

Writing a research proposal: A workshop course developed for Pharm D students

MARION K. SLACK*, TERRI WARHOLAK, JOHN E. MURPHY

The University of Arizona College of Pharmacy, Tucson, Arizona, USA.

Abstract

Background: Students typically need substantial assistance in writing research proposals since few have relevant experience.

Aims: To describe a course for assisting students to write a research proposal.

Method: Workshops consisted of a short lecture on writing a specific proposal component, a proposal outline, and an interactive class format using worksheets. Advising individual student groups was shared between the course instructor and project adviser. Rating scales were used for summative evaluation.

Results: Proposals written during the course were rated higher ($p < 0.05$) than were proposals written without the course. The mean knowledge rating was substantially higher on the post-test (4.3 on a scale of 0 to 5) than on the retrospective pretest (1.4; $p < 0.001$).

Conclusion: A course developed to enable students to write a proposal for a research study in which mentoring was shared between the project adviser and the course instructor, a focus on the writing aspects of proposal development, and a workshop class format, was associated with higher ratings of quality as well as higher ratings of knowledge learned.

Keywords: *workshops, writing, research proposal, student research*

Introduction

Pharmacy based research has been called an important tool for evaluating the outcomes of pharmaceutical care and medication management. The ability to document the positive effects of pharmacists' interventions is important to receiving recognition and payment for these services (Jamerson & Herring, 2007). Additionally, the practice of evidence based medicine depends on the use of evidence derived from scientific studies (Sackett *et al.*, 1996) and hence, the ability to generate the evidence by conducting research. The need for research related coursework and the opportunity to conduct research in pharmacy schools has been widely recognized. The American College of Clinical Pharmacy published an essential curriculum for Doctor of Pharmacy degree programmes in 2010 (Lee *et al.*, 2010). The Accreditation Council on Pharmaceutical Education draft guidance identifies research design that is "...required to conduct valid and reliable studies..." and the biostatistics related to the "Appropriate use of commonly employed statistical tests..." as required elements of the didactic curriculum (ACPE, 2014). After the European expert committee on pharmacy education recommended that pharmacy courses include a research project, the Royal Pharmaceutical Society of Great Britain decided to require completion of a "significant" research project in the final year of the professional pharmacy curriculum (Langley, 2007).

A requirement that students complete a research project implies that appropriate teaching is contained in the curriculum to support students through the process of conducting a research investigation. However, despite discussion in the literature about the need to support students who are expected to conduct research as part of their professional programmes, (Rosenberg, 1999; Zier *et al.*, 2001) there is little literature describing course work supporting students during the research process. While Murphy *et al.* (2007) reported that respondents from 12 schools of pharmacy in the United States (US) stated they required a written proposal as part of student research projects, no data were collected on specific courses aimed at supporting students during the proposal writing process. A second report described having students write mock proposals in an elective course on the design and conduct of clinical research (Boucher, 2004). Another study described using a mock proposal as a method of preparing students to write their own study proposal (Sauer & Draugalis, 2000). Using a published research report, students worked in groups to write the mock proposal. Students wrote the proposals for their own study later. Recently, a required research proposal without data collection and analysis for third year pharmacy students has been described (Vaidean *et al.*, 2013). The students worked with an adviser to identify a

*Correspondence: Prof. Marion K. Slack, *Professor of Pharmacy Practice and Science, The University of Arizona College of Pharmacy, 1295 N. Martin Ave. PO BOX 210202, Tucson, Arizona 85721-0202, USA. Tel: +1 520 626 1099; Fax: +1 520 626 4063. Email: slack@pharmacy.arizona.edu*

topic and formulate a research question and develop the proposal. The standardised format for the proposal was based on the problem/population, intervention, comparison, and outcome (PICO) format. The purpose of this article is to describe a course specifically designed to support students as they write a proposal to guide data collection and analysis for a required student research project.

Rationale/Objectives

Prior to the development of the proposal course, professional students were mentored using the same procedure used for graduate students as they wrote their project proposal. Individual students identified a project adviser and worked with their adviser to write their proposal, submit to the institutional review board for the protection of human subjects if required, collect data, analyse data, write the research report, and present a poster. This approach resulted in a heavy work load for advisers as they often would need to repeat instructions to different students as well as manage the process. Additionally, there was a lack of standardisation of the proposals.

A single voluntary workshop was offered to address these issues, however, not all students attended them and the single workshop was not adequate to support students through the entire proposal writing process. Therefore a one-semester two-hour required course in which mentoring was shared between the adviser and the course instructor was developed; the instructor focused on the writing aspects of the proposal and the project adviser focused on providing content expertise. This article describes the course on writing a scientific research proposal that students take in the third professional year of their pharmacy programme. It is the first of three courses related to the student research project. The overall objective of the course described here was to enable professional pharmacy students, working with their advisers, to write a proposal that would guide subsequent data collection and analysis as well as provide basic experience in scientific writing. The specific course objectives were that students will be able to write a problem statement, identify appropriate literature and write a review, write a purpose statement and hypothesis, develop a data collection form, write a methods section, identify information appropriate to each section of the proposal, and use appropriate scientific language to write the proposal.

Methods

Design

This is a descriptive study of a two credit hour workshop course for writing a research proposal. The primary student deliverable was a research proposal that would guide the collection and analysis of data for the project. The research project could be of any design and on any topic related to health care or public health including

laboratory research in pharmaceuticals or pharmacology, clinical studies using chart reviews to collect data, studies using questionnaires, interviews, or focus groups, or systematic reviews and meta-analyses.

The individual classes/workshops were based on a task analysis (Gagne & Briggs, 1979) of the terminal skill. For instance, for the objective, write a problem statement, the student had to recognise the type of information that is included in a problem statement, locate the appropriate information, and apply the rules for writing the problem statement, as well as be able to construct sentences consistent with scientific writing.

Subjects

Eligible participants were students in the third year of the four year professional pharmacy programme. There were between 50 and 100 students in each class. Similar to other student research programmes reported in the literature, (Ogunyemi *et al.*, 2005; Overholser *et al.*, 2010) students could work by themselves or in groups of two or three students. Allowing students to work individually or in groups addresses the issue of student preference for working individually or in a group, and provides the flexibility to respond to the needs for studying particular project topics. Data collection from students for this study was designated as exempt by the IRB.

Description of the Course

The course was designed as a series of workshops with each class focused on identifying information needed and on drafting specific content for sections of the proposal. Using a workshop format shifts the focus of class sessions from presentation of information to providing tools and developing cognitive skill. The two primary tools provided were the outline for the proposal (Appendix A) and the worksheets for drafting content during class. The outline format supports a systematic and logical approach to research (Rossenwasser *et al.*, 1997) that assists students in developing the scientific reasoning process. The outline was compared to the CONSORT guidelines to assure that it is consistent with their standards (Schulz *et al.*, 2010). The outline served as an intelligent tool that facilitated work and increased the likelihood that the work would meet quality standards (Wiggins & McTighe, 2005). The outline also served as the organising framework for the workshops, and as a 'to do' list of tasks to complete.

Key topics and key workshop activities are shown in Table I. The first topic listed is a presentation on time and adviser management. Successfully writing a research proposal and implementation of the protocol requires that students work with a faculty member as colleague/mentor and manage a project; this workshop provided basic strategies for managing time and for interacting with faculty advisers.

Table I: Topics and Workshop Activities for the Writing a Research Proposal Course

Topics	Workshop Activities
Time and adviser management	Interactive slide presentation discussing strategies for time management and strategies for productive interaction with project advisers.
Review example proposal	Students are provided a copy of an example proposal with a worksheet that directs their attention to specific components or details of the proposal. The example illustrates the proposal format that is required. On completion, characteristics of the example proposal are discussed.
Review literature	A role play with the instructor acting as a student consulting a librarian about identifying appropriate literature for the literature review is presented. A worksheet is used to guide observation of the role play. Time is provided for students to conduct searches and consult with the librarian.
Data Collection Forms	Example data collection forms are reviewed. Students retrieve an (electronic or paper) example appropriate for their study and begin drafting their own data collection form during class.
Questionnaires	An interactive slide presentation on questionnaires and an example is presented during one class followed by 2 one-hour workshop sessions during which students work on their questionnaires. A flowchart (see Appendix B) is used to guide selection of methods, i.e. questionnaires, focus groups, or interviews.
Methods Section	The methods section from the example proposal is reviewed then students draft sections on the methods using a worksheet. Specific wording is suggested to assist students with organising their thoughts.
Data Analysis	Specific format for writing the data analysis section is presented using an example then time is provided for students to draft the data analysis section for their primary hypothesis.
Writing the Problem Statement	Three paragraph strategy for writing the problem statement is demonstrated using an example. Worksheet and time in class are provided for drafting each of the three paragraphs.
Human Subjects (IRB)*	Staff member from the IRB and the College Representative to the IRB give presentations and respond to questions on completing an IRB application.
Critique of proposal	A quality rating scale is presented then distributed; students rate their proposals.
Submit completed proposal	A paper copy of the proposal is submitted for faculty review. Electronic copy is uploaded into course management system.

*IRB = institutional review board

The topic, writing the problem statement (Table I), provides an example of the instructional strategy. Using a backward design approach (Wiggins & McTighe, 2005) and task analysis to identify the prerequisite skills for the specific content, (Gagne & Briggs, 1979) the instructional strategy for the topic and the tools required were identified. The instructional strategy used to enable students to write the problem statement was to identify the components of the problem statement (topic definition, description of importance, and identification of the gap in knowledge or the problem), use a worksheet with separate headings for each paragraph topic and begin the workshop by describing the task then displaying an example and identifying the key characteristics of the paragraphs. Time was provided for students to begin drafting the relevant paragraph. Generally while students worked on writing, the instructor circulated around the room answering questions. Worksheets were submitted, although no credit was allocated, and returned to students the next day.

The same general instructional strategy was used for most of the workshops (Table I) with occasional modifications. For example, the workshop on searching for literature uses a role play to demonstrate how to interact with the librarian to obtain appropriate studies for review as well as to identify other needed information (Martin *et al.*, 2010). The worksheet uses questions to focus students' attention on specific aspects of the role play then time is provided for students to begin their literature search.

Due to quality issues that arose in the past with students using questionnaires for data collection, questionnaires were separated from other data collection forms and specific times provided for assistance with developing questionnaires and questionnaire items. During the first workshop, students were asked to work through an algorithm (Appendix B) to determine if a questionnaire, focus group, or interviews would be the best approach to data collection. The second workshop focused on providing consultation to students as they worked on developing the questionnaire.

The completed proposals were submitted at the end of the semester. The primary instructor graded them as pass or fail for purposes of assigning a course grade then sent the proposals to a second faculty member for review. The purpose of the review is to provide feedback and as a quality check however, the reviewer does not grade the proposal. The proposal is graded by the project adviser.

Evaluation

Three methods have been used to evaluate the course: 1) a quality rating of completed proposals for the last class of students that wrote proposals without the workshop course and the first class of students who wrote their proposals while attending the workshop course; 2) a perceived knowledge gained scale using a retrospective pretest and post-test assessing what students believed they knew about writing a research proposal at the beginning of the course and after completing the course; and 3) feedback comments from the worksheets. The

quality scale, consisted of 16 items that scored the problem statement, literature review, purpose and hypotheses, methods, references, timeline and budget, and overall quality using a seven-point scale from zero (not at all) to six (very well). A graduate student who was not blinded to class membership initially assessed and rated the proposals. The proposals were assessed and rated a second time by graduate students who were blinded to class membership then the ratings were averaged. The average rating was used for the analysis.

The perceived knowledge gained scale asked students to rate their level of knowledge at the end of the course and at the beginning of the course using a retrospective pretest. A retrospective pre-post-test is a “self-report during the course or at the end of treatment that measured subjects’ recall of how they were functioning before programme outset” (Davis, 2000). A retrospective pretest was used to avoid response shift; that is, the metric that respondents use to rate their perceived skill or knowledge changes from the beginning of the course to the end of the course (Howard, 1980; Nicholson *et al.*, 1985; Slack *et al.*, 2001). The topics and scale used in this evaluation are similar to the scale used by Overholser *et al.* (2010) to assess familiarity with research topics. Other studies have used a rating scale for confidence (Vaiden *et al.*, 2013) and an agree/disagree scale to assess student perceptions of the research process (Kim *et al.*, 2010). The rating scale, used in this study, was anchored on the low end with zero, no idea at all, and on the high end with five, a very good idea. There were items related to writing the problem statement, the literature review, the purpose and hypotheses, and the data selection section as well as items on identifying the study design, determining the sample size, and describing the variables, the data collection procedures, and the data analysis.

Finally, two questions were added to the in-class worksheets to obtain formative feedback. One question asked ‘What was most helpful about this class?’ and the second asked ‘What would improve this class?’

The data from the quality rating tool and the knowledge gained questionnaire were analysed by calculating means, and standard deviations (SDs). The overall means for the quality scores were compared using an independent groups t-test and the baseline versus post-course ratings of perceived knowledge were compared using a dependent groups t-test. All statistical tests were conducted using Excel[®] (Microsoft, v.2010). Key comments from the worksheets were identified and presented in a table. The a priori alpha level was 0.05.

Results

There were a total of 51 projects completed by the Class of 2013. About 55% of the student projects involved some aspect of pharmacy practice, 25% were systematic reviews or meta-analyses, 4% were studies of an educational issue related to the pharmacy curriculum, 4% were laboratory based studies, and 2% involved other issues. One study of the effects of counselling using the teach-back method was a randomised controlled trial; randomised controlled trials are an unusual design though and are not used often.

The findings from the quality assessment comparing the last class that wrote their proposals without the course workshops to the first class that had the proposal writing course workshops are shown in Table II. (Note: Students in both classes could work in groups or individually.) The average difference in the ratings between the two classes was 1.5 (SD = 0.71) favoring the proposals written through the course. All 16 items were rated significantly higher ($p < 0.05$) for the students who had the course. Thus overall, having a course with workshops for writing the proposal resulted in higher quality ratings.

Table II: Quality Ratings for Student Proposals Before and After Institution of the Proposal Writing Workshops

Quality Item	Before Writing Course Mean (SD)*	After Writing Course Mean (SD)	p-value
(1) Definition of topic provided in problem statement	3.4 (1.9)	4.8 (1.9)	0.023
(2) Extent that importance is described	3.2 (1.5)	4.8 (1.3)	0.001
(3) Extent that primary literature is used in literature review	3.9 (1.6)	5.8 (0.6)	<0.001
(4) Extent that study is described and findings provided for reviewed studies	3.3 (1.7)	5.4 (1.1)	<0.001
(5) Extent that supporting data is provided in reviews	2.6 (1.4)	4.8 (1.94)	< 0.001
(6) Extent that methods similar to proposed methods are described	2.2 (2.75)	4.8 (1.9)	< 0.001
(7) Extent that study design is clearly identified	4.3 (1.8)	5.7 (0.6)	0.001
(8) How well study variables are described	3.4 (1.6)	5.0 (1.2)	0.001
(9) How well procedure for obtaining & recording data is described	4.4 (1.0)	5.5 (0.7)	<0.001
(10) How well is procedure for analyzing data to respond to hypothesis described	4.2 (1.0)	5.3 (1.0)	<0.001
(11) How well does reference list comply with requirements	5.3 (0.3)	5.9 (0.3)	<0.001
(12) How well is timeline adapted to individual needs	3.4 (0.7)	5.2 (0.8)	<0.001
(13) Extent that content is in appropriate sections	4.5 (0.9)	5.8 (0.4)	<0.001
(14) Rating of overall use of grammar and sentence structure	5.1 (0.4)	5.6 (0.6)	0.001
(15) Rating of overall quality	3.8 (1.0)	4.8 (0.7)	<0.001

*SD = standard deviation

The findings from the student ratings of perceived knowledge gained at the end of the course and at the beginning of the course using a retrospective pretest are shown in Table III. As can be seen from the table, most students believed that they had very little idea of how to write a research proposal at the beginning of the course (overall mean rating = 1.4, SD = 1.28). At the end of the course, students believed that they had a good idea of what to do (overall mean rating = 4.3, SD = 0.76; $p < 0.001$ for comparison). The overall difference in ratings (2.9 units) suggests a substantial amount of learning.

Table III: Student Ratings of Knowledge Gain Related to Writing a Proposal^a

Step in the Proposal Process	Baseline ^b Mean (SD) ^d	At End of Class ^c Mean (SD)	p-value
1. Write the problem statement	1.4 (1.27)	4.6 (0.53) ^c	< 0.001
2. Write the literature review	1.6 (1.44)	4.6 (0.63)	< 0.001
3. State the purpose & Hypotheses	2.0 (1.42)	4.7 (0.56)	< 0.001
4. Identify the study design	1.3 (1.19)	4.3 (0.76)	< 0.001
5. Write the data selection section	1.3 (1.31)	4.3 (0.83)	< 0.001
6. Determine the sample size	1.5 (1.44)	4.3 (1.00)	< 0.001
7. Describe the variables	1.6 (1.32)	4.2 (0.86)	< 0.001
8. Describe the data collection procedures	1.6 (1.36)	4.4 (0.76)	< 0.001
9. Describe the data analysis	1.1 (1.19)	3.8 (0.97)	< 0.001
Overall Average	1.5 (1.28)	4.4 (0.76)	< 0.001

^a Contains data from multiple classes; total N = 127

^b Baseline measure is based on a retrospective pretest; the student is asked at the end of the class to rate their level of knowledge before they had the class.

^c Knowledge is derived from a rating scale for how much of an idea that students had about how to write each section, 0 = no idea at all and 5 = a very good idea.

^d SD = standard deviation

Example feedback comments from the worksheet for writing the problem statement (introduction) are shown in Table IV. Students liked the three-paragraph approach to writing the problem statement, as it gave them rules to follow for writing; they also liked the examples presented in class, and the time to work on their own problem statement during the class. Two comments on improving the class were related to what they liked about the class—that is additional examples and more time to work during class. The other comment for improvement indicated that students would like to know what would be happening in the next week’s class so that they could prepare for it.

Table IV: Example feedback comments from workshop on writing the problem statement^{a#}

What was most helpful about the class?	
	Topic sentences
	Giving us class time to work on our proposal—thanks!
	It helped organize our ideas as well as showed what was important to have in a good problem statement.
	Logical and methodical method for writing purpose statement
	The handout/lecture on what is needed in each paragraph
	Going through the specific examples to see exactly [what] we need to include
	The tip about breaking up the purpose statement into 3 major sections
What would improve the class?	
	More examples of different types of projects
	More free time to work, workshop style
	Tell class to prepare/bring in research done beforehand so it could better be done in class

Discussion

The most important findings from this descriptive study are that a course using a workshop format specifically designed to assist students with writing their research proposals was associated with a substantial increase in ratings of student learning as well as higher quality ratings of the proposals. The workshop approach worked well; it provided students with the basic information they needed to complete the task as well as provided time for drafting sections of the proposal.

The course clearly illustrates that it is difficult to translate didactic knowledge of research such as research design and statistical analysis into a project proposal. Students had completed courses in introductory statistics, research design, and drug information, however, the data on what students thought they knew about writing a proposal at the beginning of the course indicates that overall they had little knowledge of how to write a proposal (the overall baseline rating was 1.4 (SD = 1.3; 0 = no idea at all, 5 = very good idea). Hence most students would be considered novices and as novices they would require assistance with prerequisite knowledge, for example, how to write sentences that represented scientific writing.

The task of writing a proposal is authentic so students were learning a skill that could be used in meeting the requirement to write a research proposal. Anecdotally, students who completed a research project through this programme and completed a residency indicate that they have served as mentors on residency research projects to residents from PharmD programmes where students do not conduct research.

Key components of the workshop course for writing a research proposal included the task analysis, the outline for the proposal, and the worksheets. The task analysis, as recommended by Gagne & Briggs, (1979) helped identify prerequisite skills like scientific writing, that are necessary for completing the task and consequently, helped change the focus of the class from transmission of information to a workshop format.

The outline for the proposal appears to be critical to the success of the workshops. It provides the structure for the course and the topics for individual workshops. It indicates to students what they have completed and what they have yet to do. It allows both the instructor and the adviser to quickly assess work and to identify sections where students may be having difficulties. The outline also facilitates identifying links between types of information in the proposal, for example, to link the statistical analysis directly to the hypothesis. Further, the outline assures consistency in the end product, the proposal.

The worksheets have served several roles. They define the outcome expected for each workshop; for example, at the end of the workshop on data analysis, students would have a draft of the data analysis for their primary dependent variable. Worksheets were submitted at the end of class, the instructor reviewed them to identify any problems and returned it the next day. Initially, some students did not want to turn in their worksheets; they seemed afraid that their work would be lost. Also, the

worksheets have helped focus the workshops on the application of knowledge and provided a mechanism to make the class active.

There are articles in both the medical and pharmacy literature indicating that providing support to students conducting research is beneficial. Rosenberg (1999) specifically recommended that medical schools that want students to conduct research should create an environment that fosters and rewards student research. Morris *et al.* (2011) found in their study of factors associated with the publication of scholarly articles by pharmacists that training in research methods and writing as well as introduction to the publication process during training was associated with publication. Zier *et al.* (2001) found that physicians who had participated in research during medical school were more likely to conduct research during postgraduate training and to obtain faculty positions that included research. Thus research experience as students does seem to be related to participation during professional practice.

Comments from faculty who serve as advisers for student research projects indicate that the proposal writing course reduces the routine advising burden on them. Instead, they can focus on the aspects that require content expertise. The workshops avoid having multiple faculty members providing similar information to different students. Hence, the proposal writing workshops could facilitate a college's ability to offer a research experience if they have large class sizes.

Limitations

The findings of this study are limited in that it was a descriptive study that used quality assurance evaluation methods rather than methods more characteristic of rigorous research studies. That is, the outcomes were assessed primarily by using rating scales. Also, this study report describes only one course at one college of pharmacy. The outcomes are likely to depend a great deal on the overall philosophy of the college and on the specific faculty involved in the student research programme, therefore, generalizability of the findings may be limited.

Conclusions

A course developed to enable students to write a proposal for a research study in which mentoring was shared between the project adviser and the course instructor, the focus was on the writing aspects of proposal development, and that used a workshop class format, was associated with higher ratings of quality as well as higher ratings of knowledge learned. The increased ability to write a research proposal provides a solid foundation on which to build other research skills including collecting and analysing data, writing a research report, and presenting the findings at a professional meeting or publishing in a peer reviewed journal. These skills in turn develop the ability of the practitioner to undertake research which provides scientific evidence for the

practice of pharmacy that will ultimately establish the value of pharmacy care and improve patient outcomes.

References

- ACPE (Accreditation Council for Pharmacy Education) (2014). Accreditation standards and key elements for the professional programme in pharmacy leading to the doctor of pharmacy degree: Draft (online). Available at: <https://www.acpe-accredit.org/>. Accessed 16th December, 2014.
- Boucher, B.A. (2004). Design and conduct of clinical research: An elective course. *American Journal of Pharmaceutical Education*, **68**(2), Article 42.
- Davis, N.M. (2000). A medication error prevention educational retreat. *Hospital Pharmacy*, **35**, 466-467.
- Gagne R.M. & Briggs, L.J. (1979). Principles of Instructional Design. New York, New York: Holt, Rinehart and Winston.
- Howard, G.S. (1980). Response-shift bias: A problem in evaluating interventions with pre/post self-reports. *Evaluation Review*, **4**, 93-106.
- Jamerson, B. & Herring, C. (2007). Pharmacy-based clinical research: Principles and practices. *America's Pharmacist*, **November**, 37-50.
- Langley, C.A., Jesson, J.K., Wilson, K.A., Clarke, L. & Hatfield, K. (2007). What purpose does the MPharm research project serve? *Pharmacy Education*, **7**(3), 199-205.
- Lee, M.W., Clay, P.G., Kennedy, W.K., Kennedy, M.L., Sifontis, N.M., Simonson, D., Sowinski, K.M., Taylor, W.J., Teply, R.M., Vardeny, O. & Welty, T.E. (2010). The essential research curriculum for doctor of pharmacy degree programs. *Pharmacotherapy*, **30**(9), 966.
- Kim, S.E., Whittington, J.I., Nguyen, L.M., Ambrose, P.J. & Corelli, R.L. (2010). Pharmacy students' perceptions of a required senior research project. *American Journal of Pharmaceutical Education*, **74**(10), Article 190.
- Martin, J.R., Kramer, S. & Slack, M.K. (2010). Demonstrating the Literature Search Process through Innovative Role Play Instruction for Pharmacy Students. [abstract] *American Journal of Pharmaceutical Education*, **74**(10), 190.
- Morris, C.T., Hatton, R.C. & Kimberlin, C.L. (2011). Factors associated with the publication of scholarly articles by pharmacists. *American Journal of Health-System Pharmacy*, **68**, 1640-1645.
- Murphy, J.E., Slack, M.K., Boesen, K.P. & Kirking, D.M. (2007). Research-related coursework and research experiences in Doctor of Pharmacy programs. *American Journal of Pharmaceutical Education*, **71**(6), Article 113.
- Nicholson, T., Belcastro, P.A. & Gold, R.S. (1985). Restrospective pretest-posttest analysis versus traditional pretest-posttest analysis. *Psychological Reports*, **57**, 525-526.

Ogunyemi, D., Bazargan, M., Norris, K., Jones-Quaidoo, S., Wolf, K., Edelstein, R., Baker, R.S. & Calmes, D. (2005). The development of a mandatory medical thesis in an urban medical school. *Teaching and Learning in Medicine: An International Journal*, **17**(4), 363-369.

Overholser, B.R., Foster, D.R., Henry, J.R., Plake, K.S. & Sowinski, K.M. (2010). The influence of an elective introductory clinical research course on pharmacy student interest in pursuing research-based careers. *American Journal of Pharmaceutical Education*, **74**(9), Article 165.

Rosenberg, L.E. (1999). Physician-scientists- Endangered and essential. *Science*, **283**, 331.

Rossenwasser, D. & Stephen, J. (1997). *Writing Analytically*. Fort Worth, Texas: Harcourt College Publishers.

Sackett, D.L., Rosenberg, W.M.C., Gray, J.A, Haynes, R.B., Richardson, W.S. (1996). Evidence based medicine: what it is and what it isn't. *British Medical Journal*, **312**, 71-72.

Sauer, K.A. & Draugalis, J.R. (2000). Mock proposals and other group assignments: Bridging didactic research evaluation skills to research application. *American Journal of Pharmaceutical Education*, **64**, 307-312.

Schulz, K.F., Altman, D.G. & Moher, D. (2010). The CONSORT Group: CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *Annals of Internal Medicine*, **152**, Epub 24 March.

Slack, M.K., Coyle, R.A. & Draugalis, J.R. (2001). An evaluation of instruments used to assess the impact of interdisciplinary training on health professional students. *National Academies of Practice Forum*, **3**, 59-67.

Vaidean, G.D., Vansal, S.S., Moore, R.J. & Feldman, S. (2013). Student scientific inquiry in the core curriculum. *American Journal of Pharmaceutical Education*, **77**(8), Article 176.

Wiggins, G.P. & McTighe, J. (2005). *Understanding By Design*. Association for Supervision and Curriculum Development. EBSCO Publishing: eBook Collection.

Zier, K. & Stagnaro-Green, A. (2001). A multifaceted program to encourage medical students' research. *Academic Medicine*. **76**(7), 743-747.

Appendix A

Proposal Outline and Associated Key Content*

Section Headings/ Subheadings	Content
I. Proposal Checklist (page 1)	Checklist of proposal content; student and adviser verify items and adviser signs; 15 page limit for proposal excluding appendices
II. Title Page (page 2)	Title of project, course title, date, faculty adviser(s) and student(s)
III. Abstract (page 3)	Background, purpose, specific aims with working hypothesis, and significance/ expectations/impact
IV. Introduction (begins on page 4)	

A. Problem Statement (2 page limit)	Definition of topic (e.g. disease state or medication errors); importance of topic (epidemiology & cost); rationale for study (i.e. gap in literature or practice issue addressed)
B. Literature Review	Review of primary research reports related to topic; four reviews are required, one must be a review of a study using methods similar to what student(s) propose to use; adviser may require additional reviews
C. Purpose Statement	Focused and specific
D. Specific Aims/ Working Hypotheses	Typically state hypotheses as directional rather than in the null form
V. Methods	
A. Project Design	Identify specific study design, e.g. pretest-posttest, retrospective descriptive design
B. Subject or Data Selection or Product Selection [#]	Description of sampling method for surveys or delineation of patient inclusion and exclusion criteria for chart reviews, study criteria for systematic reviews, criteria for selecting products for lab studies
C. Human Subjects [§]	If project involves human subjects, state that application will be made to University IRB; if study does not involve human subjects state not applicable and why
D. Sample Size; Replicates for lab studies	Estimate number of subjects or items to be included in the study and describe rationale for estimate
E. Instruments and Variables a. Independent variable b. Instruments c. Dependent variables d. Descriptive/ demographic [%]	Description of the data collection instrument including process for developing questionnaire is provided here; identify independent, dependent, and demographic or descriptive variables
F. Data Collection and Storage Procedures [^] a. Data collection procedures b. Data storage procedures	Describe how data will be collected, e.g. questionnaire will be distributed 10 minutes before the end of a required class; for projects collecting data on humans, data storage on a secure College server is provided
G. Assumptions and Limitations	Recognize assumptions of the study (e.g. participants can understand the questions and answer accurately) and primary limitations related to generalizability of the findings
H. Planned Data Analysis	Relate planned data analysis to each hypothesis; describe how descriptive or demographic data will be analyzed
VI. Project Completion Timeline	Include rotation schedule, vacation, presentation of poster at state or national meeting
VII. Line-Item Budget	Provides estimate of true costs as if all items were actually paid for; actual cost to student(s) is specifically identified
VIII. References	Use same style required for drug information questions
IX. Appendices	Copies of data collection forms and other supporting documents

*A Word file is provided that contains the format and headings and subheadings for the proposal

[#]For laboratory based studies; a separate format/outline is provided for students conducting laboratory studies

[§]Omitted in laboratory study proposal

[%]Identified as control variables for laboratory studies

[^]Identified as Laboratory/Testing Procedures for laboratory studies

Appendix B

Survey Appropriateness Decision Aid

