Fostering collaborative learning and educational mass customization in a graduate level engineering design course

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Motivation and context

“Globalization has collapsed time and distance and raised the notion that someone anywhere on earth can do your job, more cheaply. Can Americans rise to the challenge on this leveled playing field?” [1]. The rapid progress of globalization has lead to many unprecedented changes in the world in which we teach and in which our graduates will practice. In our roles as educators, we need to respond to these changes. Meanwhile, we have reached the era of Globalization 3.0, in which individuals have the power to collaborate and compete globally. In this realm, Globalization 3.0 has led to a new paradigm called Mass Collaboration [2], which is a form of collective action that occurs when large numbers of people work independently on a single project. In order to realize such new forms of engineering education for which it is envisaged to get rid of any boundaries, new educational models encompassing the design of programs and courses, novel ways to deliver them, new IT-infrastructures, etc. have to be developed [3]. In this paper, we present an educational model for personalized mass customization of engineering education suitable for globally dispersed distance learning settings. The approach is anchored in the scholarship of education learning and utilizes a combination of collaborative, cooperative and collective approaches to learning. In terms of learning technologies, it addresses recent changes in e-learning and the way society utilizes contemporary learning technology such as Web 2.0 applications. Web 2.0 and Learning 2.0 refer to a second generation of Internet-based services, such as social networking sites, wikis, communication tools, etc. that emphasize online collaboration and sharing among users. A key characteristic of educational Web 2.0 environments is the harnessing of collective intelligence. A key contribution of the model presented is that Collaborative Learning not only serves as an innovative instructional methodology, it also is a major learning objective for those being educated based on our model.

Relevance of the Paper to the Special Issue

Educational mass customization supports personalized learning and thereby the development of diverse knowledge and competencies in a class [4, 5]. Collaborative learning enhances the knowledge of a group by encouraging diverse individuals to learn from each other [6-8]. In this paper, we discuss an educational model for achieving collaborative learning and mass customization in a distance learning setting and present its implementation in a graduate level setting.

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implemented educational model

me6102: “designing open engineering systems” is a mass customized graduate level engineering design course at the woodruff school of mechanical engineering at the georgia institute of technology. it is offered to students in atlanta, savannah, lorraine (france) and part-time students in industry. the location from where me6102 is taught alternates between atlanta and savannah. to reach all students, the instructors incorporate state-of-the-art synchronous and asynchronous education techniques.

figure 1. educational model of me6102
In the paper we present and discuss the implementation of an educational model that facilitates mass customization and collaborative learning using the different instruction tools shown in Figure 1. The key instructional tools used in the course are:

a) Learning Goals and Competencies
b) Assignments
c) Learning Essays
d) Individual answer to the Question for the Semester
e) Collaborative Answer to the Question for the Semester
f) Semester Learning Essay

The three main aspects of the course structure are *Scaffolding*, *Customization*, and *Collaboration*, where the scaffolded part sets the frame for the course, the customization allows personalized and individual learning and development and the collaboration part utilizes this developed diversity to create new knowledge and fosters collaborative learning. In the final paper, we will discuss these tools and their function in our educational model.

In terms of content, the course is based on three cornerstones: Globalization 3.0 [10], Wikinomics [2] and Open Engineering Systems [11]. The driver for Globalization 3.0 as defined by Friedman is “the newfound power for individuals to collaborate and compete globally” [10]. This power is utilized in the new era of collaboration described by Tapscott and Williams as wikinomics [2]: mass collaboration, crowdsourcing and peer production are the principles that spawn breakthroughs such as Linux and Wikipedia. The students are now challenged to make the step to engineering and design Open Engineering Systems in and for this future environment. The content of the course integrates topics from economics (e.g. globalization, global markets), business (e.g. value chain, supply chain, outsourcing), law (intellectual property protection), IT (e.g. web 2.0) and social sciences (e.g. social networks, cultural differences, motivation).

**Implementation of the Web-Based Collaborative Learning Framework**

In this paper, particular emphasis will be placed on the web based collaborative learning framework that is developed for this course. It is the communication center for the distributed course participants. The framework provides the following functionality: a) online lecture material and videos, b) students’ profiles, c) my ME6102 on a page, d) students’ assignments and learning essays, e) ratings and comments on content by peers, f) best practices, g) collaborative answer to Q4S, h) student web-log (blog), i) discussion forums, and j) private messages.

All required materials like online lectures, assignments and papers are downloadable. The submitted assignments and learning essays are also shared here and can be commented on by peers; outstanding pieces of work are outlined by the instructors. To facilitate the social network on the website all students and instructors have profiles containing personal details, contact information, research projects they are involved in, their expertise, and educational background (see Figure 2). This section also include the students’ “ME6102 on a Page” where they list their learning goals and competencies for the course, how they have augmented their individual question for the semester and which aspects they would like to focus on in the collaborative answer. Each student has the opportunity to report individual progress and thoughts to the peers in a blog.
One of the main features of the framework is the platform for the “Collaborative Answer to the Question for the Semester” (see Figure 1). It is based on an online wiki-system with a hierarchical structure of web pages that allows users to create sections and subsections that can be edited by anyone in the class. The log of revisions to the sections is maintained so it is also possible to see each individual’s contribution to the collaborative answer. The setup simulates mass collaboration since it is not limited in participants and everybody can contribute independently; however the learning outcome is collaborative. The communication between the contributors is managed with discussion forums and private messages in the social network.

This collaborative learning framework is not only a functional educational instruction tool but also a learning objective in itself. The students experience the new collaboration principles presented by Tapscott and Williams [2]. They learn about the opportunities and challenges and how to utilize mass collaboration for creating new knowledge and breakthrough products.

Figure 2 – A screenshot of the collaborative learning framework showing a student’s profile and ME6102 on a page
Closing Comments

In this paper, we present an approach to foster collaborative learning and mass customization in a graduate level design course. Collective learning is achieved through the use of collaborative answer to the question for the semester and the best practices. Mass customization is achieved by having the students define their own learning objectives and competencies and augmenting the individual answer to the question for the semester to address their learning goals. Further details will be presented in the final paper. In the final version of the paper, we will present students’ experience in this course and the lessons that the instructors learnt as a result of this implementation. Although the approach is demonstrated in a single course, the approach has various applications for collective learning outside of a regular classroom. The framework has the potential to be used as a tool for open and mass collaborative education.
References