WATER EDUCATION: AN E-LEARNING PLATFORM FOR WATER-RELATED COMPETENCE DEVELOPMENT

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ABSTRACT

The Danish water sector needs competence development as a response to changing water management structures and implementation of European legislation, and the number of international students enrolled in at DTU Environment is increasing. Based on their different backgrounds there is a clear need for adaptation and development of the existing courses. To accommodate this, DTU Environment has created an e-learning platform called Water Education, based on the software platform Moodle. It is scheduled to be operational in 2011. Based on the experiences so far, it can be concluded that in some areas major time savings can be obtained during the course execution and increased learning has been documented compared to a traditional classroom teaching on the same topic, but the students' backgrounds affect their attitude towards e-learning. More recorded lectures are sought and presents a potentially positive way forward.

KEYWORDS

Competence development, continued education, e-learning, blended learning, water sector.

INTRODUCTION

The Danish water sector is in dire need for competence development to accommodate the changes in Danish water governance (decentralisation, privatisation and larger entities) and the implementation of relevant European Union (EU) directives such as the Urban Waste Water Directive, the Water Framework Directive, the River Basin Management Plans and the Environmental Quality Standards. In parallel, the number of international students enrolled in the two-year Master of Science programme in Environmental Engineering at DTU Environment or visiting in short-term stays is increasing. Since these students come with a wide range of different backgrounds (although working knowledge of mathematics and natural sciences including chemistry and physics are prerequisites) there is a clear need for adaptation and development of the existing courses. In response to these needs, DTU Environment has created an e-learning platform called Water Education scheduled to be operational in 2011.

PLATFORM AND SYSTEM

Water Education is based on the free and open-source platform Modular Object-Oriented Dynamic Learning Environment, abbreviated Moodle [1], which is widely used and offers several learning applications like online quizzes and lessons directed by the student answers and communication tools like chat fora and instant messages. Additionally, it can accommodate hyperlinks, self-running Flash presentations, and audio-visual (AV) files as supporting learning material.

Module structure

Water Education will offer different modules aiming at 1 ECTS each, and the approach is then for the student to “choose & click” the relevant modules. The collated modules are then arranged together in a course tailor-made for the individuals’ needs and several courses may build on top of each other. Alternatively, a starting quiz, with feedback, can be used to determine the intrinsic level of knowledge and hence point to the appropriate level to begin. Construction of courses with increasing level of complexity is also possible (see Figure 1). Each module is built-up by a harmonised structure:

- A guide to the module (including description of teaching and evaluation methodology)
- Introduction to the topic covered in the module
- Theory (including a literature list)
- Training exercises with automatic feed-back and/or example solutions
- Evaluation test, quiz or online delivery.

Also suggested for the water treatment technologies, are elements showing case studies where the techniques have been implemented and the student can identify e.g. major drawbacks and benefits in practise. This is structured in accordance with the Conceive-Design-Implement-Operate (CDIO) syllabus [2].

Module topics

At this point in time the course content in Water Education range from basic water chemistry to integrated management of urban water quality in at total of 31 modules (see Table 1). Of these are 20 tested and already implemented in DTU Environment teaching activities, another 6 has been tested and subsequently revised, and 5 are scheduled for testing. All courses are given at a high technical university level, integrating and resulting in the building

of knowledge, comprehension and application, together with analysis, synthesis and evaluation skills.

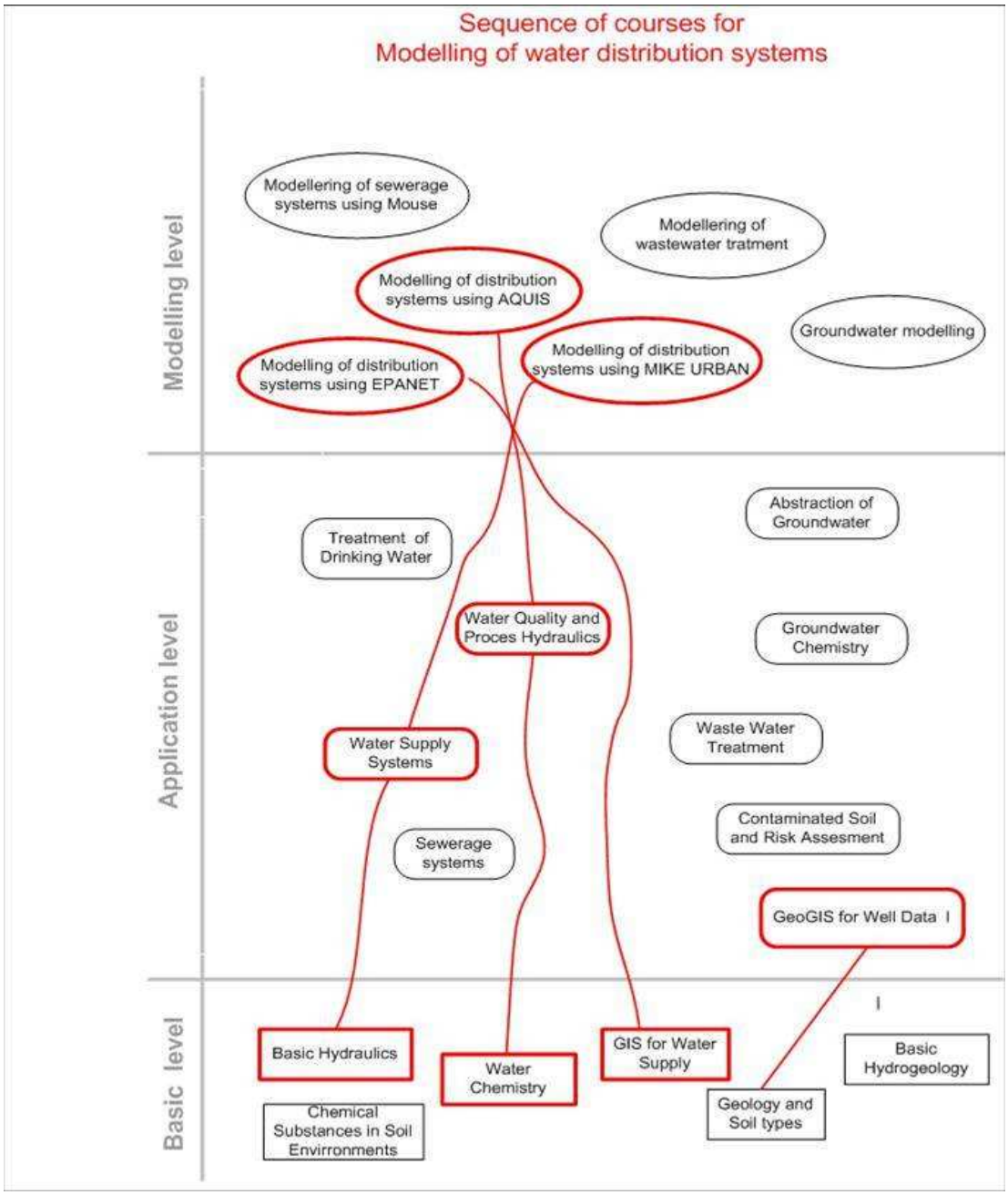

Figure 1. Planned education tree for the modules in Water Education [3]

Resources

Even though the structure of the modules have been harmonised in Water Education, the actual resources used vary from module to module. It is also related to the wishes of the individual teachers, and resource availability, so therefore no harmonised approach has been utilized. However, some general and repeated resource can be seen:

- Text materials; scientific and/or technical notes, reports and book chapters by the concerned teachers or with permission from the publisher.

- Presentations containing text, pictures, tables and figures as well as film sequences occasionally with comments.
- AV materials; pictures, tables, figures and film sequences as well as animations including Flash.
- Links; pointing to relevant supplementary materials such as reports, online videos etc.
- Quizzes; for self- and examination tests.
- Exercises; training exercises with model solutions and delivery exercises with feedback.
- Modelling/simulation tools; with user's manual and exercises.
- Communication; discussion and announcement fora, chat and instant messages.

Table 1
Topic, modules and resources

Courses	No. of modules	No. of quizzes	No. of deliveries	No. of videos/Flash	No. of training ex.
Water chemistry and environmental chemical processes	6	7S 5E	1S 2E	1	9
Drinking water treatment	9	2S 9E	1E	10	26
Wastewater, biological processes and reactor hydraulics	3	2S 4E		6	13
Integrated urban water quality management	9	1S 1E	7E		9
Environmental chemistry and ecotoxicology	4	22E	2E	1	4
	31	12S 41E	1S 12E	18	61

(S) Self tests/training; (E) examination

All modules contain at least one element of examination; over 50 quizzes or deliveries; hence some modules contain multiple elements of examination, Table 1. Sixty-one training exercises with sample solutions; 12 self testing quizzes and 1 delivery with feedback are also available.

Need of teachers

In the module design phase: teachers are needed to produce new teaching materials and collate relevant supplementary information, but staff trained in other disciplines as information technology (IT) staff, graphic officers are valuable to generate functional and graphically appealing materials. Students, assistants and colleagues are also important for evaluation and testing. Here, 5 professors/associate professors. 3 post doctoral fellows, 2 IT persons, and 1 graphics expert collaborated to build-up the Water Education platform and construct the resources used. BSc/MSc-students have been commissioned for testing and providing feedback. The development period extends from 2009 to 2011. In the course execution phase at least one teacher need to be assigned in order to provide feedback, answers to questions and moderate fora. In e-learning courses featuring discussion fora teachers are involved in teaching activities (e.g. moderation of discussion among the students) almost on a daily basis. The possibility of choosing the time to participate in the course is a benefit also for teachers, who can better organize their activities as opposite to the fixed time schedule required by traditional teaching methods. If joint fora and chat rooms are provided the students, according to our expertise, quickly to collaborate and share knowledge.

Status

Water Education has not been made public yet, but some of the modules have already been used by the students enrolled, in e-learning and blended learning courses offered at DTU Environment. 134 students have taken the modules in Environmental chemistry and ecotoxicology as supplement to a regular course. 49 students have taken the modules in Water chemistry and environmental chemical processes and in Wastewater, biological processes and reactor hydraulics as one course blended learning course, Table 1.

The overall fate of the e-learning is however governed by the resources (funding, staffing) put into it. The future of e-learning at DTU Environment will most likely consist of a mixture of approaches:

- Blended learning as continued education for Danish water professionals: e.g. a 3-day face-to-face interaction, a few months access to the relevant modules, and a follow-up interaction day.
- E-learning for international students and Danish water professionals: with the “choose & click” courses and regular DTU distance learning courses.
- E-learning modules used as supplement and support to regular courses, e.g., reports exchanged with self-correcting quizzes and online placement of recorded lectures.

This is in a great deal of agreement what Welsh et al. [4] postulated for e-learning in 2003.

Outlook

To this point the students’ feedbacks on the modules in Water Education have been positive, as the majority of the students appreciate the possibility to study and complete exercises whenever they want. Requests for more recorded lectures has been raised but not yet accommodated. However, in recent literature it has been highlighted that this element is regarded to be very valuable (92%) by the students, and a majority (72%) accessed this type of resource on a daily or weekly basis [5]. Hence, this resource needs to be incorporated to a greater deal. In Water Education 4 previous laboratory exercises are now running as self-testing Excel macros or quizzes. It has resulted in higher scores in the subsequent students’ examinations, presumably to an increased learning, and less time spent on reporting formalities. While constructing the resources time is used by the teachers but time savings are made as the correction and feedback on reports are diminished. If the modules are used consecutively the time savings are repeated. All laboratory work should of course not be removed from regular courses and the e-learning should within this context only be seen as a powerful supplement. In course evaluations the students are asked to estimate their work load and active participation and this has been noted to be substantially higher for e-learning modules than regular course, and hence an increased level of activation has been noted. However, here it was also evident that the cultural background of the students (nationality, training and age) also affected their attitude towards the e-learning.

CONCLUSIONS

Based on the experiences gained in the blended learning courses at DTU Environment, it can be concluded that in some areas major time savings can be obtained as the student submissions can be automatically evaluated, for example, when moving from a traditional report to an online evaluation test. More importantly, an increased learning was documented for some of the e-learning modules compared to a traditional classroom teaching on the same topic. It has also been made clear that suitable audio/visual files such as films,

animations, etc. is time consuming and costly to produce, but increases the interest and interactivity of the student. Therefore, they may be valuable tools for a better learning experience. During the spring and summer of 2011 all Water Education modules will be put in place and it is our intention that Water Education should be opened for full scale testing during 2011.

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Biographical Information

Eva Eriksson is associate professor at the Department of Environmental Engineering. Since 2008 she is coordinating a 2.5 ECTS blended learning course which is offered twice annually.

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Henrik Bregnhøj is external associate professor at DTU, Copenhagen University and e-learning consultant. He has conducted many aspects of e-learning since 2004, such as online group work, advanced presentations and Excel exercises with automatic feedback.

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