Enhancing
Students' Information Retrieval Skills
Within a Traditional Pharmacology Course

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ABSTRACT. The primary objective of this project was to allow undergraduate pharmacy students to employ the skills developed in an Information Systems course within a traditional pharmacology course. As a required assignment students prepared a 20-question drug monograph. The monograph required student teams to use primary, secondary, and tertiary literature, conduct a Medline search, summarize a recent research article, and provide proper references. Thirty-five monographs were completed, with grades ranging between 80% and 100%. The students accessed information, reported the findings, and provided citations. The assignment allowed students to enhance their skills in information systems and written communications, key skills for lifelong learning, and the provision of pharmaceutical care. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworthpressinc.com]*

INTRODUCTION

As the profession of pharmacy becomes more patient-focused, colleges and schools of pharmacy need to enhance the communication and in-

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formation retrieval skills of their graduates (1,2). Didactic and experiential courses that teach students drug information retrieval skills have been part of entry-level education for many years (3-5). Unfortunately, the skills gained in these courses are rarely honed elsewhere. In 1996, the Commission to Implement Change in Pharmaceutical Education emphasized the need to train pharmacy students in the use of information systems (6). The recently adopted accreditation standards of the American Council on Pharmaceutical Education (ACPE) recognize this as well, and suggest a greater emphasis on the application of computer and technological tools to pharmacy practice, the enhancement of communication skills, and the development of problem-solving skills (also known as problem-based learning) in order to promote skills for lifelong learning (7). In a broader context, higher education has advocated information literacy and resource-based learning in order to help students become independent learners. For example, the Middle States Association Commission of Higher Education noted that bibliographic instruction, information literacy, and resource-based learning "have roles to play in helping students to become more self-directed and independent learners, and faculty to become more effective in helping students to learn how to learn" (8).

Written communication skills have been recognized as important for the provision of pharmaceutical care (7). As noted by Hobson and Schafermeyer, however, pharmacy faculty are frequently hesitant to incorporate written assignments into their courses for a variety of reasons such as large class size and time constraints (9). Nevertheless, Hobson and Schafermeyer as well as Holiday-Goodman and colleagues proposed that increasing the number of writing assignments in pharmacy courses would enhance learning and need not be an overwhelming task (9,10). Further, a recent report demonstrated that failure on a "Writing Proficiency Exam" predicted poor performance in higher level pharmacy courses, which highlights the importance of written communication skills for overall success in a professional curriculum (11). Finally, although data are lacking to support the following hypotheses, one can only presume that an inability to obtain and analyze published literature, and to communicate effectively will impair lifelong learning and may impact negatively on patient care.

To enhance our students' ability to provide pharmaceutical care and improve their lifelong learning skills, our college recently implemented several curricular changes in our B.S. in Pharmacy program and urged the faculty to institute other new strategies to enhance students' oral and written communication skills. The faculty were encouraged to develop interdivisional assignments and/or courses in order to facilitate curricular integration. The changes also were made to ensure that the curriculum was

attuned to impending changes in the scope of pharmacy practice in the State of New York (*e.g.*, allowing pharmacists to prescribe medications under protocols and order laboratory tests needed to monitor patients) and in anticipation of the new accreditation standards which emphasize the need for students to utilize information systems and communicate with patients and health-care professionals (7).

A new 1-credit, 2-contact-hour course entitled "Information Systems" was added to the second semester of the first professional year of our curriculum. The spring semester of 1996 was the first time the course was offered. The overall goal of this course was to ensure that students can use the primary, secondary, and tertiary literature to answer an information request from a member of the faculty or another health-care professional. This goal was met via didactic lectures and experiential training in the drug information center and the library.

In an attempt to encourage students to utilize and enhance the information retrieval skills learned in the information systems course and to enhance their written communication skills, an assignment was implemented in a required pharmacology course the following semester. The objectives of this assignment were: a. to increase students' exposure to primary literature, b. to enhance students' written communication skills, c. to use information retrieval skills to answer questions that could be posed by a health care professional, and d. to enhance curricular spiraling (the process in which critical concepts and skills are reinforced at escalating levels throughout the curriculum).

METHODS

A structured assignment entitled "An Abbreviated Product Monograph" was developed for fourth-year, first-semester students enrolled in a traditional pharmacology course during the fall of 1996 semester (see Appendix A). Students were given the opportunity to select a partner, or one was assigned. Each team of two students was randomly assigned a medication covered in the course that, for the most part, also was included in the list of 200 prescription medications most frequently dispensed in 1995 (12) (see Table 1).

The assignment was structured in such a way that each team needed to use primary, secondary, and tertiary literature sources to answer the questions accurately. For example, students needed to use various reference books (*e.g.*, *Facts and Comparisons, American Hospital Formulary Service Drug Information*, and the *USP Dictionary of USAN and International Drug Names*), conduct a Medline search, and summarize a recently

TABLE 1. List of Assigned Medications.

Acyclovir	5-Flurouracil
Amphotericin B	Furosemide
Cefuroxime axetil	Indapamide
Cephalexin	Isosorbide Dinitrate
Ciprofloxacin	Leuprolide
Clarithromycin	Lovastatin
Conjugated Estrogens	Metformin
Cyclophosphamide	Nevirapine
Cyclosporine	Nifedipine
Didanosine	Nitroglycerin
Digoxin	Ortho-Novum
Diltiazem	Penicillin V Potassium
Enalapril	Simvastatin
Enoxaparin	Sotalol
Erythromycin	Sulfamethoxazole and Trimethoprim
Estradiol Patch	Tamoxifen
Ethinyl Estradiol and Norethindrone	Warfarin
Finasteride	Zidovudine

published research article. Standard pharmacology textbooks and class notes were not acceptable sources of information. The assignment had to be completed within 10 weeks.

Students were encouraged to use resources in the campus library, the college's study center, and/or the college's drug information center to complete the assignment. Students could request assistance from the course instructor, one of the instructors from the information systems course, and personnel in the library and drug information center.

Answers were required to be cited according to a sample reference format that was distributed to the students, and needed to be grammatically correct (see Appendix B). Individual answers were scored by post-B.S. Pharm.D. students, but the final grades were assigned by the instructor. The assignment was worth 20 points (6.25% of the final course

grade)–one point for the accuracy of each answer, with additional deductions made for poor referencing, typographical errors, and/or tardiness.

RESULTS

Thirty-five monographs were completed by the students. Scores ranged from 80% to 100%. Nine student teams (26%) received a score of 100%, while 30 teams (89%) received a score of 90% or greater (see Figure 1).

The errors made by the students were of two major types: factual and procedural. The most common errors were an inappropriate/incomplete reference source or format and an incomplete response (see Table 2). An example of an inappropriate reference was the use of an outdated edition of the *Red Book* (Medical Economics, Montvale, NJ) to obtain the current average wholesale price; an example of an incomplete answer was listing drug interactions without describing them. A total of 57 percent of the

FIGURE 1. Grade Distributions for the 35 Completed Drug Monographs.
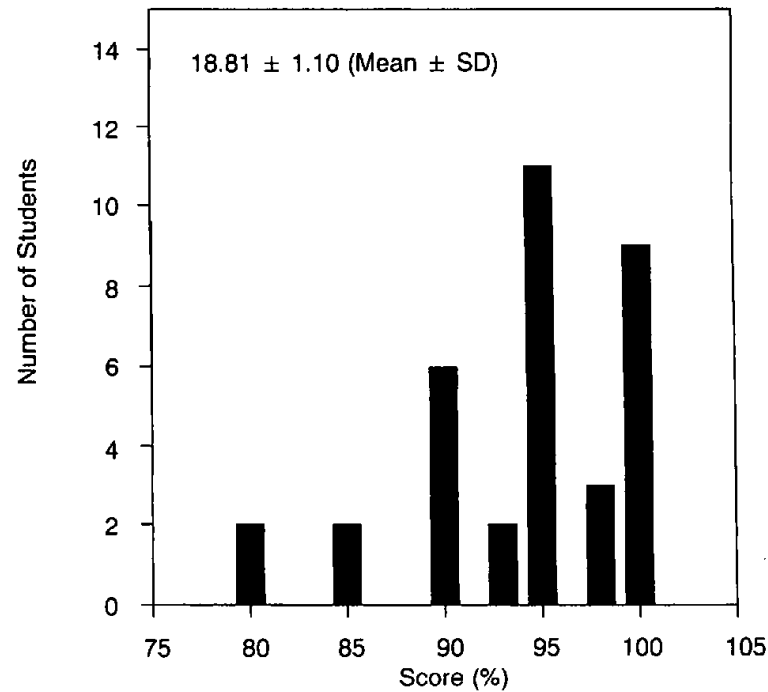
assignments had a minimum of one literature citation error (points were deducted once per assignment for improper reference source or format), and 25 percent of the completed assignments did not adequately document a proper Medline search. Table 2 lists the most commonly observed errors.

Although not formally assessed, the five post-B.S. Pharm.D. students who participated in this project stated that the experience was a positive one as they gained additional teaching experience. The post-B.S. Pharm.D. students were able to grade the assignments within a period of two weeks.

DISCUSSION

Inclusion of a written drug monograph assignment in a pharmacology course was a useful addition to the course and provided students with an opportunity to employ and practice their information retrieval skills. Although the grades assigned for the project were all "B" or better, the goal of the project was to provide an opportunity for students to enhance their communication and information retrieval skills. It was not designed to be a summative assessment of their knowledge of a particular pharmaceutical agent. Consistent with this approach, as reviewed by Holiday-Goodman and colleagues (10), most writing assignments need not receive a grade, but rather the effort is rewarded. These authors indicate that writing should be stressed as a learning method and not an assessment tool (10). Thus, the grading scheme used for the current assignment was designed to encourage the students' participation but would not be a major determinant of their overall course grade.

In a previous report, 80 percent of first-year pharmacy students reported having no experience with bibliographical retrieval software (13). Despite the fact that our students utilized bibliographical retrieval systems

TABLE 2. Types and Numbers of Errors Observed.

Content/Factual	Procedural
Incorrect/incomplete information (30)	Improper/incomplete reference/format (20*)
Improper patient counseling (4)	Improper/incomplete Medline search (9)
	Missing information (4)
	Late papers (2)

Numbers in parenthesis represent the number of assignments with that type of error.
*20 of the 35 assignments had at least one incorrect citation; points deducted one time only.

in the Information Systems course, 25 percent of the student teams still had difficulty with the Medline search. This reinforces the need to encourage curricular spiraling–*i.e.*, provide students with many opportunities to practice key skills obtained during their early pharmaceutical education in order to ensure continued competence and growth.

Future Directions and Limitations. Based upon student comments and faculty observations, the monograph format will be modified in several ways. For example, the terms "citing references" and "analytical method" will be more clearly defined. Despite providing a sample reference format, as noted previously, an inappropriate or incomplete reference citation was a common error. As a result, greater emphasis is now placed on preparing a correct reference citation in the Information Systems course.

In addition, several unanticipated issues regarding the assigned medications arose, which will necessitate other changes. For example, student teams assigned combination products (*e.g.*, sulfamethoxazole and trimethoprim) had difficulty answering questions that requested a specific fact about the medication (*e.g.*, the elimination half-life). In order to make the assignment relatively equivalent for all teams in terms of the time commitment, combination products will be avoided in the future. Confusion also arose concerning products that are available as different salts or dosage forms. In the future, the assigned medication will be as specific as possible with regard to these factors as well.

Several students were resistant to working in teams. Probing by the instructor revealed that a major reason for this was that the assignments needed to be completed outside of normal class hours, which poses a problem for any commuter-based institution. Although it may be desirable for student teams to be randomly assigned, this is not always feasible given schedule complexities. In addition, as our class size commonly ranges between 70 and 120 students, it is not always feasible to grade students independently. A positive aspect of the team approach is that it may enhance students' ability to function in a group setting. On the other hand, potential limitations of the team approach include whether all members contribute equally to the project (and receive the same score) and develop all the required competencies. While recognizing these potential limitations, we will continue to utilize self-selected teams.

In the future, assessment of the project as a learning experience will be conducted. Additional assessments to be conducted include student perceptions, ability of students to perform within the confines of a team, and effect on the development of lifelong learning skills.

CONCLUSIONS

In conclusion, implementation of the drug monograph assignment allowed students to enhance their skills in information systems and written communications–key skills for lifelong learning and the provision of pharmaceutical care. Placement of the project in a required pharmacology course provided benefits to the curriculum, students, and faculty. Students were able to synthesize and evaluate information from a variety of disciplines and resources. We believe the project also helped the students recognize the value of a problem-based approach to learning many facets about a medication. Finally, since the project was developed by an interdivisional faculty team, it provided an opportunity for faculty to collaborate in order to improve curricular spiraling.

We believe inclusion of assignments aimed at increasing skills such as communication and information retrieval should occur throughout a curriculum. The result will be graduates better prepared to meet the challenges of providing pharmaceutical care and becoming lifelong learners.

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APPENDIX A

ABBREVIATED PRODUCT MONOGRAPH

Instructions: All questions are to be answered for the assigned medication. Immediately after writing the answer to each question, you *must* cite at least one reference from the primary, secondary, and/or tertiary literature that you used to answer the question. References from class notes, a faculty member, or another health-care professional are not acceptable. When citing a reference, please use appropriate reference format–such as the one used in the *Journal of the American Pharmaceutical Association, Journal of Pharmaceutical Sciences*, or the *Journal of the American Medical Association*. In certain situations, you will need to attach all or part of the reference(s) that you used. If you have any questions, please consult with the instructor. *This assignment must be typed (preferably using a computer) and handed in on time in order to be graded.* Proper sentence structure and grammar must be used. Submit material as follows: cover page with your name(s), social security number(s), and name of the medication. Then, type the question, type or draw your answer, and type the reference citation. The assignment is worth 20 points toward your final grade.

QUESTIONS

1. Indicate the United States generic name of the medication and the USAN if different.
2. List all United States trade names plus manufacturers or marketers.
3. List the strengths and dosage forms marketed in the United States.
4. Note the average wholesale price for at least one strength of one trademarked product.
5. Write/draw the chemical formula and chemical structure.
6. List two FDA-approved indications for this product (if there is only one, state so).

7. List two non-FDA-approved uses for this product.
8. Indicate the product's pharmacologic category and describe the primary (or major) and, if applicable, the secondary mechanism of action for one of its FDA-approved indications.
9. Describe the method by which the medication is metabolized and/or eliminated from the body.
10. Indicate whether there is/are active metabolite(s). If applicable, write the name of one active metabolite.
11. Delineate the elimination half-life of this agent in normal, healthy adults.
12. Note the pregnancy category.
13. Medication dosage:

   - Dosage of this medication in normal, healthy adults for one of its FDA-approved indications.
   - Dosage of this medication in adults with hepatic impairment.
   - Dosage of this medication in adults with renal impairment.

14. List three major adverse effects or warnings associated with the use of this agent.
15. List two primary research articles published within the last three years for this product. Attach a copy of the first page of each primary reference
16. Using one of the selected primary references from Question #15:

   a. Indicate the purpose of the research study.
   b. Briefly describe the methodology used in conducting the study.
   c. Prepare a brief overview of the study results and conclusion.

17. Attach the first page of a Medline search in which your medication was studied in humans for one of the FDA- or non-FDA-approved indications noted above.
18. Describe two clinically significant drug interactions noted with this agent.
19. Indicate whether there is an official analytical method for this product. If yes, attach a copy.
20. Assume that you are dispensing this medication to a patient in a community pharmacy. Using lay language, *i.e.*, language that would be understood by an average patient, describe the information you would provide to the patient.

APPENDIX B

AN ACCEPTABLE REFERENCE FORMAT

If you wish to cite a journal article, the basic format is as follows:

> Type the last name of first author then a space then first and middle initials followed by a comma; then the remaining authors written in the same way. If there are more than three authors, type out the first three and then type et al. After the list of authors, type a period. Then, type the title of the article with only the first word of the title with an uppercase letter. After the title, type a period. Then, type the official abbreviation of the journal in *italics* using Index Medicus terminology. If you cannot type italics, underline the title of the article. Then, type a period. Leave one space after the period and type the year that the article was published followed by a semicolon (;). Then, the issue volume followed by a colon and then the page numbers. Finally, type a period. Note the following examples:

> Horton R, Smith R. Signing up for authorship. *Lancet.* 1996;347: 780.

> Hussain AR, Iseki K, Kagishima M, et al. Absorption of acetylsalicylic acid from the rat nasal cavity. *J Pharm Sci.* 1992;81:348-349.

Textbooks follow a different format:

> Here, type the authors or editors, the name of the book in italics or underlined (all words have first letter in upper case), the city and state in which it was published, the publishers, and the date of publication. Note the following examples:

> Young YL, Koda-Kimble MA, eds. *Applied Therapeutics-The Clinical Use of Drugs* (6th edition). Vancouver, WA: Applied Therapeutics, Inc; 1995.

> Jacobs DS, Demott WR, Finley PR, et al. *Laboratory Test Handbook* (3rd edition). Hudson, OH: Lexi-Comp Inc; 1994.