

*Research Article***Pharmacology on the Internet – A Web-CT Course Teaching Information Literacy for Pharmacy Students in the University Of Kuopio**Ewen MacDonald¹ and Jarmo Saarti²¹ *Department of Pharmacology and Toxicology and* ² *Library, University of Kuopio, PL 1627; FIN-70211, Kuopio, Finland**Date received: 04/04/04**Date accepted: 16/05/03*

Abstract

For the past three years we have provided our third year pharmacy students with an elective course in information literacy – “Pharmacology on the Internet”. The course intends not only to provide students with useful links to pharmacological information, but also continually stresses the need to view such material with caution. Thus, students become aware of the fact that even apparently authoritative sites may contain out-of-date information, not to mention the deceptions and deceits abounding in less reputable sites. The course has been well received by the students; numbers enrolling in the course have increased each year. The students state that after completing the course, they have a greater critical awareness of web-based material. We performed a pre-/post-course questionnaire on attitudes to different kinds of web based material. There were not many changes occurring which could be attributed to the course, but a statistically significant change was noted in their assessment of pharmaceutical company web sites. Prior to the course, they viewed these sites as less reliable than governmental agencies, but after the course they assessed them as being just as reliable, easy to use, up-to-date, “scientific” and useful in their future profession as sites run by public organizations.

Keywords: Pharmacology; pharmacy education; information literacy; Web-CT; web based teaching

Introduction

The amount and expanse of drug-related information available on web-sites continues to grow exponentially. Students are increasingly coming to rely on these web-sites as their primary sources, and the use of the printed word either in the form of traditional textbooks or research publications has correspondingly declined. However, web-based material, though available at the click of a mouse, cannot be accepted as fact in the same way as textbook material. Unfortunately, students often fail to appreciate the differences between these sources, mixing references from peer-reviewed articles with quotations from web-sites. Three years ago, we decided that we would create a course which would try to address this problem of information literacy. The basic aims of the course were two-fold; to make students aware of the wealth of useful pharmacological information available on the world-wide-web but

also to highlight the pitfalls and limitations associated with web-based sources. A survey of pharmacology graduates identified information technology, in particular accessing biomedical databases as a skill not being met by traditional pharmacology courses (Hughes et al. 1997). Though the situation has not been assessed in a scientific manner in Finnish pharmacy graduates, there is anecdotal evidence that our educational system still fails our students in this respect (Savela, 2003)

The University of Kuopio is a higher educational institute specializing in health-care disciplines. The Department of Pharmacology & Toxicology is located within the Faculty of Pharmaceutical Sciences and the course to be described is intended for students in their third year. Pharmacy education in Finland is a two-tier system; a three year course (120 study credits) with an intake in our institute of 160 students each year. Forty-five of these students proceed after the third year with two more years of advanced courses for the degree of provisor. At the end of the third year, all students must prepare a written presentation in one of the pharmacy disciplines; in pharmacology the topics are usually based on therapeutics and students must search the clinical literature to obtain the material required for this essay project. For many students, this is the first and last time they will be expected to write a presentation with references from the literature.

The course described here, "Pharmacology on the Internet", is available as an elective (non-compulsory) course with one study credit (1.5 ECTS). In Finland, one study credit is considered to require an effort of 40 work hours by the student. The pharmacy curriculum is designed that in the third year students can take elective courses; for the first two and a half years most of the courses are compulsory and the timetable is rigid and tight. During the last few months of the third year, the timetable has many elective courses, often at the same time. Therefore it seemed preferable that this course related to web-based material should be available on-line, with students being able to access the material whenever and from wherever they wished. The University of Kuopio has purchased access rights to the Web-CT platform; therefore the course is managed from that commercial system. Since, the course only utilizes a small portion of the total Web-CT potential; it could probably be run on any of the other web-based teaching management systems.

Course content

The introductory page to the course describes the course aims to potential students. These are 1) to teach the students how to use the internet to access pharmacological information; 2) to teach a critical approach to internet-based material and 3) to use this material to revise pharmacological and toxicological concepts handled in other aspects of the pharmacy course. The students are also informed that the current version of the course consists of 15 exercises; these must all be completed in order to obtain the course credit. They are also advised that the exercises should be completed in numerical order, since completion of some of the earlier aspects help in undertaking the later tasks.

The 2002 version of the course (an English translation of its name would be "Pharmacology on the Internet") can be viewed at

<http://webct.uku.fi:8900/webct/public/home.pl> and after clicking on the log on to MyWeb-CT the user name of mcdonald and password of student will allow the interested reader to see the course. The vast majority of students attending the University of Kuopio speak Finnish (Swedish is the second official language of Finland), thus the instructions are in Finnish, though as students progress through the course much of the material they are required to read will be in English. Therefore, we will provide here a brief summary of the course content. There are 12 actual exercises (exercises 1 and 14 are web-based questionnaires on student attitudes to web-based material and exercise 15 is the course evaluation which is filled in anonymously).

Exercise 2 – Introduction to use of the Internet. This exercise contains four exercises where students are given links to sites (e.g. Finnish National Agency of Medicines) and report back on what they have found (e.g. why was the sale of a meprobamate/quinidine product recently banned)

Exercise 3 – Hypertension therapy. Students are acquainted with the site run by the Finnish Medical Association – Duodecim and answer a series of multiple choice questions based on the material on the treatment of hypertension. These first two exercises are an introduction to the web with students accessing given sites and extracting information.

Exercise 4 – Using the Internet to obtain drug information. In this exercise, students are introduced to the various search engines (Google, Hotbot, Lycos, Evreka etc). They are also taught two important concepts; first that restricting their search to Finnish sources will severely restrict the amount of information they obtain and secondly, much of the information available is out-of-date. This is illustrated by searching for an anti-Parkinson drug called tolcapone which has been withdrawn from sale in the EU due to its liver toxicity in November 1998. Many apparently authoritative sites do not mention this crucial information i.e. they were prepared before this knowledge was available and have not been up-dated.

Exercise 5 – Information for the lay public and experts. Students check for information in Finnish on interactions with drugs and grapefruit juice and then try to supplement the meager details available by expanding their search to include other sources. They are taught how to use the search engines and key words to limit the number of irrelevant sites indexed.

Exercise 6 – Medline. The concept of using key words to pinpoint a published work is introduced with students having to identify an abstract missing the source and authors. They are further taught how to use the limits section in Medline to restrict the number of irrelevant articles identified in a literature search.

Exercise 7 – Information on Novel Drug Entities. Students are given the name of an experimental drug and a source page for information. They must then search the world-wide patent database to find indications for this drug, information on other drugs with a similar mechanism of action and then try to see how much information about these experimental compounds has been published in the peer-reviewed literature.

Exercise 8 - COX-2 inhibitors. This exercise is devoted to reading an article sponsored by a pharmaceutical company (Pfizer/Searle) on one of their new products, celecoxib. This site is part of the professional development programme arranged by the American College of Pharmaceutical Education (2 hours study credits). In addition to teaching students about this new class of drugs, it also makes them aware of the wealth of material available on-line to keep their expertise up-to-date after they qualify.

Exercise 9 - Toxicology. A review of basic toxicology prepared by National Library of Medicine in the United States. The purpose of this exercise is again to highlight the availability of excellent teaching material in drug-related topics.

Exercise 10 – New anti-cancer drugs. The basis for this exercise is an article written in the financial pages of a Canadian newspaper in the summer of 2001. Students are randomly allocated a new compound and have to find out as much as possible about its use, how far it has gone in clinical trials and if it has any competitors etc.

Exercise 11 – Student web-pages. The students are introduced to the molecule of the month site hosted by the Department of Chemistry, University of Bristol, U.K. (<http://www.bris.ac.uk/Depts/Chemistry/MOTM/motm.htm>). In that site, students are invited to submit web-based material to be selected as the molecule of the month. Our students review the pages on the nerve gas, VX and then independently select a second site and report on what they learned.

Exercise 12 – Unreliable sources. Here the students are sent to a site run by a company called International Antiaging Systems and compare the recommended uses for the drug deprenyl given on that site with that in a pharmacology textbook. They are also asked to evaluate the scientific credentials of the author of the deprenyl article, Mr. James South. The students try to see whether this so-called expert has published anything in the scientific literature. This is one of the most important exercises in the course, since students must be made aware that web-based material may be misleading and downright dangerous. For example, they are expected to prepare a list of drugs which can cause serious interactions if taken at the same time as deprenyl, information not deemed relevant by Mr. South. They are also asked to state which other drug-related sites should be viewed with caution (e.g. vitamins, “recreational” drug use, drugs enhancing sexual performance etc.)

Exercise 13 – Surfing. Students are asked to propose a site to be included in the next year’s version of the course. They are asked to rate the site with respect to reliability and whether they consider that the site will still be available one year hence. This year two students recommended a site hosted by Professor Michael Gordon at the University of Kansas (<http://www.pharmacology2000.com>), the first time that two students have recommended the same site. In most cases, the sites chosen reflect the interests or hobbies of the students (pet medication etc.) or are related to the topic on which they are writing their third year essay project.

Impact of the course

This section will be divided into 2 sections; in the first part, the students' opinions of the course obtained in a confidential web-based course assessment will be briefly described. In the second part, the impact of the course on the students' attitudes has been evaluated via a pre-/post-course questionnaire (exercises 1 & 14).

Students' opinions of the course

In the three years that the course has been offered, there has been a large increase in the numbers enrolling; 30 in 2000; 43 in 2001; 70 in 2002. Each year approximately 75% of students who enroll actually complete the course. This obviously biases the evaluation, since those students who drop out do not complete the course evaluation form which is situated within the final exercise. There are several reasons why students start but never complete the course. One reason may be that there is no teacher-student contact, with students having to motivate themselves to work through the exercises. One other reason may be that as the course progresses, more and more of the exercises require a firm grasp of English. There may be more mundane reasons for course drop-out. Since the course is non-compulsory and scheduled in the final part of the third year (the final year for the majority of the students), many realize that they have enough course credits to graduate without the need to gather the 1 credit available from this course.

Each year the evaluation has been extremely positive; 4% of students state that they would not recommend the course to the next year's students. They are also asked to grade the course; in 2001 the average grade was 8.3 (maximum 10) and the current average is 8.5. We have used the Finnish school grading system, this is by far the most widely used grading system recognized by the general population, not only in the school system but more widely e.g. rating the performance of politicians, sportsmen etc. It is arranged with a score of 4 being a fail; 5 = passable; 6 = satisfactory; 7 = good (6); 8 = very good (18); 9 = excellent (24); 10 = outstanding (3) – the numbers in parenthesis represent the actual numbers of students giving that particular grade in the current course.

The most common criticism (in the questionnaire under the heading "improvement proposals for next year") is related to the excessive amount of English; though as several students point out, their language proficiency and level of confidence improve as they work through the course. The vast majority of students (89%) also state that the course has made them more critical of web-based material; a point partly borne out in the pre-/post-course evaluation.

Students' attitudes to web-based material

We asked students to rate their attitudes on five different aspects of five different kinds of web-based sources i.e. whether the students thought they would be a) up-to-date; b) easy to use; c) useful in their future employment; d) reliable and e) was their content scientific in its nature. These results are taken from the first 23 students to complete the course (i.e. we have compared their responses before and at the end of the course). In general, a

database like Medline was rated as being more reliable, scientific and more useful in their future employment than a more general search engine like Google (Fig. 1) but students felt that Google would be easier to use. Completion of the course did not significantly change these evaluations; the scientific nature of publications listed in Medline became emphasized (almost all students rated it as a maximum 5 in this area).

In the evaluation of three other areas web sites hosted by public organizations (like the national medicine agency), private companies (like pharmaceutical companies) or private individuals, there was one major change occurring in attitudes (Fig. 2). Prior to the course, students rated commercial sites such as those run by pharmaceutical companies as approximately midway between private individuals and organizations (i.e. students were rather suspicious of the reliability, scientific nature, usefulness in employment) but after the course, the sites organized by private companies were rated identically to the sites run by national organizations. This difference in attitudes was highly significant and somewhat at odds with their belief that they had become more critical in their attitude to web-based material.

Discussion

Pharmacy students in the University of Kuopio, Finland receive a traditional pharmaceutical education, most courses being in the form of lectures, laboratory practicals and written examinations. During the first three years, most of the courses they take are highly career-orientated; only 3 study credits for foreign languages are not pharmacy-related. Students have the possibility to take elective courses in their final year, but in most cases these are also pharmaceutical in nature. During the second year, students do spend time away from the university undertaking a practical period in community or hospital pharmacies. The impetus to create an internet course stemmed from an effort to provide our students with a foundation not simply in information technology but rather information literacy just prior to the time when they leave the university and join their profession. We reasoned that

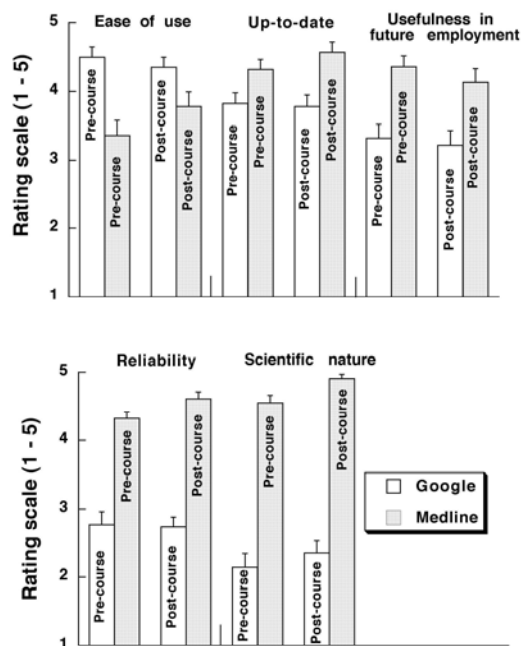


Fig. 1: Students' attitudes to a general search machine (e.g. Google) and a scientific database (e.g. Medline). Students were asked to rate on a 5 point scale of 1 to 5 (with 1 = bad and 5 = good) these two web based sources of information under five categories (ease of use; whether the material would be up-to-date; how useful they considered it would be when they started work in a pharmacy; how reliable they felt the database/search engine to be and how scientific the material identified would be). The results are shown as the mean of 23 students (error bars are standard error of the mean). There were no significant differences in the responses attributable to participation in the course (same evaluation form was accessed in exercises 1 and 14 i.e. prior to and after completion of the course).

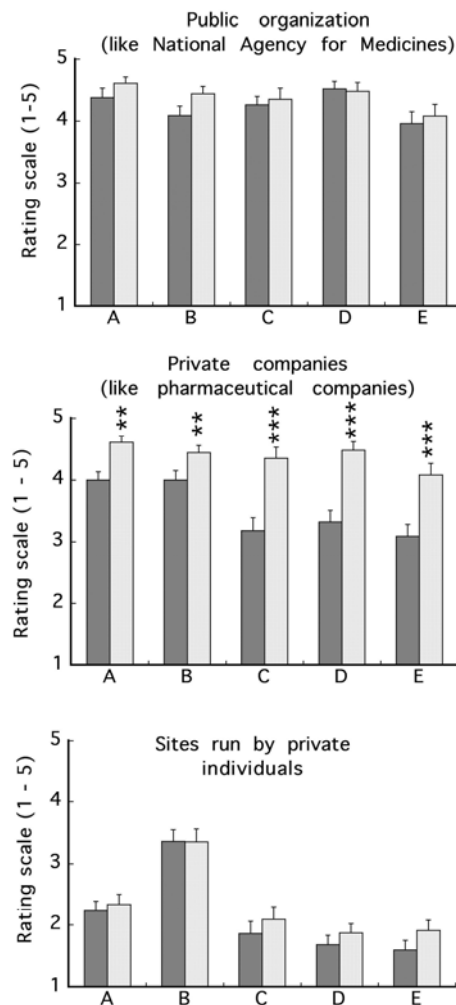


Fig. 2: Students' attitudes to web-based information sources before and after completion of the course. The students rated on a 5 point scale of 1 to 5 (1 = bad; 5 = good) the following aspects of web-based information; A = whether the material would be up-to-date; B = overall ease of use; C= how useful they considered it would be when they started work in a pharmacy; D= how reliable they felt the database to be and E = how scientific the material identified would be. Dark columns are responses prior to the course; light columns are responses after the course; those columns marked with asterisks are significantly different from the pre-course score; ** = $P < 0.01$; *** = $P < 0.001$; Student's *t*-test for paired data; $n = 23$). Error bars represent the standard error of the mean.

more and more drug information will be available on the web and our students should be confident and critical in accessing this rich source of material. Our search of the literature revealed that though there is a considerable amount of pharmacological material on the internet, this tends often to be traditional material such as lecture notes, slide shows, multiple choice questions, problem based exercises etc. (Abate *et al*, 2000; Crouch, 2001; Kerecsen and Pazdernik, 2002). While these are worthwhile, we wanted to include a component of information literacy into this course, the ability to assess as well as digest information (Brown and Krumholz, 2002)

Over the three years that we have organized this course, our basic premise that there is a need for such an educational approach has been borne out. Student numbers have increased from year to year and each year the students state that they would unreservedly recommend the course to younger students. The course contents have changed annually as sites disappear or the information they contain becomes out-of-date. However, the basic course outline has been preserved.

The course is arranged in a very open manner; any third year pharmacy student can register and they can work at their own pace. While it is possible to access the course from any computer linked to the internet, it appears that most of the students work on campus in one of our computer bays. Occasionally, it does seem that work is done at home during the weekend or holidays. For example, the tracker system of Web-CT revealed

that one student completed one exercise late at night on Christmas Eve. Most students do not possess their own computers and even those with their own computer may find accessing the course from home via a modem both slow

and expensive. In contrast, computer access within the university is free and has fast broadband access.

The course is supervised by one teacher; the exercises are arranged to be self-explanatory and often the report submitted is only a few lines long (such as those exercises with multiple choice questions where students are usually only asked to provide a brief critical assessment of the site they had read). Several exercises do require that the students submit quite lengthy reports. For example, the report to be completed on exercise 10 on new cancer drugs may be several pages long, since students have to describe the mechanism of action of a new drug, how far it has progressed in clinical trials and a review of the current therapy for that cancer. Since there are 8 drugs in the list (students are allocated a drug in a semi-random manner), there is little possibility of students copying reports from friends and the teacher does not have to read the same report over and over again.

There is something of a contradiction between the students' perception that they have become more critical of web-based material and their pre- /post-course evaluations. In the pre-course evaluation, they were rather suspicious of the reliability of web sites sponsored by private companies, with pharmaceutical firms named as examples. After the course, they rated these sites as equally reliable and useful as national organizations (the example given was the Finnish National Agency of Medicines). In fact, most pharmaceutical companies do present useful, often rather unbiased, information on their own products. The one site chosen to represent an unreliable source – International Antiaging Systems, in a loose sense could be considered to be a pharmaceutical company (it does sell products like vitamins and anti-oxidants advertised to have medicinal effects). Previously, it also sold deprenyl, a drug used in the therapy of Parkinson's disease, but nowadays this sales option is no longer available through the company without a prescription from a physician. Thus, it would seem that the students have not considered it as a pharmaceutical company but rather the site of an individual – Mr. James South.

In summary, the web course called Pharmacology on the Internet has been running for three years now and experiences from both teacher and students are largely positive. Web-CT permits student management in a reliable and relatively straightforward manner and no major technical problems have been encountered. Each year the course is revised and out-of-date information replaced with topics of current concern. Today's students are confronted with a tidal wave of information and can easily be overwhelmed. However, a course designed by an experienced subject specialist can help them surf safely to the shore. The course constantly stresses the importance of the need for critical appraisal of web-based information. The present course is in Finnish, but any interested reader wishing more details can contact the authors at mcdonald@messi.uku.fi or jarmo.saarti@uku.fi

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References

Abate, M.A., Meyer-Stout, P.J., Stamatakis, M-K., Gannett, P.M., Dunsworth, T.S. and Nardi, A.H. (2000) Development and evaluation of computerized problem-based learning cases emphasizing basic science concepts. *American Journal of Pharmaceutical Education*, **64**, 74 – 81.

Brown, C. and Krumholz L.R. (2002) Integrating information literacy into the science curriculum. *College & Research Libraries*, **63**, 113 – 123.

Hughes, I., Hollingsworth, M., Jones, S. J. and Markham, T. (1997) Knowledge and skills needs of pharmacology graduates in first employment; how do pharmacology courses measure up? *Trends in Pharmacological Sciences*, **18**, 111 – 116.

Kerecsen L. and Pazdernik T. L. (2002) From mainframe to web-based: 30 years of experience in computer-aided instruction of pharmacology. *Naunyn-Schmiedeberg's Archives of Pharmacology*, **366**, 83 – 89.

Savela, E. (2003) Professional competence in community pharmacists – continuing education among Finnish pharmacists applying the norm theory as a theoretical framework. Academic Dissertation in Finnish with English abstract. *Kuopio University Publications / Pharmaceutical Sciences* No. 62.