharmacy)	0	
Elective	30 (38)	3.5 (2.8)
Not offered	12 (15)	
Statistics		
Required	56 (71)	2.2 (0.9)
Required (prepharmacy)	25 (32)	3.2 (1.2)
Elective	9 (11)	2.8 (1.0)
Not offered	6 (8)	
Drug Information/Literature Evaluation		
Required	74 (94)	2.5 (1.2)
Required (prepharmacy)	0	
Elective	12 (15)	3.9 (1.7)
Not offered	4 (5)	

*Some totals exceed 79 (100%) as some programs had both required and elective coursework or had required coursework in both pharmacy and prepharmacy

[†]Semester hours: 1 quarter hour = 2/3 semester hour

Table 2. Characteristics of Colleges of Pharmacy and Type of Student Research Program

Characteristic	Type of Student Research Program		
	Required Research*	Elective Research [†]	None
Number (%)	20 (25.3)	45 (57.0)	14 (17.7)
Enrollment (mean, SD)	510 (328)	501 (282)	523 (409)
Public/Private [‡]	8/12	35/10	8/6
Academic Calendar (%)			
Semester	16 (80%)	38 (84)	8 (57)
Quarter	4 (20%)	5 (11)	3 (21)
Other	0	2 (4)	3 (21)

*Any form of required research

[†]Though some programs with required research also provided research electives, this category includes only those programs with electives as the sole offering

[‡]*p* = 0.01 for required vs. elective

requiring some form of research project, 12 (60%) also offered elective opportunities. Colleges offering an elective research experience were more likely to be public, while those requiring some form of research experience were more likely to be private.

Twelve of the 20 (60%) colleges with some form of required research experiences required students to conduct the components of a complete project (15% of the total). That is, the student had to develop a project proposal and/or submit an internal review board (IRB) request, collect and analyze data, and prepare a written report and/or present/defend their findings at the college level or beyond. Of these 12 programs, 6 were public and 6 private. Seven colleges required all 6 components of a project: develop a project proposal, submit an IRB request, collect and analyze data (1 allowed data from previous research to be used), prepare a written report, and present/defend the findings. Three colleges required all but a written report, but did require presentation of results. One college required everything but a presentation, and 1 required all but IRB submission and presentation of results. Of the remaining 8 programs that required some form of project, 4 required only a written proposal, 2 required a proposal and IRB document preparation, and 2 required a written proposal and presentation of the proposal.

The number of students enrolled in the doctor of pharmacy program was not related to whether the college required a complete project or had elective research experiences as the range of student enrollment was similar across the groups (ie, project required, available as and elective, or not available).

All but 1 of the 20 respondents with some form of required projects were graded either with a letter grade

(12; 60%) or pass/fail (7; 35%). College faculty members (16; 80%) served as project advisors for most required student research experiences. However, 10 (50%) colleges also used external faculty members (eg, preceptors) or non-college faculty members within the university (9; 45%). Of the 12 colleges requiring a complete project, only 3 did not use other than internal faculty members as project advisors. A variety of methods were used to review proposals; more programs (6; 30%) had the project advisor review the proposal than had a course coordinator (4; 20%) or a faculty committee (2; 10%). Most programs (12; 60%) allowed 3 or 4 students to work on a project. The majority of programs did not provide any type of financial support; 6 (30%) programs did provide either poster supplies or specific funds for which students could apply, or the faculty advisors provided support.

Students completing research projects that required data collection and analysis (*n* = 12) were commonly allowed to collect data from chart reviews (11), surveys (11), databases (11), interviews (10), clinical measures (10), laboratory procedures (9), and direct observation (8). Half (6) of the 12 colleges allowed students to use systematic reviews (eg, meta-analysis).

Most respondents (75; 94%) indicated that their college had made no changes in PharmD students' research experiences in the last 5 years. Two eliminated required projects due to increasing class size and faculty opposition. One changed from a research requirement to an elective. Five respondents indicated that their college was considering implementation of a required research project.

Few students appeared to take advantage of elective student research experiences. Most respondents (35 of 45; 78%) with elective experiences estimated that less than 10% of students participated in these opportunities prior to graduation, though 2 indicated that more than 50% of PharmD students completed an elective project.

Comments were grouped into thematic areas for reporting. Respondents attributed many benefits to required research projects regardless of whether their college required them. The largest number of benefits identified (18) was related to the opportunity for increased learning, improved critical thinking skills, and improved ability to use the literature. The second largest number of comments (16) was more philosophical; that is, respondents seemed to believe that students graduating with a doctorate should have some understanding of research and the foundations of evidence-based medicine. There were also a number of comments (7) related to preparing students for postgraduate training and to become future faculty members.

The primary problem with required projects identified by 19 respondents was the issue of resources. Several

commented on what they perceived as the impossibility of providing a research experience to large numbers of students. Lack of faculty time for mentoring was also mentioned. Other problems discussed were lack of space in the curriculum for a student project and faculty members inadequately trained to mentor student research.

Five respondents commented on their opposition to requiring a research project. They remarked on the inappropriateness of students in a professional program learning research skills and that such training should be reserved for graduate programs.

DISCUSSION

Much has changed in the years since the 2 comprehensive studies of research requirements in PharmD programs were conducted.^{12,13} This study was the first to evaluate only first-professional degree doctor of pharmacy programs. The previous 2 studies included post-bachelor of science, and non-traditional PharmD degree programs as well as first-professional degree programs. For discussion purposes, only results on first-professional degree programs from the original studies will be compared to the current results.

Research methods coursework was required in 53% of the programs, essentially the same percentages found in the 1997 (54%) and 1988 (50%) studies. Drug information/literature evaluation was required in 94% of programs compared to 98% in 1997 and 78% in 1988. Statistics coursework was required in 93% of the colleges compared to 93% in 1997 and 100% in 1988. Of particular interest is the less-than-100% requirement for coursework in statistics and drug information/literature evaluation, since both of these areas are mentioned in the new ACPE guidelines as well as in the previous 2 versions.⁹

The lack of uniformity in requirements for some of the research-related coursework (particularly research methods) and research experiences leads inevitably to questions about the extent of research experiences that PharmD programs should offer their students. The new accreditation standards for colleges offering the PharmD degree specify coursework in biostatistics, drug information, literature evaluation, and research design.⁹ In these standards the following preamble statement could lead to ambiguity on whether all should be required, though it does seem that this coursework would be strongly suggested as requirements: "Some of these areas may be addressed in pre-pharmacy courses, while the majority would be the purview of the curriculum of the professional degree program. The majority of the sections listed would reflect required course work, while some could be addressed in elective courses." Furthermore, although the

guidelines suggest the need for research-related skills, they fall short of recommending the actual application/experiential opportunities for research. In a number of colleges in other countries, research is required for first-professional degree students. A 2006-2007 AACP Task Force on Educating Clinical Scientists has recommended in a draft document that the AACP board of directors should propose an addition of a new competency to the ACPE Standards and Guidelines regarding the necessity to "introduce students to the basic principles of clinical and translational research, including how such research is conducted, evaluated, explained to patients, and applied to patient care."¹⁶ Should this occur, there will be increasing need for research-related coursework in PharmD programs.

Slightly more (15.2%) entry-level programs require an extensive research project (data collection, analysis, and write-up with or without presentation) compared to the 14.6% (6 of 41) in 1997, though less than in 1988 (22.2%).^{12,13} Results from this study showed that 65 (82%) of the colleges offered some form of research project to conduct (vs. 68% in 1997) and 20 (25%) of the colleges required some form of research project to be conducted (vs. 24% in 1997).

Since there has been a considerable increase in number of students enrolled in most colleges of pharmacy, the slight increase in percentage of colleges and programs offering an extensive research experience is heartening if one believes in the value of such projects, as is the news that 5 additional programs are considering the addition of a required project. The obvious implication of these increases in class size relative to requiring projects is expansion in workload for the faculty. It is interesting that 6 of 12 programs requiring extensive projects did not allow students to work together as a group since collaboration represents another aspect of learning that can be fostered by the projects and having each student do a project keeps the workload at the maximum for faculty members. In light of findings that research collaboration results in higher citation rates of resulting publications,¹⁷ this could be an early approach to developing teamwork skills for those who go on to further research training and research careers.

When data collection and analyses are required, much time and effort are expended by students conducting a research project and by the faculty member or other individual providing advice. Thus, requiring projects leads to opportunity costs such as time taken away from clerkships, studying, or other activities for the students and the many other ways time might be spent for the faculty advisors. In larger programs or programs with large student to faculty ratios, the impact on faculty time of a required

formal project can be great. These time constraints definitely could impact on the decision to require projects for students in first professional degree PharmD programs. In this study, however, the size of the program did not appear to impact whether projects were required or not. Conversely, benefits for faculty and students such as publications and presentations can accrue from required extensive projects in addition to the benefits associated with better student understanding of research processes and potentially enhanced likelihood of conducting future research.^{18,19} Eight of the 20 programs that required some form of project did not require data collection and analysis. Though this might be considered as a minimal experience and is certainly easier to accomplish than an extensive project, it may not achieve many of the educational outcomes that a full project could.

Important findings of this study relative to research experiences for students in doctor of pharmacy programs are that many of the responding faculty members commented that research projects allow PharmD students to develop advanced thinking skills and to understand the foundations of evidence-based medicine. The major negative issue that commenting respondents had with student research projects related to lack of resources. They did not perceive that the resources were available to support required student research experiences. The needed resources included faculty members with appropriate expertise in research as well as time for mentoring. The logistics of managing research projects for a large number of students was thought by some to be difficult or impossible. Perhaps if practice-based research networks begin to develop in pharmacy, there will be greater opportunities for external advisors to students in PharmD programs so that internal faculty members would not be stretched as far. Virtually all of these comments were reported in the previous 2 studies of research in the education of doctors of pharmacy.^{12,13} Determining optimal cost-effective educational methods for developing certain research-related skills would be of value to the academy.

A few respondents were strongly opposed to requiring all pharmacy students to complete research projects; they appeared to view research skills as highly specialized and of use only in research settings. Belief that research skills are inappropriate or integral to the practice of pharmacy has major implications for how pharmacy curricula related to research is developed. Those who believe research is only appropriate in research settings will want to restrict student research experience to "research" tracks or combined PharmD-MS or PharmD-PhD programs or other elective research opportunities. Those who believe that knowledge and skill in research are integral to the practice of evidence-based medicine will want to provide

opportunities for all students to learn skills related to conducting research.

In general, respondents were in favor of elective research projects, although relatively few students appear to participate. Some respondents seemed to think that elective projects solved the resource issues associated with required projects while allowing interested students to gain experience in research.

Possible limitations to the study include that the respondents may not have known all the data required to answer some of the questions requiring specific information and that certain of the attitudinal responses from the previous studies would have been influenced in part by the different types of PharmD programs in existence at those times. However, the comments were remarkably similar.

Today's pharmacists must be able to solve problems in a systematic way and deal with the increasing sophistication of pharmacotherapy. Pharmacist graduates should therefore be equipped with sound analytical skills to accomplish this and PharmD curricula should develop skills in these areas. Accreditation standards have focused on requirements in research-related areas to provide a degree of uniformity for the PharmD graduate, though some potential ambiguity remains. The outcomes of this ambiguity can be seen in the limited (53%) requirement for coursework in research methods. Perhaps it is time for a commitment to a stronger future for the profession through the development of research skills in all PharmD graduates.

CONCLUSIONS

This study provides pharmacy educators with information on the variability of research-related coursework and research experiences in PharmD programs across the country. Most colleges require coursework in areas that support some understanding of research and a smaller number have committed to providing research application opportunities to their students. Future research in this area could focus on the types of research being conducted by students in entry-level programs, where the data are being collected and how it is analyzed, and in comparing methods for the training of individuals in research skills at this level of their careers.

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