A support program for project-based active and blended learning

L. Dewulf[1] **– A. Janssens**[1] **– J. Monbaliu**[2] **– B . Van de Walle**[1]

[1] KHBO (K.U.Leuven Association) – Dept. Industrial Sciences and Technology
[2] K.U.Leuven – Faculty of Engineering - Dept. of Civil Engineering

Abstract
To facilitate educational changes, the K.U.Leuven Association has selected a support program in order to develop practical scripts for the implementation of a digital learning environment (Toledo, based on Blackboard) as a significant innovative educational tool. Toledo enables us to implement computer supported collaborative learning. In a first pilot cooperation between the master students of Applied Sciences and Engineering of the K.U.Leuven and the master students of Applied Engineering of the KHBO is set up. Students are introduced in project-based active and blended learning in heterogeneous teams. They have to carry out an authentic engineering task, i.e. designing the (planned) harbor breakwater in Oostende. The main aim is to actively develop and train the students in competences which play currently a prominent role in the field of engineering education.

This paper focuses upon both the support program and the set-up phase of the cooperation project. At the CDIO conference 2008, they will present the evaluation outcome.

Keywords: project-based learning, competences, digital learning environment, engineering education, active students

1. Introduction

Belgium knows two engineering master degrees. The Master of Applied Sciences and Engineering is a five year theoretically oriented university education. The Master of Applied Engineering on the other hand has a more practical orientation, lasts four years and is taught in university college. Figure 1 represents the main accents of the two complementary engineering profiles.

Small dots (red) = Master of Applied Sciences and Engineering
Big dots (blue) = Master of Applied Engineering

Figure 1. Differences in engineering profiles [1]

Due to their complementary profiles, the two types of engineers frequently collaborate during their professional careers. Depending on the size of the company both types of engineers do either approximately the same job (small companies) or have a hierarchically different job (big companies). In the latter , the masters of Applied Sciences and Engineering are ranked higher than Masters of Applied Engineering. But in most companies both types of engineers are present just because of their complementary profiles: one focuses more on theory ('why') while the other concentrates more on practice ('how').

However until now no formal collaboration between these two types of engineers has been organized during their study time in the K.U.Leuven Association. This implicates for the students a lack of specific crucial competences at the beginning of their professional career. To stimulate fluent communication and the training of various generic competences through blended learning, a cooperation between K.U.Leuven master students Applied Sciences and Engineering and KHBO master students Applied Engineering is set up.

This cooperation promotes active and blended learning. The instructor becomes a coach who surveys the progress of the (group of) student(s). The student from his side actively works on his competences in interaction with his environment. In other words: the student is responsible for his own learning process. Blended learning – i.e. the combination of F2F (face-to-face) education and e-learning - will provide the best support for the development of the intended final competences [2].

In this project students have to work in heterogeneous teams on an authentic engineering task. Students get the chance to distinguish themselves from the other engineering master students; the individual character of their education becomes transparent.

The K.U.Leuven Association actively promotes quality improvement of education through the Education Development Fund (in Dutch: **O**nderwijs**o**ntwikkelings**f**onds or OOF). The civil

engineering design project is a pilot which is part of an education development project of the K.U.Leuven Association.

In October 2007 an OOF-project of the University College KHBO entitled 'Practical scripts for the competence-based and student-centered implementation of the shared digital learning environment' was selected. The objective of this OOF-project is to develop didactically justified and concrete scripts, so that the instructors and students can optimize their didactical activities within the shared digital learning environment (which is called Toledo). In this OOF-project several pilots will be set up, from which the first one, the design project, is described in this paper. The OOF staff member specifically attracted for this project has developed a practical script that helps the coaches in employing Toledo as a prominent didactical tool.

This paper focuses upon both the support program of the OOF project and the set-up phase of the design project since these are the phases that have been covered in the pilot up to now. However, by the time of the CDIO 2008 conference, this pilot of the OOF project, will be completed. At the end of the project, students will be asked to fill out an online questionnaire to give their appraisal of the project. The questionnaire contains several subjects, such as collaboration, content, organization, the use of the digital learning environment,… Furthermore we will interview 8 students (4 students of K.U.Leuven and 4 students of KHBO). In these interviews we explore their experiences of the project in detail. Finally the coaches and the didactical experts are asked to evaluate the project in an group interview. In this way, we will be able to also present the results of these evaluations at the CDIO conference.

2. Support program of the OOF project

Thirteen institutions of higher education in Flanders have joined forces in the K.U.Leuven Association. This Association promotes quality improvement of education through the Education Development Fund (abbreviated as OOF in Dutch). In October 2007 an OOF project of the KHBO has been selected and set up. KHBO has several partners (spread over different campuses in Flanders) to accomplish this project, i.e. University College KaHo St Lieven (in Gent), University College KH Leuven (in Leuven), University of Leuven (in Leuven) and University College KATHO (in Kortrijk).

All of the institutions apply Toledo as their digital learning environment. Although the Association has the intention to promote computer supported collaborative learning by means of Toledo, not only within individual institutions but also between institutions, there are up to now not many structural attempts to realize this objective [3]. This recent OOF project however tries to fill that gap.

The OOF-project is called 'Practical scripts for the competence-based and student-centered implementation of the shared digital learning environment'. The main objective of this OOF-project is to develop and implement didactically justified and concrete scripts, so that instructors and students optimize their didactical activities within Toledo. Those scripts can be implemented in various types of courses: courses that are theoretically or practically oriented, courses that contain student internship, …. Such scripts contain all the components of a didactical, pedagogical situation: context, objectives, starting competences, final competences, assessment, learning activities, the use of Toledo, teaching methods,… To implement a script in one of the courses, the instructors must act as a 'coach'. Learning is

more and more an active process for the students [4] and the coaches survey the progress of the students' learning process.

In this OOF project several pilots are set up, from which the first one is described in this paper. As stated above, Toledo can offer an added value in this pilot. Here, we define the motives to apply Toledo in the design project.

A first motive to implement Toledo is to solve a pragmatic problem: distance. KU.Leuven and KHBO are too far apart (140km) to arrange many F2F meetings. Nevertheless two formal F2F meetings are integrated, one to introduce the project work to the students and one to conclude the project. This introductory F2F meeting is valuable, because several initial ICT problems can be resolved immediately (login problems, errors…). A F2F introduction also strengthens the motivation of the students concerning e-learning, because they get acquainted with the other students and with computer supported collaborative learning.

The second motive is that Toledo also facilitates the training of competences concerning communication. Each group has a group page which is only accessible to the group members and the assisting staff. On this page students can communicate (a)synchronously and collaborate by using the discussion board, chat, e-mail, whiteboard (for graphic visualizations).

The third motive is that students can post all their documents, reports, hyperlinks etc. in the electronic logbook and their global planning in the electronic planning box by which students and tutors always have an overview of the group progress.

And the final motive is that coaches can have a clear view on the progress of each group and that they can apply process evaluation (besides summative evaluation) (see 'assessment system').

3. Set-up of the design project

3.1. Organization

A total time of 80 hours for K.U.Leuven and 110 hours for KHBO students respectively is foreseen to elaborate the project. The project work is carried out in three phases. The project work starts with a two day kick-off meeting in Leuven which is organized by K.U.Leuven. Students meet each other (the K.U.Leuven students and KHBO students had never met each other before the start of this project), get the assignment by the client (the external experts) and start planning and dividing the different tasks in the project groups. The client is the same authority who has commissioned the works in reality, which makes the students' project (more) authentic.

In a second phase, students go their own way to elaborate the different tasks. For communication, the students can use the tools available in Toledo, as well as generally available tools as Skype, MSN,… Videoconferencing can be requested (and offered) if students want to discuss problems with experts in the field of soil mechanics, probabilistic design,…

Finally, all students meet each other during a project week which is organized by KHBO in Oostende. During this week the students finalize their project. At the last day of the project week, delegates from each group need to defend their design during a consulting interview for a jury consisting of the external experts. The coaches and the didactical experts are observers during this interview and do not actively participate.

Successful outcome is only possible when students have enough sufficient prior knowledge such as basic knowledge of hydraulics and coastal engineering, soil mechanics and foundation techniques, ... But students are also encouraged to search for additional information when basic knowledge is insufficient and more specialized information is needed to tackle the problem at hand.

There are many degrees of freedom: students have a large decisive role. Students decide 'what' and 'how' to build and regulate - in group - 'who' is carrying out the different subtasks. This simulates and approximates working conditions in a consulting company where problems are solved in team.

3.2. Stakeholders

To carry out the project work the students work in six randomly composed heterogeneous student teams. The groups are randomly composed, because this reflects an authentic team situation in the field. Each group (n = 9 or 10) contains master students of both master degrees (K.U.Leuven: n = 5 or 6; KHBO: n = 4). At the outset of the project one coordinator is chosen in each group by the students themselves. The coordinator organizes and monitors all the group activities in Toledo.

For the implementation of the educational framework, an assisting staff team has been composed. The assisting staff consists of two instructors, several external experts and two didactical experts. They coach the students in an active way, because active coaching increases the success rate of the learning process of the students [6].

The instructors (one of K.U.Leuven and one of KHBO) assist the student teams regarding content problems and survey the progress of the student teams. The instructor becomes more and more a 'coach' or a 'tutor'. The responsibility for the learning process of the group is not in the first place the task of the coach, but of the student teams (and of each individual student) [5]. When the group faces problems (being late, absenteeism, delay, free riders,…), it is its own responsibility to solve them. However, the coach interferes when problems threaten to escalate.

External experts from the field (the 'client') present and introduce the engineering task during the F2F introductory days. In this way, the project becomes more authentic and more relevant. At the end, the same experts evaluate, by mutual agreement with the project coaches and the didactical experts, the output of the student teams, i.e. the design of a harbor breakwater, during a consulting interview with each team. This consulting interview also resembles an authentic engineering setting. While the project is still ongoing, the students can also contact these experts when they face problems concerning content. For that purpose the students post their questions on the discussion board of Toledo. The questions are grouped before discussion with the expert in question. For this discussion videoconferencing is an option because students, coaches and expert(s) can participate independently of their location. This is a clear additional advantage.

Regarding to (digital) didactics, the didactical experts - a pedagogue and the coordinator of the applied research and development of higher education of KHBO - are involved in the project. They assist the coaches, the external experts and the students when it comes to pedagogical questions. Finally they are responsible for elaborating the support program for this project (see supra).

3.3. Objectives

Competences play more and more prominent role in the field of engineering education. A fast changing labor market forces us to integrate competences into the curricula. Competences are introduced as crucial educational elements [7]: students need to develop and train various generic competences in order to get prepared for their professional career. Consequently, the main aim of our project is the development and training of five generic competences. These competences are evaluated on a permanent basis. At the end, the project objective is that the students have mastered these competences at an advanced level.

3.4. Assessment system

At several points in time, the staff and/or the students themselves evaluate the learning processes – i.e. the development and training of competences – and provide feedback. Students are evaluated on the basis of four assessment forms, i.e.:

- two electronic peer assessments;
- the content of the logbook documents in Toledo;
- the consulting interview at the end of the pilot;
- the Toledo-based self assessment;

At the end the scores of the competences judged by the assisting staff and by the students are put together to obtain an overall score for each individual student.

3.5. Content

A point of particular interest remains the content of the project itself, namely the design of a harbor breakwater. The project is presented as a design project based on an authentic civil engineering task, i.e. designing the (planned) harbor breakwater in Oostende.

A couple of years ago, a team of coastal engineering experts estimated the safety of the city of Oostende against flooding as insufficient. The crest height of the dike of Oostende is too low. In severe storm situations excessive amounts of water would overtop the structure and flood the inner city of Oostende. Also the stability of the dike revetment is considered critical. For these reasons, the safety level needed to be augmented urgently. An overall safety plan has been made up. However, due to juridical problems, the realization of the safety plan has been postponed already several times. Because of the urgent character of the works, an ‘emergency’ beach nourishment has been carried out in 2004. The building of two breakwaters which protect the harbor entrance are part of this safety plan but are also part of a more global economic picture.

By studying such a complex project, students need to integrate different fields of study: soil mechanics and foundation techniques, hydraulics, coastal engineering, probabilistic design, environmental and sustainable development, construction techniques, planning, cost calculation,…

Students are provided with an extended but not necessarily exhaustive amount of information such as design boundary conditions, the actual bathymetry, wave and water level records, unit prices, computational software, actual study report and scientific books, .. And they are asked to design a breakwater to protect the harbor of Oostende.

4. Conclusions

To facilitate educational changes the Education Development Fund of the K.U.Leuven Association has selected a support program in order to develop practical scripts for the implementation on the shared digital learning environment of the Association , i.e. Toledo (based on Blackboard), as a significant educational tool in innovative course work. Thanks to its different functionalities, Toledo offers many competence-based and student-centered e-learning opportunities. Consequently, this digital learning environment enables us to implement computer supported collaborative learning.

In a first pilot of the support program collaboration between the master students of Applied Sciences and Engineering of the K.U.Leuven and the master students of Applied Engineering of the KHBO is organized. Students work actively in heterogeneous teams on a design project. They have to carry out an authentic engineering task, i.e. designing the (planned) harbor breakwater in Oostende. The applied blended learning system, i.e. a combination of Toledo-based learning and F2F meetings, gives the students the possibility to develop and train the new learning outcomes - defined as competences – which play currently a prominent role in the field of engineering education. Furthermore, the students can distinguish themselves from the other engineering master students: the individual character of their education becomes transparent.

At the moment of writing, the first pilot is still ongoing. Therefore, the authors focus upon both the support program and the set-up phase of the project within this paper. At the CDIO conference 2008, the results of the online students' questionnaire and of the F2F students' interviews, as well as the evaluation of the coaches and the didactical experts, will be presented. Based on this outcome, the concept of this innovative engineering course will be fine-tuned and the benefits of the support will be elucidated, allowing the development of other practical Toledo-based scripts in the near future.

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Biographical Information

Lore Dewulf obtained her Masters of Educational Sciences in June 2007 at Gent University. Since Octobre 2007 she is assistant researcher in a K.U.Leuven Assocation project concerning educational change and improvement in higher education.

Annika Janssens obtained a Ph.D. degree in genetics at Gent University. She lectures on biological sciences and coordinates currently the applied research and development in higher education at the department of Industrial Sciences and Technology of the KHBO (K.U.Leuven Association). Since the introduction of the new Academic Master in Industrial Sciences curriculum, she is responsible for the implementation and daily coordination of the course 'The scientific project', an example of multidisciplinary project-based education in the first phase of the Bachelor in Industrial Sciences. Her research interests include competence-based and collaborative (e)-learning and student-centered coaching.

Jaak Monbaliu obtained a Ph.D. degree from the K.U.Leuven in 1992. His research activities and interests are mainly in the broad field of coastal engineering. He is responsible for and involved in several courses including project work in the regular civil engineering program of the K.U.Leuven as well as in the Inter University Program for Water Resources Engineering, an English only program jointly organised by K.U.Leuven and the Free University of Brussels. Since 2007 he is acting as Program Coordinator for the Bachelor and Master programs in civil engineering at the K.U.Leuven.

Björn Van de Walle obtained a Ph.D degree at Gent University in 2003 in coastal engineering sciences. Currently he is employed at KHBO and teaches several courses with relation to soils and water within the academical bachelor and master program in industrial construction sciences, both at KHBO and at KaHoSL (within the K.U.Leuven Association). Since 2006 he is responsible for the coordination and implementation of competence based learning in the training within the construction department of KHBO.

Corresponding author

Lore Dewulf
KHBO
Zeedijk 101
8400 Oostende

Tel: 0032 59 56 90 54
lore.dewulf@khbo.be