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Could We Be Role Models in Online/Blended Education?

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The recent EDUCAUSE survey report "2019 Key Issues in Teaching and Learning" lists a number of key issues in higher education that should be considered by decision makers in universities in their IT planning and management activities. This year the top two issues were Faculty development and engagement and Online & Blended learning [6]. This sounds surprising, because blended learning – if we consider the hype curve – has already reached the plateau of productivity already some years ago [13]. So why would blended learning and faculty development be issues now?

My personal experience suggests that computer science (CS) faculty members feel quite comfortable using various available tools, while faculty members in other disciplines are generally not fluent in using the facilities provided by novel educational tools and technologies. There are, of course, great forerunners in education, but they are few and a large share of teachers use only the basic features of learning management systems, such as sharing static learning resources for students and accepting their submissions for manual grading. This experience is quite well in line with the recent ECAR study [5].

In this essay, I discuss some of these challenges within a large research-oriented university, where I have had a privilege to follow closely a university-wide project to support online and blended learning. To set the context, I first present the project, and thereafter discuss more closely some aspects of it: automatic assessment and e-books, where computer science is a forerunner and could provide support for other fields.

In 2016, Aalto university, the top technical university in Finland, which covers also business and arts&design studies, launched a major initiative to support its strategy in education for the period 2016-2020. The Aalto Online Learning project [1] seeks to build new pedagogical solutions for online and blended learning in all fields of the university, as well as support and coordinate actions to improve relevant facilities, resources and support functions. Similar major projects or services have also been launched elsewhere, though often with considerably larger funding. Some examples include, the EPFL Center for Digital Education (CEDE) at Lausanne, Switzerland [3], TU Delft Online Learning Experience (OLE) in the Netherlands [12], and HarvardX, MITx and Stanford | Online in US [7, 10, 11].

Despite its name, the main focus of the project is creating blended learning solutions that seek to combine the best aspects of classroom learning and online learning. While some MOOCs and open online learning resources will be produced, the university did not consider creating MOOCs as a strategic goal itself. The strategy focus is supporting learning of our own students.

The project works on several levels [8, 9]. The main activity is providing direct financial support for teachers or teacher teams in terms of focused development projects, which are called Aalto Online Learning pilot projects. The pilot funding can be used to allow teachers to take a leave from their normal duties and focus on the project, and/or hire new people to help them. In some cases, auxiliary physical equipment or software licenses can be purchased. Other activities include strong support for teacher networking to extend teachers' collaboration, organizing services for creating online learning content, such as online videos, interactive online textbooks, augmented or virtual reality resources, or applying automatic assessment / feedback software. An important activity is training teachers' skills in developing and applying these new kinds of learning resources. So far, roughly 100 pilot projects have been running, incorporating over 200 teachers and implementing major revisions to some 150 courses in all Aalto. Actually, only few projects have remained as pilot trials. Instead, most of the developed resources have been adopted into regular use in the target courses.

What is the CS education perspective here? From my point of view, many CS teachers are forerunners in some areas, such as using and developing automatic assessment tools, gamification features and interactive online textbooks. This experience has given CS educators insights and expertise, which we could share to our colleagues in other disciplines.

Blended learning in computer science has a very long history, because e-learning technologies are mainly software. Moreover, adopting new tools and technologies in education has always been a natural part of CS education. At my institute, we used Unix newsgroups for students' distance guidance already in 1980's, we developed our first automatic assessment system for data structures and algorithms course in 1991, and adopted automatic assessment in programming courses in 1994, all this well before world wide web started changing the world. We did not even consider this as something special: online education or blended learning. All these development actions were just practical solutions to help students and teachers in their work and complemented well the teaching given in lectures and classroom exercises. Students gained better access to feedback and guidance when being off-campus, while classroom exercises were, of course, widely popular, too. Automatic assessment systems allowed teachers to set up more compulsory exercises, thus encouraging students to be active during the whole course, instead of working mainly close to project deadlines and examinations. Perhaps somewhat surprisingly, despite the increased workload (though split into smaller tasks) students' feedback was positive and learning results were improving in terms course grades and passing rates. From teachers' or teaching assistants' point of view, mundane grading of weekly exercises was reduced and more time could be used for guiding students and developing new learning resources.

From CS educator's point of view the above story has probably "nothing new". Yet such tools and practices may be unfamiliar in other disciplines where many teachers still design their courses building on manually graded exercises where feedback for students may be minimal and given days after the submission deadline. This raises a question whether computer scientists could help our colleagues in other fields to identify areas where meaningful automatic feedback or grading is a feasible solution, and help implementing such solutions (assuming, of course, that there is funding available for such efforts). Developing formal presentations for describing data and processes is one of the core areas of computer science. However, in my experience there is too little collaboration between us and other fields in developing educational technologies to support the needs of non-CS courses. In some cases, I have even heard comments from computer scientists hinting that such work would not have much value, because it would be just applying existing methods to a new domain, instead of focusing on developing new methods. Incidentally, I find such comments quite discouraging.

Many fields use widely formal presentations of information and could gain similar benefits as CS. Mathematics and statistics education, physics education and several technology fields are very obvious fields in this sense. They also have inherent needs for training basic skills in problem solving and manipulation of equations, before students can proceed to work with more advanced analysis and design tasks. I have been happy to follow how automatic assessment has spread among these fields in Aalto university. A very interesting new application field is automatic analysis of CAD design tasks in mechanical engineering. Their new system provides students with visual feedback for the correctness of their solutions. From their teachers' reflections I have learned that the same experience with improved student satisfaction and reduced workload of mundane checking has taken place, allowing them to focus the scarce teaching resources more on guidance than marking.

Automatic assessment provides a base for another pedagogical approach, gamification, which fits well to online learning. It often provides additional motivation for many students (but not for all them). Factors that can be involved include, e.g., gained points, or number and time of submissions, either in total or split for each exercise separately. All this data is easily collected by automatic assessment systems. Our own experience is that even in its simplest form (it can be argued whether this is gamification at all), where no achievement badges or top-score lists are used, but students can simply revise and resubmit their solutions, the effect on learning is positive. Very many students aim at getting full points from exercises by using the allowed resubmissions, even though this might have no effect on their final grade of the exercises. They simply want to see the result that their solution is "correct" – in the sense that the assessment tool accepts it. In our A+ learning environment, students' points for the exercises are shown in yellow when points are missing and green when all points have been achieved. Many students aim to get a complete green line of results, while much less would be needed for the best grade.

While the above is a baseline for us in computer science, for most of my colleagues in other fields incorporating such elements of gamification in their courses seems infeasible in the tools they use. So why not help them, if they get interested in this?

Computer science is also a natural domain for interactive online textbooks. These are based on some software platform where, in addition to automatically assessed exercises, other types of interactive widgets, like various visualizations can be incorporated. A well-known example of this is the CS principles eBook [4]. Our local introductory Scala programming course is also based solely on an interactive online textbook [2]. Compared to a traditional static book (whether printed or online), these examples demonstrate well the huge support to online learning, because they can provide continuous feedback for students and show them their own progress. For teachers, these environments, of course, allow a good perspective to follow the progress of the whole student cohort. While similar types of e-book resources are available in other disciplines, building new interactive components for them is easily beyond the scope of colleagues' skills and resources in other disciplines. Designing and implementing, for example, microservices and protocols supporting flexible exchange of information between system components needs specific computer science expertise.

While all of the above support pure online learning, they are just tools for building better pedagogical practices for blended learning. They can enrich students' learning process when they are studying outside classrooms either alone or in teams, especially when they are learning basic concepts and skills. This, on the other hand, helps teachers to enrich the face-to-face time with students, because there is less need for using time to lecture the basics. Instead, more time can be used to discuss advanced content, problem solving, design etc.

Finally, during the decades when we computer scientists have used online and blended learning, we have gained quite a lot of tacit knowledge about which methods and practices work and which do not. This is also something we can share to our colleagues in other fields. Moreover, much of such knowledge has its origin in research in computing education, which has built evidence what kinds of tools are beneficial and what is their impact.

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