Geothermal E-learning through Hungarian-American Cooperation

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ABSTRACT

University of Miskolc in Hungary has offered courses in Geothermal Engineering since 2008. This program extends for 8 semesters, with twenty courses ending with a diploma on geothermal engineering. In 2012 the university won an EU competition to continue the development of postgraduate courses in Geothermal Engineering in the form of E-learning courses. University of Miskolc's cooperative partners in this endeavor are the University of Colorado and Colorado School of Mines, and the project is being executed by INNOCENTER, Ltd. Within this framework international educators and geothermal experts are working together to develop a state-of-the-art curriculum.

1. INTRODUCTION

Hungary has a long tradition of geothermal utilization. The surface manifestations of geothermal potential in Hungary have been known since ancient times, and thermal springs in Budapest were used by the Roman Empire and the Medieval Hungarian Kingdom. Exploration for deeper thermal waters began in 1877, with balneology being the earliest use of thermal waters. During the 1950's and 1960's hundreds of geothermal wells were drilled, and many of these wells were used for agricultural purposes. At present agricultural use is still one of the important applications of geothermal waters in the country. In addition, more than 40 townships with more than 9,000 flats are heated in district heating projects. Hungary also has more than 4,000 geothermal heat pumps units in operation. Thermal waters are also used in secondary oil production, hot water being injected into oil reservoirs for enhanced oil recovery. In addition, innovative applications such as heating of gathering pipes in heavy oil-producing fields using geothermal waters are being implemented.

The demand for further geothermal education in Hungary has stemmed from demands from the industry. The petroleum engineering program at the University of Miskolc within the Faculty of Earth Science started in the early 1960's. From this point geothermal education evolved and now courses are offered with degrees at the BSc, MSc, and PhD levels. The Postgraduate Certificate in Geothermal Energy Technology was created in 2008, and is now a well-established four-semester program.

2. THE GEOTHERMAL E-LEARNING EU PROJECT

In 2012, a project co-funded by the EU started between the University of Miskolc, with collaborative contributions from researchers at the University of Colorado (USA), and Colorado School of Mines (USA). The project is being executed by the University of Miskolc and INNOCENTER Ltd, a leading E-learning company. The goal of the project is to develop a postgraduate geothermal education program in E-learning form. The title of the project is "Curriculum Development and Modernization for the Post-Graduate Training Program in Geothermal Engineering, University of Miskolc, Faculty of Earth Science and Engineering". The project has a timeframe for execution from January 2012 to January 2014, and the total budget is 600,000 Euros. The online post-grad training portal being developed as part of this project is able to manage the educational process, communications, evaluation, and monetary processes. Further, the module is compatible with the Digital University educational portal

As part of this project, the following courses are under development (the relevant number of credit hours for each course are shown in parenthesis): Renewable Energy (5), Advanced Geology (6), Advanced Geophysics (6), Fluid Dynamics (6), Hydrogeology (5), Drilling Well Design (6), Geothermal Reservoir (5), Geothermal Water Production (5), Geoinformatics (5), Geothermal Chemistry (5), Geothermal Heat-Transfer Systems (5), Geothermal Heat-Transfer Systems (5), Geothermal Power Production (5), Geothermal Direct Uses (5), Geothermal Heat Pump (5), Geothermal Environmental Impacts (5), and Geothermal Environmental Impacts (5).

The first step in the project was to prepare and develop drafts of the curricula by experts in

geothermal engineering, which could them be translated into E-learning form. During this period, domestic and international practitioners were contacted to be involved in the project. One of the goals of the curriculum development was to develop a set of practice-oriented education material. On the other hand, a goal of the project was to collaborate with educators from the U.S. and other European countries to develop a state-of-the-art curriculum.

3. DIGITAL CURRICULUM DEVELOPMENT

The course notes have been written in both English and Hungarian, as this permits the courses to be offered online to both domestic and international students. The digital courses will be a student-centered approach, and differentiated individual work and teamwork will be integrated into the online training program. The state-of-the-art curriculum is being created with reliance on the most recent scientific achievements published in international journals. INNOCENTER, Ltd is responsible for taking the written curricula for each course and designing figures, animations and videos that transform the work into E-learning form. After calling upon professional readers and linguistic reviewers to review and proofread the curricula, we shall arrange the verified material. The courses are formulated so that they address the institutional and disciplinary requirements for receiving credits from a major university.

4. MODERNIZATION OF THE CONTENT

An important aspect of the project is to develop cooperative modules integrated into the educational portal for online content and knowledge management system. An important aspect is to have both substantive individual-based work as well as team-based work. The different E-learning courses are being developed so that they can be administered by different qualified instructors.

5. INSTRUCTOR TRAINING

Altogether 16 training programs for university instructors (60 people) in 5 topics are being developed for the E-learning courses that are part of this project. Training courses include the following:

- Training curriculum developers
- Enhancing digital literacy in education
- Applying modern pedagogical tools and devices to E-learning efforts
- Using modern pedagogical methods in E-learning
- Training in English professional terminology

The overall aim here is to promote the instructors' digital pedagogical skills and competences. The results of the development can be viewed at www.digitalisegyetem.hu.

6. EDUCATIONAL SYSTEM

The digital text of the learning materials is divided into paragraphs that are stored in the database separately, with distinct attributes attached to them. This method makes possible to have a dynamic text with different views and extracts. Navigational features, the display of a table of contents with adjustable levels of detail, and the linking to objects in the text are all standard functions of this dynamically compiled text. The rich learning materials can include multimedia content, illustrations, audio, video, interactive animations and tests.

Teachers can use 12 different exercise types for creating tests that can be parameterized with numerous different settings, affecting the functionality and display of these tests. Deadlines for tests make the scheduling of the learning process manageable. Access to tests can be managed on group level, but also on individual user level.

NetLearn is a complex online learning management system (LMS) that provides a single framework for managing complete learning process, including the authoring, distribution and publication of e-learning teaching materials and the administration of the different processes. It was developed by the INNOCENTER Ltd. After a standard authentication protocol, users can log into the LMS using any modern internet browser. The multimedia content of the learning materials can be accessed with a typical PC configuration. The LMS provides a rich array of tools for communication, student and teaching administration, statistical analysis, testing and evaluation and for authoring learning materials online. NetLearn is based on standard internet technologies. The software was developed using the PHP server-side language, HTML and Javascript. It runs from a web server, data is stored in an online database. During the development, it was essential to use solutions based on international standards. A typical NetLearn server environment includes, but is not limited to the highly affordable Linux environment with an Apache server and MySQL database server. NetLearn also comes with its own mail server, which provides interface for sending and receiving e-mail messages from within the LMS. The infrastructural backend for videoconferencing is provided by a dedicated server. NetLearn, as a multiuser environment, provides different user statuses for easy access right management, but these typical roles can be distinguished further on group level. The same user can have different roles in different groups; the tasks he can carry out and the available tools are provided accordingly.

3. CONCLUSIONS

A novel educational framework has been developed for geothermal education in an E-learning format. This framework includes contributions from international researchers, as well as practitioners. The E-learning format has the potential to be used by students from around the world.

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