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DEFINING A PEDAGOGICAL MODEL: THE TU DELFT ONLINE LEARNING EXPERIENCE

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Introduction

The Delft University of Technology (TU Delft) is a traditional brick-and-mortar research university, which specialises in Science, Design and Engineering. The university has one campus with 20,000 Bachelor and Master students and, after building years of experience in open education, has recently started offering accredited online education.

In 2007, TU Delft started a university-wide programme for OpenCourseWare[1], and during the past seven years has developed more than 150 courses, covering a wide range of content from 15 Bachelor and 35 Master programmes. From the start, it resulted in more attention for education. Externally, the programme gave other educators the opportunity to use and enhance our content, while internally, it improved the course quality for our students. This led the university to develop an open strategy, not only for education, but also for research. The university leadership strongly believes that 'open' is an obligation for a public university.

When in 2012 the Massive Open Online Course (MOOC) movement started, the university board decided to join edX[2], a consortium of top universities founded by MIT and Harvard, with a strong focus on open education. TU Delft was the first European partner to join the consortium. In September 2013, the first two TU Delft MOOCs started with in total more than 80,000 students. Currently we have 17 MOOCs open for registration, which have welcomed approximately 365,000 students from all over the world.

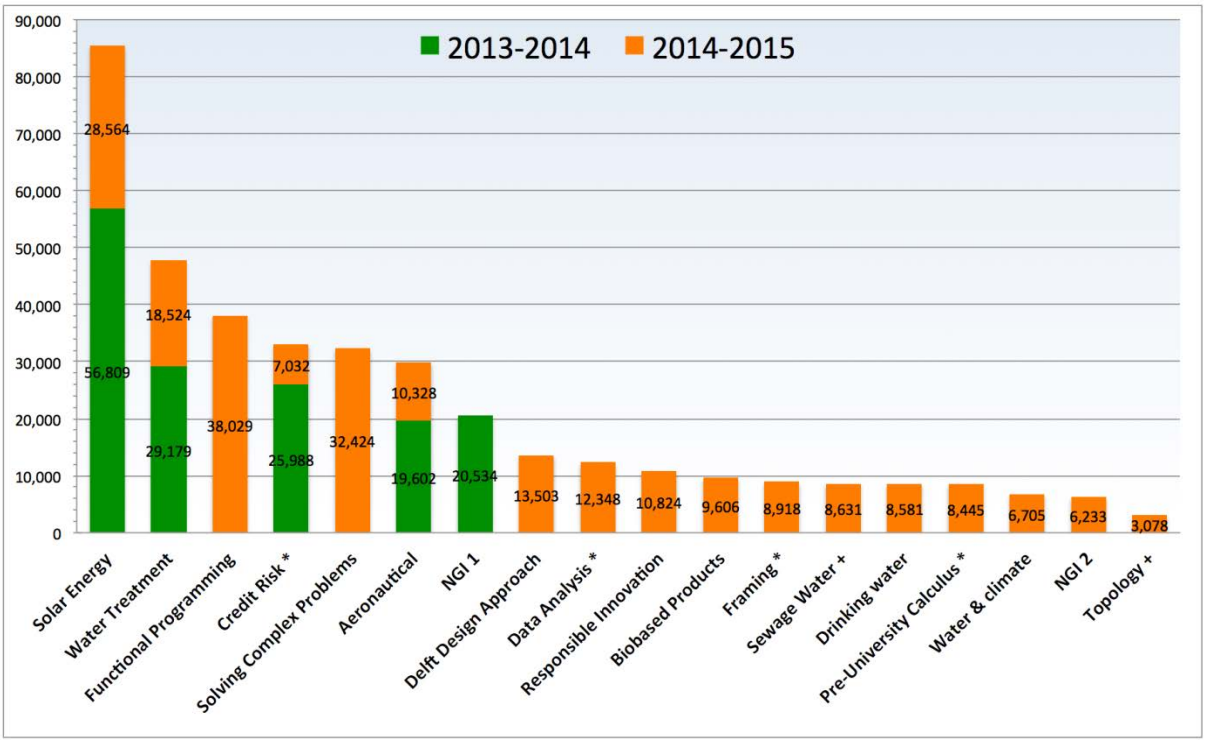

Figure 1 Number of enrolments per MOOC (+ course is running, * course has not started yet)

Together with the MOOCs, we started 3 pilot projects offering online courses. These included a full online MSc programme in Water Management, 6 courses of MSc Aerospace Engineering, and 5 courses of the MSc Engineering & Policy Analysis. This was also the start of the fully online accredited courses offered by TU Delft.

[1] TU Delft OpenCourseWare at http://ocw.tudelft.nl/
[2] TU Delft MOOCs on edX at https://www.edx.org/school/delftx

The pilot showed that there was a great potential for online courses, but that we could not achieve this potential by operating on the traditional way education alone was organised.

In early 2014, the Delft University of Technology (TU Delft, 2014) started an innovative program with the aim to respond even more effectively to recent developments in open and online education, in order to meet the massive growth in demand for this type of education. The development of the Extension School, with a multidisciplinary team of experts in education, technology, business and management, is an important step towards a holistic approach that combines the entire open and online education portfolio at the TU Delft.

Drawing on the fields of Distance Education research and the university's vision of the "engineer of the future", Delft University of Technology's Extension School have created a unified pedagogical model and several instruments to support its implementation. This paper will describe the 8 principles that hold the Online Learning Experience (OLE) model, the stages in the course development process and an overview of how they are related to the OLE, its challenges and further developments.

Developing a pedagogical model

The creation of a pedagogical model is an important step for TU Delft, and contributes to greater consistency in the development of online courses. One of the model's strengths is to guide all course development teams through the realisation of several shared principles, which are supported by a common model that combines science, design and engineering education with online learning concepts. In addition, sharing our model worldwide is important as a means to engage future learners, who are interested in our online education. The model explains how online education at TU Delft has been set-up and what kind of an online learning experience it aims at.

In order to create a structured model, several steps have been implemented. These include the development of an online course proposal, teachers' training workshops, and regular meetings to give pedagogical and technical support. As Salomon (1992) argues:

> *… what matters is not just the design of a computer tool or program, not even the design of a single task or curricular unit. Rather, the cultivation of minds, which itself requires mindful engagement in a social process of meaning appropriation, requires that the whole learning environment, not just the computer program or tool, be designed as a well-orchestrated whole. This includes curriculum, teachers' behaviour's, collaborative tasks, mode of peer collaboration and interaction, tasks, learning goals, and the like (p. 64).*

In this sense, developing a pedagogical model for the TU Delft Open & Online Learning relates to more than merely adding distance learning principles and methodologies to a campus based environment. It involves preparation, planning, training and support, in order to successfully meet all different parts of the course development process.

TU Delft's Online Learning Experience

The Online Learning Experience (OLE) is a student-centred, online learning model that holds eight interrelated principles, which define TU Delft's online courses.

Figure 2 The eight principles that define TU Delft's Online Learning Experience

Flexible

The concept of flexible pedagogy can be perceived in a broader sense, meaning more than simply being able to study independent of time restraints or location. As Kirkpatrick (2011) argues, "students expect and need greater convenience and flexibility – in their choice of materials, their pace and timing, and their ways of learning" (p.19). In this way, flexibility is also about offering students the possibility to choose the educational resource format that will help them learn in a more effective way. In some courses, it may also be possible to select between different learning activities and topics to study, depending on the learning goals.

Diverse

Diverse learning and cognitive styles are more adequately supported when learners can choose between different content formats (Oz & White, 1993; Crosby & Stelovsky, 1995; Yaverbaum et al., 1997; Daugherty & Funke, 1998). Students will be challenged with different types of learning activities, which can be collaborative or individual, depending on their learning goals, in order to improve retention and performance, while motivating to learn (Kolb, 1984; Cassidy, 2004).

At another level, diverse groups of learners enrolled in our courses are enriched with different perspectives and ideas, contributing to a culturally-rich learning experience where integrity, respect and inclusion are fostered.

Inclusive

TU Delft's contribution to open education creates, at a simple level, "a positive impact on society by providing access to education for those who could not previously access it" (Moore, 2014, p. 200). But inclusion goes beyond simply giving access. Related with the *Flexible* and *Diverse* principles, inclusion requires preparing learning technologies, offering different types of learning activities, content in multiple formats and flexible choices to maximize student participation throughout the courses.

The learning technologies used and the way they are presented to students needs to be taken into account in order to promote an inclusive teaching and learning environment. As Moore (2014) describes:

> *… accessibility and flexibility of learning technologies cannot be assumed; rather, they result from intentional design considerations and features that seek to understand multiple users, operates from a pluralistic definition of learners, and seeks out solutions to make a design functional for as many users as possible (p. 199).*

During the course development process, several templates are used for the learning activities, content and course structure, in order to ensure a more accessible and user-friendly course to the widest possible audience, regardless of technology, device or ability.

Supportive

The importance of developing a learning community is stressed by several authors (Lipman, 1991; Pallof & Pratt, 1999; Garrison, Anderson & Archer, 2000; Wenger, McDermott & Snyder, 2002), where members both support and challenge each other, leading to effective and relevant knowledge construction (Anderson, 2008). Our courses are designed to promote the development of a learning community where students can share experiences and learn from others, supported by an e-teacher with expertise in the field that gives direct instruction and guidance, promotes peer interaction, answers questions and gives feedback throughout the course to facilitate learning. The 5-stage model provided by Salmon (2000) is an effective way to support and build the learning community that should be customized to the unique needs of each online learning community.

Interactive

In an online course, interaction can be seen as a continuum that grows from the simplest learner-interface interaction (accessing information) to higher-levels of learning, when learners can apply what they learn in real life and develop meaningful knowledge from information – learner-context interaction. In order to reach these high-levels of learning, other types of interaction are also required: learner-content and learner-support (interaction with other learners and the e-teacher). In fact, learner-support interaction is critical to the development of communities of learning (Rumble, 1999; Murphy & Cifuentes, 2001; Wenger, McDermott, & Snyder, 2002). Our courses are designed to provide different forms

of interaction, using interactive strategies that promote learning at different levels (Schwier & Misanchuk, 1993; Gilbert & Moore, 1998; Berge, 1999), with a focus on high-levels of learning.

Active

An important method that is promoted at TU Delft is that of active learning: a learner learns most effectively when actively engaging with the content and actively create knowledge. With active learning, the focus lies on learning instead of instruction. Students are required to read, write, discuss, or be engaged in solving problems. Active learning engages students in two aspects – doing things and thinking about the things they are doing.

A second aspect that is considered important is that active learning is not only an individual activity, but should also been done in interaction with others, because "knowledge is socially constructed and learning develops as a result of dialogical and dialectical interactions between teachers and learners and between two or more learners" (Vygotsky, 1978). Learning is seen as a social process where interaction between students, but also between students and teacher, is important for the learning process (social constructivism). In our online courses, students will be able to actively engage with the learning community and course content, embedded in the TU Delft's spirit to think critically, to take the initiative, to operate independently and to work in teams.

Authentic

According to Ring and Mathieux (2002), online learning should have high authenticity, high interactivity and high collaboration. As mentioned in the *Interactive* principle, our courses are designed to promote learner-context interactions to reach high-level learning, enabling students to apply technical and scientific know-how into their own context. Some courses give students the opportunity to participate in discussions about important issues in society. In other learning activities, collaboration is needed to come up with solutions to solve real-world problems.

Innovative

TU Delft's research approach of open and online education is principally engineering-based, inter-disciplinary, and strongly data-driven. Increases in the available amount of quantitative and qualitative educational data offer researchers new opportunities to observe, analyse, and ultimately improve learning processes. The *Innovative* principle relates directly to a number of emerging developments in education, inspired by reports, such as the NMC Horizon Report for Higher Education[3]. This kind of innovation requires close cooperation with teachers and course developers as well as direct evaluation and analysis. The results and conclusions will feed back to the course development process and teacher training, aiming to optimize the online learning experience.

Implementing and evaluating the model

In order to support course teams well, a number of stages in the course development process have been defined. First, the orientation stage, in which a project proposal is written by the teacher to get funding and support for developing an online course.

Then the preparation stage, in which a course team is formed, teachers are trained during a kick-off meeting and via the training opportunities the Extension School has to offer. In this stage courses are designed with the support of the e-learning developers and the production is planned. Course teams have to search and select what open learning materials are available that they can use or adapt and what has to be developed by themselves.

In the production stage, course content is produced, like assignments, tests and videos and the course design is implemented in the digital learning environment. After that, the course is tested by beta testers to see if everything is working as intended.

In the delivery stage, the course will run and possible improvements will be identified. After course delivery, the follow-up stage is meant to evaluate the whole process with the course teams and prepare for the next run.

Table 1 shows an overview of the stages in the course development process and how they are related to the Online Learning Experience and support staff.

[3] The New Media Consortium (NMC) Horizon Reports Higher Education Editions at http://www.nmc.org/nmc-horizon

Table 1 Applying the OLE model throughout the course development process

Course development process stage	What has to be done	Activity to implement OLE and instruments	Who (Support staff)
1. Orientation	Write proposal	Introduce OLE model to teacher	Account manager and product manager
2. Preparation	Create course team Kick off meeting Training Course design and planning	Train course teams according to the OLE Help course teams apply the OLE in course design, using guidelines	E-learning developer and product manager
3. Production	Produce course content and implement it according to the course design	Guide in developing content that meets OLE using templates	Instructional designer, teaching assistants and e-learning developer
4. Test	Test course	Checklist to ensure course is according to OLE principles	Beta testers
5. Delivery	Run course and identify improvements	Pedagogical and technical support to run the course according to the OLE	E-learning developer, instructional designer and technical support
6. Follow-up	Evaluate and prepare for next run	Questionnaires Report that identifies points to address in re-run	E-learning developer and policy officer for quality assurance

Evaluating the OLE requires an evaluation of the process by its actors: students, teachers and staff. Quality assessment is based on guidelines and indicators from the European Foundation for Quality in e-Learning (EFQUEL) and the European Association of Distance Teaching Universities (EADTU), allowing TU Delft to evaluate its online learning courses and programmes using internationally agreed quality standards.

The evaluation process of the learning experience includes the collection of learners' feedback through questionnaires and preparing a report, where the gathered data is analysed and converted into clear recommendations for improvements. The final step is to improve the next course re-run, incorporating recommendations previously identified, which therefore contribute to continuous course improvement.

The overall evaluation practice includes, not only the online learning experience itself as experienced by students, but also the support given by staff during the course development process. At another level, all evaluation procedures regarding engineering education will be included.

Challenges and further developments

Naturally, the many challenges that need to be resolved will help us refine the development of this model. Many educational scenarios coexist among TU Delft's eight Faculties, from courses with traditional lectures to a strong focus on constructivist pedagogies like active learning, project-based learning and design-based learning. Wrapping up different learning strategies in a single model can be seen as challenging, since it needs to take into account different didactical approaches. In this sense, the OLE can also be an opportunity to think about the changing need in educating engineers (Kamp, 2014), leading to positive changes in pedagogical practices and learner experiences.

Creating and implementing the OLE is an important step to ensure high quality online courses. The aim of the Extension School is to be innovative, which means that the model will continue to develop based on new research, evaluation and experience that we gather at TU Delft. Although still under development, the model is already being gradually implemented in TU Delft's online course creation process. After further developments of the OLE, we will start implementing it more broadly.

Having the vision to "Educate the world & enhance quality of online & campus education", the Extension School is developing TU Delft's strategy for the next phase of open and online education, extending its offering and reaching more students across the world. We believe that the OLE will help us achieve this in a more consistent and sustainable way.

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