

Development of a Course to Promote Research Awareness in Pharmacy Students

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ABSTRACT. A 1-credit elective course, Pharmacy Research Seminar, was established to give pharmacy students at all levels an appreciation of the research process. The course, which has been given for two consecutive years, consists of a weekly presentation and discussion by a senior honors student or faculty member representing all pharmacy disciplines. The presenters describe how they approach a research problem. Students are graded on the basis of team-produced essays, summarizing the presentation, and posing questions generated by the group. At the end of the course, students are asked to complete a course evaluation. Evidence indicated a change in the student's view of pharmacy research and a possible effect of their career plans. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworthpressinc.com]

INTRODUCTION

In the standard pharmacy curriculum, information is frequently presented to students as a discrete set of immutable facts when in reality it is a complex array of data that evolved from observations, curiosity, and carefully designed experiments (1). Moreover, the scientific knowledge base

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continues to evolve as new information becomes available, yet, our students are rarely taught to appreciate the origin and evolution of the knowledge they acquire. A literature evaluation course begins to make students more aware of the research that leads to the myriad of facts. Such a course teaches students how conclusions are drawn and how to interpret results. However, the well-educated pharmacy student must also gain an understanding of the various approaches to the complex problems hindering the advancement of health care. Faculty involved in research understand that complex problems must be simplified before being addressed. We are aware that with the many approaches to simplifying and addressing the problem, the choice of an approach can affect the results and conclusions one obtains. A similar understanding of the approach and process would give our students a better understanding of the ambiguities, limitations, and value of the research results presented in the literature. This will also lead to a better understanding of the evolution of the knowledge base in pharmacy. The student who can appreciate this evolution of our knowledge base is better equipped to discuss apparently contradictory findings with the lay public and other health professionals. Therefore, it seems appropriate to develop a course to address these issues.

The results of a study by Winans and Madhavan (2) suggest that students who are exposed to research through courses, projects, or mentors have more confidence in their perceived research ability and knowledge. Further, those with increased confidence are more likely to pursue graduate education toward a research career. When asked for ways faculty could encourage more students to become interested in research or research-related activities, some students responded, "Tell us about it" (2). Thus, it appears that a second benefit of such a course would be to increase student involvement in research. This is becoming more important since pharmacy student enrollment in graduate programs has been declining (3). In addition, there are numerous reports calling for schools and colleges of pharmacy to develop new programs that encourage students to pursue graduate education (4-7).

In the fall of 1995, a course entitled "Pharmacy Research Seminar" was offered at the University of Connecticut to provide a formal structure in which current research areas and contemporary issues in pharmaceutical sciences and pharmacy practice can be discussed. The class was originally designed to provide a research topics course for the School's honors students to assist them in selecting a research project, but quickly evolved into a more generalized research discussion for all interested students. Consequently, while one intent of the course was to familiarize students with the research being conducted by the faculty of the School, there was a

broader intent of introducing students to the wonders and excitement of the research experience.

COURSE DESCRIPTION

Learning Objectives

The objectives of the course are:

1. to demystify the research process,
2. to provide a forum for interested students to inquire about and obtain more of an in-depth appreciation of the research leading to the principles taught in the traditional didactic curriculum,
3. to provide an environment that encourages independent learning through small group discussion and critical evaluation of presentations,
4. to sharpen students written communication skills, and
5. to encourage students to explore research opportunities in their professional careers and consider graduate studies in pharmacy.

The course most notably addresses the Outcome/Competency 5B, Scholarly Concern for Improvement, listed in Background Paper II from the AACP Commission to Implement Change (8). Specifically, it states that “Entry-level pharmacy graduates must recognize the need to increase their knowledge to advance the profession through *systematic, cumulative research* on problems of theory and practice [*emphasis added*].”

Prerequisites

There are no formal prerequisites for this course. Thus, students of all levels and backgrounds, pharmacy, prepharmacy, and other majors, work together in this course. Some mentoring results from this arrangement.

Since topics differ each year, students may repeat the course up to two more times. Students repeating the course a second time are required to give a seminar in the course.

Course Format

The course is offered as a 1-credit elective each fall, meeting once a week for 50 minutes. Senior honors students are required to present their

thesis research as part of the class. Remaining class sessions consist of presentations by faculty selected from among those who wish to participate. The topics of the presentations vary from the laboratory sciences to the social, administrative, and clinical sciences. In so far as possible, a balance among the various research areas is sought. The offerings each year are representative of the current research emphasis of the faculty. Table 1 shows the variety of topics presented in the first two offerings of

TABLE 1. Topics of Presentations in "Pharmacy Research Seminar."

Course Offered Fall 1995
<p>Introduction to Pharmacy Research</p> <p>Scientific Integrity (Part I of a two-part workshop)</p> <p>Role of the Inflammatory Response to Outcome of Lung Injury</p> <p>Micro- and Bulk Viscosity of Polymer Solutions (Student Seminar)</p> <p>Properties of Enteric Coating Polymers (Student Seminar)</p> <p>Drug Permeation Across Bovine Brain Endothelial Cell Culture (Student Seminar)</p> <p>Genetic and Environmental Facets that Underlie Colon Cancer Risk</p> <p>Microparticulate Drug Delivery Systems</p> <p>Scientific Integrity (Part II of a two-part workshop)</p> <p>Research in Cardiovascular Pharmacology</p> <p>Examples of Clinical Pharmacy Practice Research</p> <p>Evaluation of a Device to Enhance Patient Adherence to Prescribed Drug Therapy</p> <p>Computer-Based Drug Design</p> <p>Liver and Kidney Damage Caused by Acetaminophen</p>
Course Offered Fall 1996
<p>Introduction to Pharmacy Research</p> <p>Interaction of Enteric Coating Polymers with Malononitriles (Student Seminar)</p> <p>Homeopathic Drugs (Student Seminar)</p> <p>The Use of Antidepressant Drugs in the Elderly (Student Seminar)</p> <p>Optimizing Drug Therapy for the Individual Patient (Student Seminar)</p> <p>The Potential for Opportunities in Managed Care Study (Student Seminar)</p> <p>Effects of Activation of Peroxisome Proliferator Activated Receptor Alpha on the Susceptibility to the Action of Model Hepatotoxicants (Student Seminar)</p> <p>Macromolecular Absorption Across Alveolar Surfaces of the Lung</p> <p>The Ethical Use of Animals in Research</p> <p>Cellular Uptake of Antisense Oligonucleotides</p> <p>Carbohydrates as Drugs and Potential Therapeutics</p> <p>Research Opportunities in Psychiatric Pharmacy</p> <p>Delivered Dose and Toxicity of Inspired Vapors</p> <p>OTC Needle/Syringe Availability in the Community Setting</p>

the course. After an introductory session, the faculty and honors students make weekly presentations. Each year, we have included a presentation on a social/ethical issue facing researchers. In 1995, presentations on scientific integrity were included in the series. In 1996, there was a seminar on the use of animals in research. These topics were included to expose students to the broader issues surrounding science.

Each class period consisted of a 45-minute presentation. Speakers were asked not to present a formal research seminar, but rather were encouraged to discuss how their research problem was formulated and approached. The most effective presentations consisted of a short autobiography of the presenter (1-3 minutes), a general background of the area of the presenter's expertise (3-5 minutes), a discussion of the research problem and its significance (15-20 minutes), a discussion of methods and results (10-20 minutes), and a discussion of the conclusions and how they relate to the significance (5 minutes). This format was provided to each presenter in advance. At the end of the 45-minute presentation, there were 5 minutes for questions. Student teams met during the week to discuss the presentation.

The course has been offered twice, fall 1995 and 1996 (20 and 14 students enrolled, respectively). In preparing for the course, we expected students to ask questions at the end of each seminar. In fact, we expected the class to be rich with student interaction. With this in mind we structured the 1995 offering of the course such that the presentations were followed by discussion with and among the students. After the expected discussion, each student was to write a one- to two-page essay containing a summary of the seminar and their reaction to it. While the reactions to the seminars in the essays were rich, there was little discussion immediately following the seminars. It seemed to us that students needed more time to digest and integrate the information presented during the seminar before they could formulate questions. Therefore, a change was made in the second offering of the course.

Instead of trying to extract discussion from reticent students after seminars, we now group the students into teams of three or four. Where possible, each team consists of students from various levels (a prepharmacy student, a professional program student, a senior student, and a student involved in a research project). After each seminar, teams are required to meet to discuss the seminar, clarify ideas and concepts, generate ideas and questions, and have their questions answered (usually by the person who presented the seminar). Students quickly learn to meet early in the week so there is time remaining to contact the presenter in person or by e-mail to pose their questions. Each week, a reporter from the team writes a three- to

four-page essay summarizing the seminar and the team's discussion. The responsibility of reporting is rotated among the students.

Course Grading

The course grade is determined by attendance (10%), essays (50%), peer grade (20%), and final exam (20%). The essays are graded based on clarity of expression, completeness of the summary of new information, ideas/questions generated by the team, and evidence that answers were obtained. All members of the team receive a common grade for the ideas/questions generated by the team and evidence that answers were obtained. Only the reporter is graded on clarity of expression and completeness of the summary. Peer grading is included to assess individual effort in the teams rather than to assess overall performance. Each student is asked to assign a grade from 0-100%. The peer grades for each student are averaged. Peer grading is performed twice per semester so that we can provide feedback to students on their expected level of effort. The final exam consists of a course evaluation and several open-ended questions to determine what influence the course had on the student's perception of research and career plans. The final exam (Tables 2 and 3) is liberally graded based on effort put forth rather than on content.

COURSE EVALUATION

Twenty students registered for the class the first year and 14 registered the second year. Two of the students who took the course the first year chose to repeat the course at its second offering. The final exam consisted of an objective survey (see Table 3) and a series of open-ended essay questions (see Table 2). The surveys were returned separately from the final exam paper to assure confidentiality. The survey consisted of a series of statements to which students were asked to respond on a standard Likert scale. The 1995 survey differed slightly from the 1996 survey. Where the survey questions overlapped, a pooled score is given in the summary of results (see Table 3). There was no statistically significant difference between the survey responses given in 1995 and 1996, except where noted.

The students overwhelmingly agreed that the course met or exceeded their expectations (Statement 1; 4.29/5.00) and that they enjoyed the course (Statement 3; 4.43/5.00). Students agreed that the course affected their view of pharmacy research (Statement 6; 4.10/5.00). However, they were mixed as to whether the course affected their career plans (State-

ments 7 and 11). The course appeared to solidify the plans of many students, but other students are "keeping their options open." However, the course encouraged at least three students to actively pursue their research interests the following semester. One student went on to enroll in our honors program, finish a thesis, and is now enrolled in a Pharm.D. program. A second student, an honors student, began clinical research the summer after taking the course the first time and has since decided to pursue a graduate degree in the pharmaceutical sciences. A third student, an honors student, is in the process of identifying a research supervisor in the field of nutritional sciences. In addition, one student who had previously intended to apply to medical school was excited by research and is now enrolled in a graduate program in the pharmaceutical sciences.

The first year the course was offered, we asked whether students would benefit from small-group discussion (Statement 18a). The answer was only slightly better than neutral (*i.e.*, 3.17). However, in the second year when small-group discussions were implemented, the students reported that they did benefit from this change (Statement 18b; 4.54). In fact, there is a significant difference between the response to Statement 18 in 1995 and 1996. It was interesting to see that the students not exposed to the small-group discussions underestimated their value.

Students involved in group discussions reported a slight increase in the time devoted to the course. However, even with this increase in time devoted to small-group discussion, students still did not find the course to be too time-consuming (Statement 2; shift of 0.82) or involve excessive work (Statement 19; 2.00). The course was perhaps not challenging enough the first year; the extra work involved in group discussions increased the time demands, but provided a richer learning environment during the second year.

We attempted to determine the reasons that students did not ask more questions immediately following each seminar. The main reasons appear to be a time constraint in general and limited time for the students to formulate their questions (Statement 24, 3.19; and Statement 26, 3.97). The lack of questions had much less to do with feelings of intimidation and lack of interest (Statements 25, 2.48; 27, 2.33; and 28, 2.10). It appears that students presented with such new ideas each week just need time to put their thoughts in order and formulate questions. It was observed that those students who more readily asked questions immediately after the seminars were the more senior students. However, within the constraints of the small sample size we saw no correlation between survey responses and student level (*i.e.*, years in school or honors/nonhonors). It seems that small-group discussions are more beneficial to junior students,

TABLE 2. A Sample of Student Responses to Open-Ended Questions.

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1. *What seminar format (not content) did you prefer?*
 - liked receiving handouts of the slides presented by the speaker
 - liked when the speaker posed questions at the beginning of the presentation to generate interest and attention
 - preferred presentations with lots of background so students can better understand the research
 - class sessions should be longer with more credits
 2. *Should we encourage more interaction/discussion? If so, how?*
 - liked the small group discussion
 - give introductory reading material a week ahead of time
 - lengthen class sessions
 3. *Did you find it worthwhile to write essays? Why or why not? Can you suggest an alternative to writing essays?*
 - writing essays was difficult
 - noticed an improvement in my writing skills
 - writing essays helped organize/solidify/clarify thoughts and enhance understanding of the material
 4. *What impact, if any, has this course had on your professional plans?*
 - this course opened up a lot of possibilities for the future; I never knew there was more than "working in a pharmacy" or that research was more than discovering new molecules
 - this course solidified my interest in graduate school
 - one seminar showed that there is research in community pharmacy, too
 - I knew there were certain types of research I never wanted to do and I still don't want to do them
 5. *What impact, if any, has this course had on your view of pharmacy research?*
 - broadened my view of research
 - surprised at how specific each research project is and how it all builds to answer bigger questions
 - learned that lack of funding can be discouraging
 - before taking this course, I thought research meant working in a smelly lab; now I have found out that research is diverse and can mean working with patients in the community or working in a lab
 - I have more respect for pharmacy research and for the professors
 - pharmacy research is not as dull as I thought
 - I had a negative attitude toward research; this course actually made me want to consider doing it

6. *What did you like best about the course?*

- group discussions were helpful
- relaxed atmosphere
- to see students successfully engaged in research
- the variety of topics each week
- learning about new career opportunities
- hearing the passion that professors feel for their research; often this does not come through in required courses
- learned about topics I might not have encountered until later in the curriculum; gave me an edge over other students
- hearing the more personal nature of those involved in research from the short biographies given at the beginning of the presentation

7. *What did you like least about the course?*

- presentations seemed rushed; not enough time
- presentations that ran over time
- presentations without handouts
- trying to get the team together at a common time
- group dynamics in the assigned team
- sometimes the seminars were over my head

8. *How could this course be improved?*

- field trips to laboratories
 - lengthen the class session
 - include some industry researchers
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allowing them to express themselves more and develop their communication skills. Other responses to the open-ended survey given at the end of the course are listed in Table 2.

Evidence of Student Learning

Each week we reviewed the students' essays and provided written feedback as well as a grade. Written evaluations were provided for each essay. In addition, verbal feedback was given when the student needed encouragement to make significant improvements in writing style, the

TABLE 3. Summary of Course Evaluation Surveys.

No.	Statement	1995*	1996*	Pooled 1995/96		
		<i>n</i> = 20	<i>n</i> = 14	Avg.*	SA/A*	SD/D*
1.	This course met or exceeded my expectations.	4.22	4.38	4.29	31	0
2.	This course consumed too much of my time.	1.56	2.38	1.90	3	25
3.	I enjoyed this course.	4.35	4.54	4.43	30	0
4.	My background was NOT adequate to appreciate the material presented in this course.	2.68	2.00	2.41	7	22
5.	I would NOT recommend this course to my friends.	1.89	1.46	1.71	2	29
6.	This course has affected my view of pharmacy research.	4.22	3.92	4.10	27	1
7.	This course has NOT altered my professional plans.	2.72	3.08	2.87	9	11
8.	Since taking this course I am more likely to consider doing research in pharmacy at some point in my life.	3.83	3.77	3.81	22	3
9.	This course has broadened my view of opportunities available to someone with a pharmacy degree.	4.56	4.54	4.55	31	0
10.	This course is NOT relevant to pharmacy practice.	1.61	1.46	1.55	0	30
11.	This course has helped me gain focus on my career direction in the profession of pharmacy.	3.56	3.67	3.60	16	0
12.	During most seminars I felt intimidated by my lack of knowledge.**	2.71	1.92	2.39	8	21
13.	During most seminars I felt excited about the new ideas I was learning.	4.17	4.31	4.23	29	0
14.	This course will help me in my other pharmacy courses.	3.78	3.71	3.75	24	3
15.	This course did NOT make me aware of any new area of pharmacy that I found exciting.	1.78	1.69	1.74	0	29

*SA = Strongly Agree, A = Agree, N = No Opinion, D = Disagree, and SD = Strongly Disagree. Mean values were calculated from the scale such that SA = 5, A = 4, N = 3, D = 2, and SD = 1.

** Items showing a significant difference in scoring between 1995 and 1996 (by chi-square analysis: $p < 0.05$).

TABLE 3 (continued)

No.	Statement	1995*	1996*	Pooled 1995/96		
		n = 20	n = 14	Avg.*	SA/A*	SD/D*
16.	From this course I found a new area of pharmacy that I plan to pursue in some way.	3.50	3.15	3.35	15	6
17.	This course helped me to integrate/apply material taught in required pharmacy courses.	3.56	3.77	3.65	20	3
18a.	I would have benefited from small-group discussions after each presentation.**	3.17			9	7
18b.	I benefited from the required small-group discussion session after each presentation.**	4.54			13	0
19.	The work required for this one-credit class was excessive.	1.67	2.46	2.00	3	26
20.	This course has NOT changed my understanding about how scientists approach problems.	2.06	2.23	2.13	1	25
21.	The fifty-minute period was appropriate for each presentation.**	2.61	4.00	3.19	16	13
22.	I was able to formulate questions during class time.	2.22	2.62	2.39	3	21
23.	I found NO educational value in writing the essays for homework.	2.11	1.62	1.90	1	27
I did not ask more questions in class because:						
24.	There was not enough time.	3.00	3.46	3.19	16	13
25.	I did not want to look foolish in front of my peers.	2.56	2.38	2.48	5	18
26.	I did not have enough time to formulate my questions.	4.00	3.92	3.97	24	3
27.	I was intimidated by the presenter.**	2.67	1.85	2.33	4	19
28.	I was not sufficiently interested.	2.28	1.85	2.10	1	23
29.	I plan to take this course again next fall.	3.78	3.67	3.73	20	4

*SA = Strongly Agree, A = Agree, N = No Opinion, D = Disagree, and SD = Strongly Disagree. Mean values were calculated from the scale such that SA = 5, A = 4, N = 3, D = 2, and SD = 1.

** Items showing a significant difference in scoring between 1995 and 1996 (by chi-square analysis: $p < 0.05$).

completeness of the summary, or the effort in generating questions and getting them answered. Each week we saw evidence of student learning as their ability to write well-integrated, comprehensive summaries of the presentations improved. In addition, we noted improvement in the students' ability to formulate questions based on their understanding of the seminar and clearly summarize answers to these questions.

In addition to the evidence of learning from the essays, we noted personal and professional growth from responses to the final exam. Students overwhelmingly agreed that Pharmacy Research Seminar broadened their view of career opportunities available to them (Statement 9, 4.54). Additional evidence of personal and professional growth was seen from responses to the open-ended questions on the final exam. Many students commented that they are now aware of opportunities to do research in community and hospital settings as well as in the pharmaceutical industry. One student commented frankly, "Before taking this course, I was under the impression that pharmacy research only consisted of working in a smelly lab, but I found out that this field is very diverse." Two students commented that the course gave them the knowledge and confidence to explore research as a career option.

CONCLUSIONS

The course described in this paper is part of a larger effort to involve more of our students in original scholarly activities. We also have an active honors program in which many students (25-30) are involved in independent research projects during the academic year and in the summer. This course fits in nicely with our emphasis on the voluntary involvement of our students with original scholarly activities. Based on the open-ended and objective surveys, the course appears to have met its objectives; however, it must be noted that the data are limited due to small class sizes of elective courses such as these.

The course is personally rewarding for the faculty involved in it. The coordinators take pleasure in seeing the improvement in students' writing and critical-thinking skills during the semester as well as their professional growth and awareness of new opportunities. The presenters, both faculty and senior honors students, enjoy discussing their research. The faculty presenters also have the opportunity to entice bright young students into their field of research or into doing research with the faculty as mentor. We highly recommend that other schools and college of pharmacy offer this relatively low-maintenance, high-reward course in their elective series.

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