SECTION 6

WORKSHOP ON PHARMACOLOGY TEACHING: INFORMATION TECHNOLOGIES AND CREATIVE IDEAS

Chairpersons
Dr. Wayne S. Schwark
Dr. David P. Aucoin
Dr. Gordon L. Coppoc

How Can Information Technologies Enhance Pharmacology Teaching?

Gordon L. Coppoc, D.V.M., Ph.D.
Department of Veterinary Physiology and Pharmacology
School of Veterinary Medicine, Purdue University
West Lafayette, IN 47907

The Problem

Veterinary medical education is at a crucial stage in its evolution (Pritchard, 1988). The information explosion in the biomedical sciences is real, but only a small proportion of the information is relevant to an individual student or veterinarian; a personalized sieve is needed. The tremendous cost of student laboratories and an increased sensitivity to the use of animals has decreased the use of what used to be a more individualized, problem-oriented mode of teaching. The vacuum has been filled by lectures given during laboratory periods and highly standardized forms of examinations. Fact acquisition has swamped other goals of education such as learning to learn, to make deductions from direct observations of natural phenomena, and to solve problems.

The hypothesis of this paper is that information technology can help us in the following ways. It can help to individualize instruction. It can use simulated animals (structural and functional) to help students learn basic concepts. It can provide drill and practice needed for students to gain proficiency in making observations and solving simulated problems. It can serve as a reference/information resource to be used as an aid in solving problems, simulated and real, preparing students for careers in which information tools will be a natural part of their life.

Using my course in veterinary pharmacology as a vehicle, I will present a brief overview of ways each of these hypotheses can be implemented. The talk will be in three parts: overview of course goals and activities, actual uses of computer during the past semester, and plans for the future.

Pharmacology Course Description

The Purdue veterinary curriculum requires six semester credit hours of pharmacology. Two courses of three credits each meet four hours each week for 16 weeks including the final examination. Principles of pharmacology, neuro and autonomic pharmacology, and autacoidal pharmacology are taught in the first semester. Chemotherapy, endocrine pharmacology, cardiovascular and renal pharmacology, and miscellaneous topics are covered in the second semester which is the subject of this paper. There is a three semester credit hour course in toxicology the next year (third year of the curriculum), but there is no formal clinical pharmacology course.

The following is a list of goals it is hoped the students will adopt as stated in the course syllabus: (1) to learn a framework of drug related information and skills on which you can build independently as needed later in life, whether in advanced courses, clinical practice, or other aspects of veterinary medicine; (2) to learn the fundamental concepts of interaction of drugs with target animals, infectious organisms, and society and how to describe these interactions; (3) to learn how to obtain, to critically evaluate, and organize information on drugs and drug usage; (4) to learn the classes of drugs and specific prototypes of each class required for advanced courses in veterinary medicine and clinics; (5) to correlate the study of drugs and drug actions with related biomedical sciences to enhance the mutual understanding of them and pharmacology; (6) to learn that a thorough understanding of drug action, absorption, metabolism, excretion, etc., enables one to make rational decisions about drug therapy; and (7) to understand where gaps in our knowledge occur that might prevent one from universal application of the principles of rational therapy based on first principles and where pragmatic decisions based on clinical trials must be used. MEDIC [Minimum Essential Drug Information Checklist] (Coppoc and Stuckey, 1977) and a set of guidelines (Smith, 1978) for evaluating published papers are used to provide

frameworks for students to use in studying each drug and its clinical application.

Elements of the course are directed at achieving each of these goals, but for this presentation, only those exploiting information technology will be discussed. During the past year, the four hours of class per week were divided into two hours of lecture and two hours of discussion/ independent work. Students were required to write a term paper on a pharmacologic subject of their choice for 30% of their grade. Drug vocabulary quizzes accounted for 10% and the remaining 60% was divided between a mid-term and a final examination. Approximately 50% of the mid-term and final were take-home, case oriented questions that were handed-in at the time of the exam. The in-class examinations were divided among multiple-choice, short answer, and essay questions. Thus, nearly 70% of the course credits were from activities other than traditional in-class exams.

Use of computers in the course during the past semester can be divided into four categories: communication, drill, evaluation, and information access. Each of these will be discussed in greater depth emphasizing the general course goal being served, but first a general description of the computer system will be given.

Student Computer Laboratory

The key part of the student computer system is an AT&T 3B2-500 UNIX minicomputer (network name is "dog") with 10 terminals. This computer is connected to our University ethernet backbone and communicates with other School of Veterinary Medicine (SVM) computers, including personal computers, through TCP/IP based protocols including File Transfer Protocol (FTP), Telnet, and Network File Server (NFS). The Student Computer Laboratory also has three dual monitor interactive video work stations with laser disc players, one of which is an IBM InfoWindow system. It has a Macintosh II computer and several MSDOS based machines, some of which are connected to random access slide projectors. The Macintosh II and one of the MSDOS machines are connected to the SVM ethernet providing a means of moving files from the servers to and from personal computers. The Student Computer Laboratory is open to students 24-hours a day via a combination door lock.

UNIX is not the easiest operating systems for novices to negotiate so Dr. James Morrison, our Director of Clinical Computing and Intelligent Systems Development created a menu system. The menu system allows novices to use essentially everything we require of them with very little knowledge of how to use UNIX. The only absolute requirement for students to use the system is knowing how to sign-on to the system using their ID and password and then typing "menu."

Communication

Each student in the School is given an ID and an account on the "dog" machine with storage space for personal files. Their computer ID is used as a means of automatically recording their performance on computer based exercises and quizzes in the appropriate instructor's directory. Instructors can use electronic mail "E-mail" to communicate with individuals, groups, or the entire class. Sample uses of the individual E-mail capability include informing students of their grades on class projects and for giving them other personal information. The Groups corresponded to the working groups for the pharmacology course and group-specific information, e.g., a BRS-Colleague password, could be given them by E-mail. The entire class could be notified of changes in schedule or of changes in information available on the system. Students used the E-mail system to ask the instructor questions about their account or grades as well as for communicating with their colleagues within the SVM and at other universities. One of the major goals of the Purdue Student Computer Laboratory is to have students learn to see computers as useful in everyday life. Communication with colleagues is an excellent application of computers and, therefore, this was encouraged.

Drill

One of the continuing challenges of pharmacology courses is the problem of how to get students familiar with the large number of drugs that they are implicitly expected to know by writers of textbooks, professional literature, other veterinarians, and their clinical instructors. Hirsch (1987) has written persuasively that some minimal level of familiarity with terms persons encounter during reading is a requirement for them to be effective (obviously) readers, but more importantly before they will even attempt to read. Looking up more than a tiny percentage of words is highly inefficient and most readers will not do so. If the text contains too

many unknown terms the majority of readers become frustrated and give up. The interesting hypothesis that Hirsch advances is that readers do not require more than a vague idea of the meaning of the words. Context and a general familiarity are generally sufficient to allow persons to read acceptably and to avoid excessive frustration.

Some courses cover the "minimal" vocabulary by including large numbers of drugs in the course content, but this author believes it is neither possible nor cost-effective for students to learn all drugs in great detail. Nonetheless, as argued above it is useful for students to have a "recognition response" when they encounter drug names in conversation and the literature. This need is included under goal 4, "to learn the classes of drugs..." and as mentioned earlier is given only 10% of the grade weight in the course because it is viewed as less important than other components of the course.

Drugs have been divided into three groups: classic, prototypical drugs; drugs commonly used in veterinary practice; and others. Classic, prototypical drugs are emphasized in course content. "Other" drugs are ignored. Commonly used drugs that are not otherwise special, are self-taught explicitly from a classification - drug name listing that is given students at the beginning of the course. This listing is also available on the student system in a multiple-choice format under the VAGUS (Roesel) authoring system. Question stems present either a drug name or a classification. Students then select the appropriate classification or drug name, respectively. There are 60 to 80 questions in each of 11 general categories of drugs covered during the semester. These 11 categories are available from the first day of the semester for practice and to allow the students to become familiar with them in quiz format at their own pace. The twelfth category covers the major list of approximately 80 drugs selected from the entire course and is only made available during the last two weeks of the course to force review. An audio tape was made to give the students an example of how to pronounce the drug names and to help those who learn best through auditory channels. The tape was designed to be used with each category in the "sequential" mode and gave the correct answer to each question as the drug was pronounced. Each category could also be practiced in a "random" mode.

Evaluation

For grading purposes, students were required to complete a 20 question quiz automatically selected from the larger question bank in each of the 12 general areas. Students could take the exam as many times as they wished to improve their scores, but were required to have at least 70% on all exams to earn a grade higher than C in the course. When students elected to save their quiz score, it was automatically added to a data file in the instructor's directory. The best score for each quiz was used in the calculation of the final grade.

Student reaction to the use of computers for drill and evaluation over drug vocabulary was evaluated with a questionnaire. Sixty percent (35 of the 53 students responding out of a class of 58) strongly agreed that the computer delivered vocabulary quizzes were preferable to one-chance, weekly in-class quizzes. Another 21% agreed for a total of 81% viewing the computer delivered quizzes positively whereas only 7% were negative. This is as close to a ringing endorsement of any educational approach as one is likely to get, therefore, this approach will be used again next year with a few modifications. Use of the computer in this way meets two of the premises for how information systems may be useful in teaching, individualizing instruction and provision of drill and practice. This is admittedly not practice in problem solving, but cases to provide for this will be added in the future as they are written.

Information Access

The SVM computer system is being designed to provide access to information on several levels. The goal is to provide a useful tool to SVM personnel, but more importantly, to develop in students the habit of using computers for obtaining information. Course goal number 3, "learning to obtain ... information on drugs and drug usage" was pursued by in three ways. First, all lecture outlines and study guides were placed on the system in a format that facilitated being moved to student personal computers or their personal files for modification by them. Second, a license was purchased for "askSam," (askSam) an information manager that runs on MSDOS machines. Under terms of this license, students may purchase the program at reduced cost. Third, students were provided with student accounts on BRS-Colleague (BRS-Colleague) to give them electronic access to

Index Medicus to obtain information for their term papers. Access to BRS-Colleague was provided through the SVM computer network and results of searches could be downloaded into the students' personal accounts. Training in using the SVM computer system to access and download information from BRS-Colleague and on the use of electronic data bases was given by the instructor and the SVM Veterinary Medical Librarian during pharmacology laboratory periods.

A questionnaire was used to learn how many students had used the electronic database for their term papers and their reactions to using the system. Not all students in the class of 58 responded to every item, therefore, in the following the number responding to a question will be given in parentheses.

Most of the students used the system at least once; 61% (n = 58). Most students, 65% (n = 55) agreed or strongly agreed that they would use BRS-Colleague or other electronic data bases routinely if they were available. The 39% of the students who do not use BRS-Colleague gave the following reasons for why they did not use the electronic data base system (n = 22, percents are relative to the whole class): 0%, I dislike using computers; 7%, I felt inadequately prepared for using the BRS database; 9%, I could not get the computer to work properly and gave up; 2%, I never got around to it; and 21%, I found enough information from other sources before getting around to BRS. The lasting impact of the exercise is ambiguous as judged by responses to the following statement: "This experience has increased the probability that I will use an electronic data base like BRS after I graduate." Of 55 students responding, 47% agreed or strongly agreed with the statement, 14% disagreed and 36% were neutral.

Access to CD-ROM databases, e.g., AGRICOLA, may be superior because students may feel less pressured to do their search quickly. They were made aware that BRS-Colleague was costing $17 per hour and that they should be efficient. Although the total BRS-Colleague fee for the connect-time logged during the semester was less than $600, the sense of urgency may have had a negative impact. It is also possible that access to a more veterinary or agriculturally oriented data base system (e.g., AGRICOLA or CAB veterinary and agricultural abstracts) may have improved student acceptance. Many students could not find much information on their topic in the MEDLINE database to which they were confined on the student accounts.

Future

Plans for the future are directed at two goals: (1) encouraging students to use computers as daily, information delivery systems, and (2) improving the use of computers as aids in increasing the efficiency of learning.

None of the applications presented above assisted students in learning difficult concepts nor did they give students practice in applying the concepts and information gained. Therefore, future work will include developing computer based, dynamic systems that model physiologic/pharmacologic events. The renal system will be used as a model for developing these lessons because of the complexity of events occurring here make a dynamic, interactive model a potentially invaluable adjunct to learning the basic concepts. Also, there is a strong interaction between structure and function of the various portions of the renal tubule so that drugs having similar effects on ion transport may have very different effects on the kidney depending on where their primary action is exerted. Finally, clinic cases reflecting various renal disorders or that have systemic effects altering renal function will be used as vehicles for making the lessons relevant in students' eyes.

Plans for improving the information aspects of the system include the development of on-line hypertext formulary systems that can be used during problem solving sessions, e.g., during case simulations using VAGUS. A goal of this hypertext system is that it would be downloadable for use on student personal computers. Programs like PETDR (Riviere et al., 1988) that facilitate computation of drug dosages and withdrawal times will also be developed and put on-line so that they can be used while working on case simulations. Finally, a bulletin board system will be re-installed on the system and some mechanism for encouraging use of it by faculty and students for Special Interest Group discussions will be sought.

Summary

In summary, we have made a start on the application of information management tools to education, but we have a long way to go. Perhaps by working together and sharing information and lessons we can integrate them into our teaching programs. Faculty can become coaches to students who are actively involved in their own education and who are developing abilities and habits that will provide a lifetime of intellectual growth.

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