# ELECTRONIC TEACHING MATERIALS - CASE STUDIES, USE OF MEDICAL IMAGE DATA

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**Abstract**
The paper focuses on the description of the activities designed and realized in an extensive project aimed at training future non-physician health workers. Within the implementation period of the project, which is February 2010 - June 2012, a number of logically interconnected activities have been carried out. In the current period, teaching materials, namely tests and study texts, are being finalized and piloted. In this paper, special attention will be paid to a specific part - the preparation of case studies which will enable students to use their theoretical knowledge in solving problem situations (PBL). In particular, methodological and didactic requirements needed for the preparation of valid case studies will be presented, as well as examples of specific case studies and educational use of medical image data. The paper also discusses and summarizes the benefits and potential risks of using problem-based learning through case studies.

**Key words:** e-learning, Moodle, case studies, nursing, Medimed, DICOM

## Introduction

Projects aiming at the preparation and implementation of teaching with the support of e-learning have different goals and strategies. The project Effective Teaching in Secondary Health Care Schools (project No. CZ.1.07/1.1.02/02.0074) involves, besides the participants from Masaryk University, 45 teachers and 857 students from three secondary health care schools in South Moravia.

The project covers various areas, while the main ones are: teacher training in ICT and e-learning, preparation of comprehensive study materials and teaching activities in a shared environment, working with medical image data, teaching students using the online materials created within the project. One of the project features is sharing expertise and intensive cooperation, notwithstanding the different curricula of the involved partner schools. Parts of

the study materials are supplemented with English, German and Latin terms (CLIL). Although it is sometimes very demanding to ensure cooperation, the project brings a number of positive results. It, for example, enables the teachers, who were the creators of the study materials during the first phase, but gradually move from this role to that of tutors, to gain indispensable experience in preparing online activities for students and provides them with relevant strategies, management principles and tools of online communication.

A substantial part of the teachers' work and of the project coordination takes place in LMS Moodle which has proved to be a suitable environment not only for the preparation and completion of the teaching content and the related communication, but it also offers a sophisticated yet simple tool for the alignment of project activities.

## Medical image data in online teaching

Part of our current project makes use of the results of the MeDiMed project (www.medimed.cz) in which routine processing (e.g. acquisition, access, reliable long-term archiving) and transfer of medical image data provide conditions for wide access and medical data exchange using the possibilities of information technologies and medical informatics. Thus, the longstanding and extensive cooperation between the Institute of Computer Science MU and hospitals can participate on the improvement of the tuition at secondary health care schools. Medical image data produced on a daily basis by various medical modalities (e.g. ultrasound, digital mammography, magnetic resonance imaging, CT, X-ray and many others) in medical workplaces are stored in standard DICOM format in huge archives - PACS (Picture Archiving and Communications System). This source of studies is also interesting for education at secondary schools. We have chosen tailored commercial PACS technology to serve as a repository of our educational system. Medical studies involved in this repository have to be modified according to the requirements of education:

- Automatic study anonymization
- Study description
- Key words assignment [1].

For using the medical image data outside the medical facility it was necessary to adjust the access to the source data in the database for the project target groups (students and teachers of the partner schools). The database, supplemented with images in relation to the teaching materials and

thematic units, is mostly used via a web interface, which offers easier access as well as basic tools for the diagnostics of the image data. Depending on the logon rights, selected studies are made available to specific persons or groups of users via the web interface TomoCon Web System (TCWEB) which allows viewing and evaluation of patients' digital image data. In addition to being a management system, TCWEB enables transmission, visualization and diagnosis of the patients' image data via a standard web browser and it also provides basic tools for transformation, e.g. zoom, crop, change of grayscale. Needless to say, the transfer of all data is encrypted and secure.

Medical image data are integrated in the created online courses in the LMS Moodle in several ways, e.g. as part of study materials, test items or case studies from which users are referred to a specific study or directly to individual images.

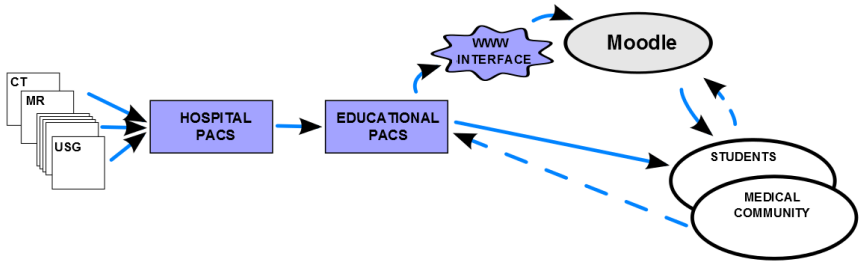


Figure 1: The basic structure of the educational system

Students of the partner secondary health care schools can also attempt at working with modified diagnostic workstations which are very much the same as the routine diagnostic environment. They can master standard procedures using the PACS technology.

From the didactic point of view the medical image data can be used in the following ways:

- primary source of information - topography,
- information about diagnostic methods,
- individual work - searching for signs of pathological states (with navigation), designing proposals for further diagnostic-therapeutic procedures (case studies).

• monitoring the development of symptoms of pathological conditions, procedures and effects of treatment,

• broaden the knowledge of specialized terminology.

## Case studies in e-learning

Using case reports in learning is a profitable teaching method which allows a better orientation and preparation for clinical practice and collaboration with patients in model situations applied thematically to the taught whole and specialization.

It is generally considered an important part of training health workers at various functional levels. [2] The same also applies in the context of the creation of case studies and their use in this project. Case studies are seen as an opportunity to verify the students' knowledge and their independent work (auto-educational processes) in solving problem situations within the PBL. Case studies develop a number of important professional and personal skills: solving problem tasks, ability of critical thinking, synthesis of knowledge in cross-curricular links, ability to take responsibility for the chosen solutions, taking into account the requirements of lege artis (according to their level of competence). [3] To the same degree as the use of cases studies is important for students, it plays an equally important role for teachers, not only during the creation of the materials, but also in the evaluation process of the learning outcomes.

In some case studies medical image data are used and they are included for several didactic purposes: introduction to modern technologies of visual examination records, the ability to distinguish physiological and pathological conditions, understanding the problems of clinical diseases and their symptomatologies, ability to identify diseases or deviations from normal health. Students are provided with materials in a form that suits their abilities and knowledge gained in current learning. The selected images that present difficult situations to students, are supplemented with verbal descriptions and commentaries. Ultimately, the practical application of medical image data in the case studies should enable students to cope with the problems in mastering advanced information technologies.

In the preparation of case studies we comply with the requirements beyond the mere presentation of theoretical knowledge, but we also emphasize the necessity of their practical use and choice of care procedures according to the best practice of evidence-based nursing. A scientific approach to the preparation of case studies is essential (e.g. according to Yin

methodology [4]), which facilitates assigning tasks and their solutions in explicit form on the basis of a consistent operationalization of questions and tasks. This does not expose the students to risks arising from ambiguous and unclear tasks, but allows them to concentrate on performing the task and on their own potential (e.g. knowledge, logical reasoning, abstraction and synthesis of knowledge).

The practical course of creating case studies in the LMS Moodle environment has been as follows:

- methodological seminar - the principles of valid case reports, recommendations for selecting the samples, eliminating the risks of the lack of objective information, organizational guidelines,
- identification of the case studies focus - prepared by the creators of materials in relation to the study content of the processed materials using the Glossary module,
- preparation of case studies content as well as the tasks using the Book module,
- methodological seminar - technical processing of case studies in the Lecture module (processing during seminars), resolving the ambiguities of professional character,
- peer review - using rubrics in the Database module.

Professional and formal level of the teaching materials is continuously ensured by several mechanisms: professional, methodological and technical support, peer review - the creators' mutual evaluation, the students' feedback.

## Conclusion

The project activities have led to the creation of complex e-learning materials for students of the participating partner schools. Both target groups, students and teachers, not only continuously acquire relevant materials for the learning process, but they also master a number of skills and gain experience with electronic teaching support and the use of ICT. The practical impact of the project activities is expected to be an improved competitiveness of the supported target groups in the labor market.

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