Web scenarios - building on reality and supporting the problem-based learning structure of an undergraduate medical programme

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Abstract
Design: EDIT (Educational Development using Information Technology) is a tool designed to produce and present web scenarios for problem-based learning (PBL). The scenarios were introduced in 2001, and are now used in all semesters, usually two per week and in a fixed order.
The medical programme has access to 10-12 group rooms equipped with a computer, projector and white board. A total of 170 scenarios are currently used. They are chosen to reflect common symptoms, health problems and concepts related to basic science. Most scenarios represent patient cases, but some explore social and population problems. Patient cases cover the spectrum of age, sex, and background. Scenarios contain hypertext, diagnostic material, pictures, video films, etc. Multimedia materials are used to promote realism, stimulate the senses and provoke feelings. Triggers lead to advanced questions, and not to answers. Links to learning materials are not given. The scenarios are available from any computer (password protected). Students can send queries via the EDIT-system, which can be answered by e-mail or at a resource lecture. A database of scenario components has been built up.
***Analysis*:** The introduction and use of web-based scenarios has been highly successful and EDIT has become an integral part of the medical curriculum. Both students and teachers consider EDIT scenarios to be much more stimulating than the former "paper cases". They are public within the faculty and can easily be revised. The very process of creating new scenarios has highlighted the importance of scenarios in PBL and has heavily influenced the organisation of other semester-associated learning activities.

Introduction

In 1986, the Faculty of Health Sciences (FHS) at Linköping University, Sweden, introduced problem-based learning (PBL) as the main educational philosophy for all undergraduate study programmes. The medical programme was second in Europe after Maastricht in this process (1). The rationale and positive effects of using the PBL approach has been reviewed in recent years (2-4) and this model is now, in different formats (5), fairly widespread in medical education. The benefits of its application include the integration of subjects into relevant professional contexts and its ability to cope with the rapid growth of medical knowledge.
In 2001, web-based PBL scenarios were introduced by the EDIT project (Educational Development using Information Technology). Inspiration came from Sydney University, Australia, which had started to use web-based scenarios for their new graduate medical programme in 1997 (6). The main aim of our project was to use information and communication technology (ICT) and multimedia in scenarios to improve students' learning. Another objective was to familiarise students with handling computers and accessing information from the Internet, thereby preparing them for the use of ICT.

The rapid development and use of the Internet made web-based scenarios possible. The introduction of such scenarios into medical education has been positively received at many faculties over the last few years, e.g. in Maastricht, the Netherlands, (7) and at Harvard Medical School in Boston, USA (8). On-line delivery has also been used outside the health sector in a variety of educational courses. The introduction of this method has been reported, e.g. in engineering, with generally good outcomes (9).

The role of the scenario in PBL

A PBL scenario should motivate students by presenting a problem in a realistic context relevant to their future profession. The scenario should also challenge students' prior knowledge and and conceptions and raise questions from which learning needs can be formulated. Criteria lists for case construction have been published (10, 11). The selection of problems and the order in which they are presented are also important factors. Scenarios should reflect common health problems and be chosen in such a way that they exemplify important concepts relating to the goals. The qualities of the scenarios are likely to influence the outcome of students' learning in PBL (12-14).

In our medical curriculum, subjects are integrated into mainly organ-based themes covering the important aspects of the future profession. Within such themes, everyday situations or problems are selected as scenarios. The scenarios are processed in tutorial groups consisting of 6-9 students and a tutor. Previously, the scenarios were presented in the form of "paper cases".

The EDIT system

A web-based database application for the production and presentation of PBL scenarios with multimedia was constructed by the University's IT department. The system has a user-friendly interface with a simple design that can include different multimedia formats (Figure 1). The scenario is allowed to develop gradually without exposing all the information at once. EDIT is presented on a password-protected intranet. An easy-to-use system for the administration of users, scenarios and scenario components, and a simple evaluation system for feedback and questions to teachers, scenario constructors and administrators have been developed (15).

The EDIT group rooms are equipped with a computer (cordless mouse and keyboard to allow all students equal group participation), a projector, a screen and a whiteboard. The projected screen image, enlarged on a whiteboard, enables the group to focus on the same part of the scenario at the same time. Students document learning issues and questions continuously. The MS Word documents produced during the tutorial session can be sent by e-mail to the group participants.

The organisation and principles of scenario construction

The EDIT-project has a part-time coordinator and a webmaster. Programme coordinators have been appointed for the periodically very time-consuming work of editing the scenarios. The scenario constructors (teachers and clinicians) are supported in the process of constructing new scenarios by the small production unit. The production unit can assist with video production, pictures and other multimedia presentation forms. In addition, a faculty network, consisting of teachers from diagnostic specialities such as radiology, clinical chemistry, pathology and microbiology, produce digital images such as X-Ray and microscopic images. A database of multimedia components has been created, which facilitates the re-use of previously produced material in other programmes. To avoid copyright problems, most of the

material in EDIT has been produced by the faculty, but if other material is used, permission is obtained from the owner and the source is clearly stated.

The actual administration of scenarios and scenario parts is carried out by the EDIT webmaster. However, an easy-to-use administrative interface has been developed and this work could currently be done by the different programme administrators.

Creating an EDIT-scenario

A scenario usually starts with a short and open review of a patient's complaints and background to encourage a broad discussion. This is followed by links (10-20 in total) adding more information in a stepwise fashion about diagnostic investigations and treatments, with pictures of different mechanisms to stimulate discussions on a general and detailed level. The scenario has a summary page (300-400 words) and a tutor's page. The latter, which is accessible only to teachers, contains keywords related to semester objectives, suggestions for study and support for tutors lacking specific subject competence. It is not the aim that all groups should study exactly the same issues or that all the suggested issues are covered.

Scenario constructors are advised to use real patient records as a base. Besides texts, which are edited to suit the hypertext format, the scenarios may be illustrated in a variety of ways: photos, lab lists, microscopic pictures, radiological material, and videos, schematic pictures of cellular mechanisms (Figure 2), tables of epidemiological data (Figure 3), etc.

Short videos are used to portray patient encounters. Such sequences should provoke an emotional response, as this has been found to stimulate students' discussions and questions. Amateur actors, health care staff and, in some cases, patients have been filmed for this purpose. Films have also been used to illustrate workplace conditions and healthcare settings in developing countries.

Scenarios should stimulate students' interest and be challenging. The different documents included should give rise to questions and learning goals without giving answers. Graphs, figures and models are therefore sometimes deliberately blurred in order to stimulate discussions and questions. All scenarios are edited and revised several times by the EDIT-team in cooperation with the constructors before publication on the EDIT website. Each scenario has a responsible author and, frequently, co-authors.

Legal aspects

The use of pictures for educational purposes is regulated by Swedish copyright legislation and agreements about teachers' right to copy. However, these laws and agreements are not applicable for digital publication on the Internet. Therefore, permission from copyright owners must always be obtained. The easiest way to obtain pictures for the scenarios has therefore been to make sure that a teacher or an employee has the copyright. When using patient data, these have either been anonymised or the patient's permission has been obtained.

General permission to publish official material has been given by various public authorities. So-called free picture archives on the Internet are often blocked by copyright laws from permanent Internet publishing. Linking to a picture or a film is legal, but the drawback is that web addresses often change and move. Since the aim of a PBL-scenario is to stimulate student's investigation and self-directed learning, direct links to web-based learning material (i.e. databases) have been avoided.

How a scenario is used
A scenario is processed during two group sessions, each of two hours duration. The scenario is analysed according to a structured model. The different components of the scenario are explored as the students work through it. The group analyses the problem by frequent brainstorming, thereby discovering their level of understanding and prior knowledge of the given situations. Finally, the group defines common questions and learning goals for individual study. When the group meets again, the scenario is explored and the acquired knowledge is discussed and applied. After finishing this process, a summary (200-400 words) of the scenario is accessed and read out by one of the students. The aim of the summary is to cover the salient points of the actual case and highlight the biological and other mechanisms without providing a key to all problems.

When the group, despite every effort, is unable to resolve or fully understand a problem, it may resort to a system of formulating questions. These questions are often dealt with at a resource lecture to which many teachers are invited. Students can now submit these questions in advance and teachers can therefore come better prepared.

In Phase I (semesters 1-2) and II (semesters 3-5) the students work through over 30 scenarios per semester. In the clinical Phase III (semester 6-11) there are nine EDIT-scenarios per semester (except semester 6 which is used for the students' research projects). The role of scenarios in clinical semesters is to complement the clerkships and focus on basic science and pathophysiological mechanisms, epidemiology, prevention, and ethics.

Implementation
EDIT was introduced into semester five of the medical programme in 2001. Lectures and other learning resources are planned to fit around the sequence of the scenarios. The scenarios represent the hub of the semester and are chosen to illustrate fundamental phenomena in a context of common health problems. A total of 170 EDIT scenarios are currently used by the medical programme. EDIT scenarios from the medical programme have also been used to prepare non-European physicians for the national license examination which is a prerequisite for practice in Sweden. More than 600 medical students now use the EDIT system every semester.

Evaluations
The integral evaluation system provides continuous feedback to the scenario constructors and to the project group. The groups send their detailed comments on the case, spelling corrections, suggestions for improvement, and their views on how the scenario has functioned as a whole. This information is taken into account as the scenarios are revised. The role and function of the web-based scenarios are also always discussed in semester evaluations.

Evaluations have shown that teachers and students are positive to this new way of presenting scenarios. The greater realism created by the multimedia components was much appreciated. The overall evaluation after the pilot semester in 2001 was positive with a rating of 8 out of 10. It was observed that questions raised by students working with EDIT scenarios were more elaborate and profound.

Most initial complaints concerned technical problems, which were solvable. Some students complained that the EDIT scenarios presented too many triggers, which was experienced as a higher level of guidance that was unduly influencing the learning process, limiting the

students' own creativity. The guidance to encourage students' attention to areas not previously studied in sufficient depth was followed, but the students' concern was carefully addressed by trying to make the scenarios more open and less obvious in their design, and by being more restrictive with the total number of documents in each scenario.

Following these measures, implementation continued in the medical programme and the system was later introduced and evaluated in nursing. Evaluation of the scenarios was carried out by two master degree students of cognitive sciences. The first student focused on the actual use of the system and the interaction between users and computer. Positive views of EDIT were obtained but some changes to the system and use of the equipment were suggested, and a number of the suggestions have been implemented in the further development of the system. The second student applied a socio-cultural perspective to analyse how students used and created meaning out of the pictures and videos. The main findings were that student groups did not respond productively to some pictures and that the role of the tutor in achieving a reasoned and a professional perspective was important.
Following an international selection process, EDIT was chosen as one of the finalists in the European Academic Software Award (EASA) competition in Switzerland 2004. EDIT has also helped the medical programme to achieve top position in the national evaluation undertaken by the Swedish National Agency for Higher Education in 2006-07 and to the award for excellence in higher education in 2007 given by the same agency after an evaluation by an international expert group:
http://www.hsv.se/quality/qualityassurance/centreofexcellentqualityinhighereducation.4.5b73fe55111705b51fd80001723.html

The application with a description of the design of the medical curriculum and can be found here:(http://www.hu.liu.se/content/1/c6/05/26/67/ans%C3%B6kan_l%C3%A5guppl%C3%B6st_ejl%C3%B6senord.pdf.)

Lessons learnt
The strength of the web-based scenarios is that they can be used throughout the entire medical programme. EDIT has become an integral part of the PBL curricula in many undergraduate programmes at FHS. The structuring of semesters now focuses on an overview of contents and learning recourses. EDIT scenarios have become the hub around which other learning activities are organised. Whether a lecture or laboratory module takes place before or after a scenario assumes great importance. Our project has also influenced a major revision of the medical curriculum that was implemented in 2004. The IT skills of students and teachers have improved and a pedagogic debate has been generated across the faculty.

The very process of creating new scenarios has highlighted their importance in PBL. A number of lessons have been learned about how a well-functioning web-based PBL scenario should be selected and constructed. Scenarios should reflect priority health problems in the population and be relevant to the semester in question and its objectives. It is desirable to select valuable examples, using a variety of patient cases and other encounters. As others (10, 11) have suggested, triggers/documents should not be complex or overly structured . Documents included should raise questions and not give answers. There is a risk of overloading scenarios, which could deprive the group of time for reflection and brainstorming in relation to the triggers. Therefore, even if multimedia material seems to improve theory building and theory evaluation it must be used selectively. The scenarios in EDIT do not contain learning resources, which the students must search for themselves.

A characteristic of EDIT is that complete scenarios or parts of scenarios can be reused in other undergraduate programmes. In this way EDIT has contributed to cooperation between undergraduate programmes and between teachers of these programmes.

The complexity of modern scenarios means that tutors have to prepare more thoroughly for the tutorials in order to facilitate the students' learning process. To prepare tutors, meetings are organised before every new theme and the scenario constructors present their scenarios.

Groups working with paper cases can use any room. EDIT, however, demands well-designed and expensively equipped group rooms, and this poses extra security demands. This raised costs but also raised awareness of the importance of building design and of long-term planning.

The web-based presentation form makes all scenarios "public" in the faculty, which means that they can be seen and scrutinised by many more teachers than before. Using feedback from students and teachers, most scenarios have been revised and improved several times. In our experience, such changes are much harder to achieve with paper scenarios. Both students and teachers appreciate EDIT scenarios as being much more fun and stimulating to work with than the former "paper cases".

For further information see:
Home page of the medical programme: http://www.hu.liu.se/lakarprogr/om_lakarprogrammet
EDIT web scenarios (user name:Password: guest): http://www.hu.liu.se/edit

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