An e-learning system for pharmacist continuing education in Poland

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Abstract
The aim of this project is to develop an e-education system for the continuing education (CE) needs of pharmacists. The e-learning system assumptions were ease of use for end-users, easy to administer, to assist development and rebuild ability and the possibility to deliver both a wide range of helpful multimedia materials and online tests and role-play quizzes.

During the trial period over 250 users registered at e-duk@cja (http://papaver.farmacja.cm-uj.krakow.pl/learn/). We estimate that about 13% of all practicing pharmacists from Cracow Pharmaceutical Board visited the e-learning website. One hundred and ten pharmacists notified their wish for full access allowing the possibility of testing and educational credit accumulation and 43 decided to take the exam.

Results of this post-introduction inquiry reveal positive reception of this e-learning system.

Keywords: *Pharmacy continuing education, e-learning, internet based education, professional education*

Introduction

Newer technologies such as computers and video conferencing are not necessarily better (or worse) for teaching or learning than older technologies…they are just different… The choice of technology should be driven by the needs of the learners and the context in which we are working, not by its novelty. (Bates, 1995)

An e-learning process means delivering learning content and services (learning support) using digital technology. Learning and teaching with use of internet technologies and more general—electronic media is not a new concept. Sharing and gathering of knowledge using a communications net, started in parallel with the widespread use of the internet and its progenitors. People and companies involved in the new networking area found this way as a potential route of information interchange. Good examples of utilization of internet resources and possibilities in education were initially found in the financial area. Delivering knowledge for employers and taking the most from e-learning showed that such a way could be effective and cost-effective (Strother, 2002).

One of the characteristics of an e-learning system is a different design and construction compared with a traditional educational approach. Hamid split these two processes into so-called "Building Blocks" (Hamid, 2002) as shown in Figure 1.

As it is clearly shown in Figure 1, the main difference between traditional and e-teaching is expressed in the medium between learners and learning providers. One effect of such situation is a lack of control over the whole teaching process, and this is one of the most often featured disadvantages of distance learning. Other disadvantages include: computer and internet (often broadband) access; lack of the possibility to react to students' needs; the specificities of materials prepared under internet requirements (students can

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e-teaching

| Learners |
| content |
| applications |
| infrastructure |
| portal |
| browser |
| **Learning provider** |

traditional teaching

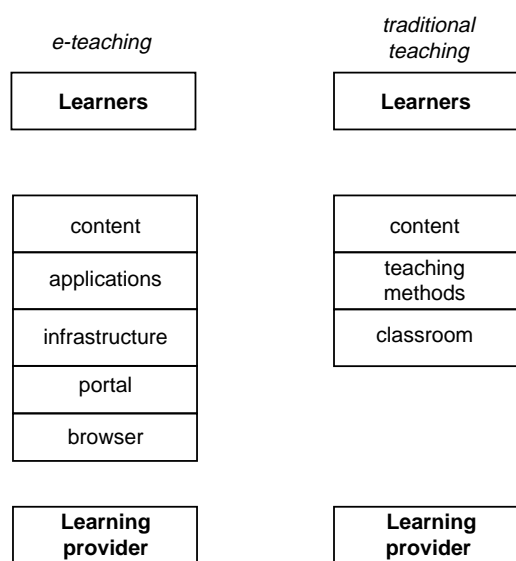| Learners |
| content |
| teaching methods |
| classroom |
| **Learning provider** |

Figure 1.   The building blocks.

feel isolated); and, information can vary in quality and accuracy, for example, graphics, images (McKimm, Jollie and Cantillon, 2003).

The advantages are: lower costs than traditional classroom education; the possibility of reaching people unable to take a part in traditional courses (due to reasons such as costs, distance, job obligations); the learning content is available from any location and at any time; it encourages more independent and active learning and provides a useful source of supplementary materials to conventional programs (McKimm et al., 2003).

Unfortunately the quality of e-learning based courses is rated rather negatively in much of the literature (Massy, 2002). The reasons are numbered between two themes: the technical and the meritorious. The technical issues are often independent of the authors of courses but the second theme depends entirely on them. It must be emphasized that technology can help, but cannot replace, the quality of educational content. To summarize, the challenge for e-learning systems and its adherents is to turn e-learning into e-knowledge (Mason, 2005).

As it was mentioned above, teaching and learning via the internet with use of digital technology also has weaknesses. Despite this, such a method is more often chosen as an alternative to traditional education, even in health-related areas (Trinkle, 1999; Lau and Bates, 2004). The UK National Health Service seriously considers the possibility of using e-teaching tools and methods in staff continuing education (CE) (NHSU, 2004), and in particular the nurse professional education environment is very active in providing knowledge via digital carriers (Forman, Nyatanga and

Rich, 2002; Denny and Higgins, 2003; Abramczyk, Lewoc and Izworski, 2005).

Pharmacists must be acquainted with current science and professional progress. To offer the best possible medical services, health specialists must engage with life-long learning processes. CE is still a growing part of academic teachers' and educational specialists' activities. However, the main is still traditional lecturer and student-based courses, which depend on the specificity of the health-related profession. Some sections of the presented knowledge cannot be simply translated using virtual means and should be practiced during face-to-face meetings. On the other hand, there are many topics, which could be fulfilled during self-education process. The crucial point is to deliver valuable materials and control the learning progress.

Properly used e-education techniques enable the above-mentioned requirements, and it is possible to use them in medical and pharmaceutical areas, with many examples from both undergraduate and postgraduate education in the professional literature. These vary from simple HTML-based web sites helpful in specific pharmaceutical areas (Reynaud, 2001) to technically advanced multipurposeful systems (Leemans, Verstraeten, Zwaenepoel and Laekeman, 2003; Rutter and Hunt, 2003; TOLEDO, 2005). The TOLEDO system (TOLEDO 2005) enables not just knowledge presentation but also its control. Taking just pharmaceutical and medical CE Path into consideration, the American experience and advancement must be emphasized. Freely accessible portals (MEDSCAPE.COM, 2005) offer the newest knowledge achievements from a wide range of pharmaceutical areas and at the same time provide educational credits for CE systems. The CE credits are necessary to prolong the professional license, which enables the practitioner to work both in hospital and community pharmacies. The CE knowledge domains are divided into topics, which contains articles. The assessments have a cross-sectional character and the user confronts them after all prior materials have been addressed. The effectiveness of this path of CE, including specifically of pharmaceutical education, has been investigated by educational specialists (Maio, Belazi, Goldfarb, Philips and Crawford, 2003; MEDSCAPE.COM, 2005).

E-learning systems are also used to deliver knowledge to patients suffering from chronic or even terminal diseases (Reis, McGinty and Jones, 2003). There are also additional interesting educational chances offered for interactive, online courses, which provide possibilities of up-to-date problem solving (Quattrochi, Pasquale, Cerva and Lester, 2002). For example, Quattrochi et al. (2002) proposition deals with using interactive web-based tools to optimize neuroscience learning.

According to Polish pharmaceutical law require-ments, every practicing pharmacist must gain 100 educational credits during a 5-year period. The educational credit pool is subdivided into two groups—those with and those without an exam. CE credits are necessary to extend the professional license for the next period. The educational activity remains under the control of accredited Faculties of Pharmacy and Local Pharmaceutical Boards supervision. Every pharmacist has their own "educational card" where the points are recorded. Polish law allows for internet-based types of education and distance learning for pharmacists and medical doctors.

Aim of the project

The aim of this project is to develop an e-education system for the CE needs of pharmacists. The project assumptions were:

- meritorious—that the system should be able to deliver the best possible knowledge for from the pharmaceutical area of interest for pharmacists and other healthcare specialists
- technical—it should be easy to use for the learner, operating system independent and easy to admin-ister and enlarge.

The project was planned as a cooperation between the Faculty of Pharmacy, Medical College, Jagiello-nian University represented by the Department of Pharmacoepidemiology and Pharmacoeconomics and the Local Pharmaceutical Board.

Materials and methods

The IT solution—the PHP and JavaScript with MySQL database system

e-duk@cja (http://papaver.farmacja.cm-uj.krakow.pl/learn/) is an online learning platform, which consists of the powerful PHP (PHP: Hypertext Preprocessor) web scripting language and the fast MySQL database server. With no restrictions and special requirements, e-duk@cja is able to run on any PHP enabled web server, on any environment that PHP and MySQL supports, which includes Linux, Solaris, BSD, Mac OS X, and Microsoft Windows environments. The reasons of choosing the PHP language were: wide usage, simplicity and ease in rebuilding the whole system.

The whole code is divided into functions and the PHP parts are not directly connected with HTML, which facilitates rebuilding and adding any new functions and elements. All data are stored in MySQL database, which is designed to avoid any redundant information and provide easy access to

data. To improve security in the more unsafe places of the code, PHP is supported by Java Script.

The whole system is divided into two parts—public user and system administrator. The administrator part is secured by HTTP access. There is no need to have any knowledge about HTML or PHP to administer the system; everything can be done by a special panel. There are two types of public user, with high and low access. Users with high access can view all data and exams, whereas, others can only see selected elements. The administrator decides which user can gain high access.

System construction

The e-duk@cja system is vertically and horizontally divided as presented in Figure 2.

The highest and overriding part of the e-duk@cja system is the Section, generally formulated by subject (for example, Pharmacology). Each section has its own administrator responsible for meritorious con-tent. The sections are subdivided into more detailed topics (for example, hypertension pharmacotherapy). The topics can contain an unlimited number of lectures and multimedia resources for each. Scientific articles are a separate part of the system but can also contain information connected with proposed topics, and usually they are more general than lectures. An important characteristic of the system is the possibility to control students' progress with use of online tests. The tests are composed to include the whole know-ledge presented in one topic domain. The section administrator is responsible for ascertaining the number and level of difficulty of the questions. The pool of questions is larger than number of queries available for every user during his/her exam. The system automatically and randomly chooses the number of questions settled by administrators and checks the correctness of the answers. Each user can go through a single test only once, after which the user decision approval system automatically blocks any possibility to resolve and correct the test.

Every pharmacist registered in the Local Pharma-ceutical Board and in the e-duk@cja system has their
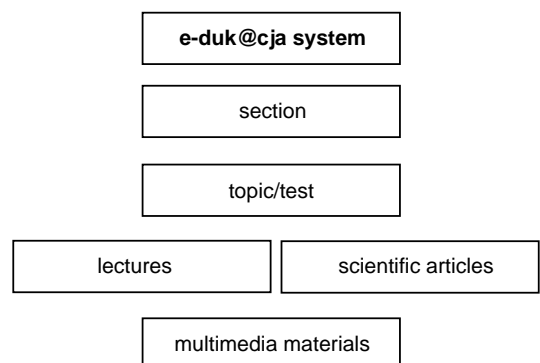

Figure 2. e-duk@cja system construction.

own account. The system automatically adds the educational credits into the user account after passing the exam. It is planned that in quarterly intervals the Pharmaceutical Board will send certificates of participation for successful pharmacists.

The system offers both exam and non-exam topics but one of the most important characteristic of e-duk@cja must be emphasized: both types of training end with a test, which is the key for a students' professional development control. The difference is in the number of test questions and difficulty level.

Materials types: Text, presentations, movies (streaming)

The e-duk@cja system can incorporate every type of multimedia file. The IT-responsible administrator attaches the appropriate files for each lecture or article. The user is able to view the movie (streaming), active chart, presentation and other resource during the self-study. During the testing period, all types of media listed above was tested and there were no observed problems.

Security for copyright protection

The knowledge content offered by the authors of the lectures remains their intellectual property, and copyright for their work must be maintained. There are three levels of copyright protection:

1. server protection
2. web page encryption
3. downloadable PDF file encryption.

Server protection is designed to prohibit the intrusion of unauthorized persons to sensitive data. As an addition to standard security procedures offered by Linux distributions, a cell phone monitoring system was designed. Any unauthorized logging in is registered and an administrator is alerted by an SMS mobile phone message. Thus, he is able to take preventive actions.

HTML encryption is performed *ad hoc*, since the PHP server is set-up to produce web pages dynamically. The encryption is designed to prevent direct HTML reading and copying. It is performed by ionCube PHP HTML encoder1.9 distributed for free (IONCUBE 2005). Additional JavaScript code prevents clipboard and context menu use. The JavaScript code is also encrypted by ionCube library so it is impossible to erase it and copy web page even after downloading it on the client machine.

PDF protection is also designed as two-stage system. The first stage is encoding provided by Acrobat® preventing copying and printing. The second stage is performed by a self-authored application. The program is designed to binary encode PDF file, mixing bits with the use of an arbitrary selected large prime number. Such an encoded file is displayed by a self-authored Delphi application using OCX plug-in distributed for free by Adobe®. Therefore, the client machine has to have Adobe® software installed and running under a Windows environment. The whole package for download is organized into simple and standard Windows installer (EXE file), which guides the user step-by-step through the installation procedure. Once installed, on each run, the software decodes the binary file *ad hoc* into the PDF, which is displayed with full quality while at the same time it is impossible to copy and print the education material. Clipboard use is also blocked in addition to the PrtScr key; this was achieved by implementation of specific Windows® API procedures. Moreover, when any such illegal attempts are detected, the user is warned once and any further attempts close the viewer automatically.

Authors realize that there are no completely secure computer systems, however, in our opinion such sophisticated and multi-level security systems are vulnerable at very low level. Moreover, since part of the security system is own-written it is less standard, and therefore, harder to be cracked. It is also still under development and will be implementing new ideas and solutions.

Results

Subjects included in the preliminary phase test

During the quarterly meeting of Pharmaceutical Board Heads and community and hospital pharmacy managers, information about the online learning system was presented. During the test period (from 14 February to 31 March) every pharmacist registered in the Local Pharmaceutical Board had free access to the educational content. There were two main topics from different sections as shown in Figure 3.

Number of participants after 3 months of test time

There were over 250 registered e-duk@cja system users during the testing period. That means that about 13% of all practicing pharmacists from Cracow Pharmaceutical Board visited the e-learning website. One hundred and ten of them expressed the wish for full access associated with the possibility of testing and accumulating educational credits. It is worthy to emphasize that pharmacists from different pharmaceutical boards wanted to participate in this type of educational activity as well.

Number of positive tests passed

During the three months 27 pharmacists decided to take an exam. Thirteen of them took tests from both

Test period content

1. section	PHARMACOLOGY
1.1 topic	Hypertension pharmacotherapy
1.1.1 lecture	Pharmacological aspects of hypertension treatment – drug scheme selection criteria
1.1.2 lecture	Pharmacist role in hypertension therapy optimization
2. section	TOXICOLOGY
2.1 topic	Drug safety
1.1.1 lecture	Medication errors
1.1.2 lecture	Medical errors
1.1.3 lecture	Geriatric pharmacotherapy safety
1.1.4 lecture	Geriatric pharmacotherapy DRPs'

Figure 3. Two topics presented during testing period.

topics. Out of the 67 tests 61 were passed and six were failed.

Comments and feedback from users

To estimate users' satisfaction level and suggestions online, a post-training inquiry was prepared. Registered users during system login time were presented with a blank web browser window with six fields:

- rate on a scale of 2–5 the usefulness of such type of pharmacists' postgraduate education (a traditional Polish school-based scale where 2 is the worst and 5 is the best mark)
- rate on a scale of 2–5 the ease/convenience of daily e-duk@cja system use
- rate two proposed topics for usefulness in daily professional life and quality of preparation
- propose any further topics which would be

Table I. Post-training inquiry results.

Part	Average rate (2–5 scale)
Usefulness	4.71
Easiness/convenience	4.48
1.1. Topic (drug safety) usefulness	4.48
1.1. Topic (drug safety) quality of preparation	4.15
1.2. Topic (hypertension) usefulness	3.86
1.2. Topic (hypertension) quality of preparation	4.0
New topic propositions	• pain therapy • cancer therapy • plant and natural drugs • pharmacotherapy during pregnancy • modern drug formulations
Main changes in e-duk@cja system propositions	• enable to download and print materials
Accepted payment level	• 20–40 PLN (ca. 5–10 Euro)—24% • 5–20 PLN (ca. 1–5 Euro)—52% • I am not going to pay—24%

interesting and should be presented in the e-duk@
cja system

- what kind of changes could be made to increase the
quality of the e-duk@cja system?
- are you interested in taking part in online studies
even if they would be not freely available and how
much would you be able to pay for a topic?

Every registered user with full access could fill the
inquiry once. Twenty-one pharmacists decided to take
a part in the survey. The results are presented in
Table I.

Discussion

The aim of the project was the development and
implementation of an online, CE tool. Based on the
results and feedback opinion from the test pharma-
cists, it should be emphasized that such a possibility is
needed and could be worthy of further exploration.
On the other hand, it is just the first step, and as with
every web portal, E-mail: e-duk@cja must to be
regularly upgraded and developed. If not, it will
become just a curiosity without any practical
significance.

Future perspectives and plans of development are
closely bound up with financial issues which are often
the crucial factors for such projects. The e-duk@cja
system was created as a non-profit activity of the
Faculty of Pharmacy in cooperation with Kracow
Pharmaceutical Board. During the first months,
pharmacists could use the system free of charge. All
consumable costs like internet connection, server and
other costs were covered by the faculty and
pharmaceutical board. Future plans include payment
via SMS for single courses or time periods of full
access. It is planned to further disseminate the system
in the future. During postgraduate studies organized
by the Faculty of Pharmacy the live and static web
content could be helpful for students to fulfil the
curriculum needs. From a technical point of view it is
planned to offer users higher levels of services, such as
live lectures (video streaming) and videoconferencing.

The usefulness of internet technologies in medical
and pharmaceutical distance learning is a hard fact.
Properly prepared courses can bring the learners real
benefits. The word "properly" means here not just
system without meritorious mistakes, but also system
that is easy to use from a technical point of view, and
with an attractive form. Internet-based pharmaceu-
tical CE activities cannot completely substitute for
the real life courses. Direct face-to-face contact
with patients as well as experienced teachers is very

valuable. On the other hand, looking at today's job
market regulations shows reduced opportunity to take
part in traditional courses. This is one of the reasons
for introducing web-based CE. The number of active
online course participants during the testing period
proves that such an idea could bring measurable effect
and usefulness for pharmacists.

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