Experience in CAAD Education Using a MOOC System

Ádám Tamás Kovács¹, Mihály Szoboszlai²
¹,²Budapest University of Technology and Economics
¹,²{kovacsadam|szoboszlai}@arch.bme.hu

This paper describes some of the challenges of using a Massive Open Online Course (MOOC) framework system with a variety of digital content. Situated in the 'efficiency' paradigm of digital design methods and Computer Aided Architectural Design (CAAD) education, we allow participants to set their own schedules, meet demands that are appropriate for their abilities, and determine their own path. The content within this framework motivates students through life-like tasks and examples. This paper shares our experiences in CAAD education through a course curriculum developed by applying a variety of digital content. We have focused on resolving the problem of inefficient teaching of CAAD systems by developing a blended learning curriculum.

Keywords: CAAD, education, b-learning, MOOC, curriculum analytics, mind-map

INTRODUCTION

In ancient Greece, pedagogues and tutors dealt with only a few students, so they could tailor the schedule, the difficulty, and the focus of the curriculum to the students. This fully personalized education allowed the students to return to a topic which was not clear enough and deal with it until it was completely understood. With the spread of public education, teachers began to handle 20-30 students, which precluded personalized education. The only goal could be to reach as high a percentage of the class as possible through knowledge transfer. This meant that those who were less talented, as well as those who were above average, were left on their own. Another difficulty arises in the university setting - namely, that members of a class come from vastly different backgrounds, so even fewer students can be reached efficiently by teaching, since they cannot all understand at once. In practice, the instructor shows something that one part of the class can follow, another part cannot and falls behind, while the rest become bored. Moreover, this absurd situation cannot be solved by traditional means, since we cannot place a teacher beside every student.

With the latest technology, we are able to resolve this problem by developing blended learning - that is to say, b-learning curriculum which may be the next stage in engineering education after getting to Computer Aided Design from pure geometry. (Szoboszlai et al. 2015) With a Massive Open Online Course (MOOC) frame system and with a variety of digital content (such as educational videos, tests, and other interactive content), we can allow all participants to set their own schedules, to meet challenges that are appropriate for their abilities, and to determine their own focus. This content motivates students through life-like tasks and examples. If the knowledge we teach is too abstract, or if its practical value is unclear for students, then only extrinsic motivation can urge them to score more points or achieve better grades.
This is less effective than stimulating their inner motivation to work for their own benefit.

To introduce our new curriculum, which could be applied to basically any CAD or CAAD course, we chose "Digital Concept Planning" in the course group of "Applied Informatics for Architects", where we use Trimble SketchUp. The reason of our choice is that this is the course which students usually encounter first, so they are fresh subjects who have not acquired any bad habits by learning such applications in the past.

THE OPERATION OF THE FRAME SYSTEM

We wanted to use an existing MOOC platform, thus we made a research and it turns out there are several platforms on the market that one can use [2]. In order to choose one, our main criteria were free usage, interactive and audiovisual content support, user friendly interface, and intense personalization. As a result, we launched our course in Open learning [1]. There are several features which facilitate putting the entire curriculum into an easy-to-understand structure, and this provides a quite good site to organize and manage the course.

The curriculum has its menu page, where the students can see all the lessons with their scheduled dates. One can only access the lesson content after its scheduled date. It is important to have the opportunity to share different types of content, from the traditional types to the latest interactive ones - e.g., videos, animated GIFs, Prezi presentations [3], Cl3ver 3D presentations [4], etc. Several different types of tests can be integrated into the curriculum, which while makes the exams more interesting and also makes correcting them faster. It is good to visualize the requirements of the whole semester or the lesson. That way, students always know where they are at the moment and what they have to accomplish. The opportunity for diverse content also supports this purpose.

Under-the-hood management of curriculum has a very user-friendly visual content editor which can be edited by those who have permission to do so. This is an advantage, because this way the educators do not have to know coding, and if someone drops out for whatever reason, one can be more easily substituted. From another standpoint, less energy is necessary for getting use to the system.

In a proper educational frame system, communication plays a great role. In Openlearning system, the three layers of information exchange are supported: student-student, student-teacher, all of the students-teacher. On the main page, there is a news session, where we can share all the course news with all of the students simultaneously, for instance, if there is a test in sight or a deadline coming. They get email notification when we make an announcement. Students can talk to each other or the teachers via instant message. Hence, if they have a brief question, we can answer them immediately. They can also use the forum, which works as a Q&A session, where students can help each other. Meanwhile, teachers can view the conversation as well and can correct information, if needed. This system works much better than communicating via emails, because usually students have similar problems, so we do not have to answer the same mail several times.

It also has a built-in analytics system, which can be used to see how students use the contents. Thus, we can change it accordingly for the next semester. First of all, we can check every student's account and see which course content he watched or what activities he has performed. In this manner, we can communicate with him in time and possibly prevent a falling behind or a dropping out. Secondly, we can follow...
how many people clicked on each page and what was the average time spent there. This way, we can tell which content was more useful or harder to understand and can make corrections for next semester. Thirdly, we can make a heat-map (Figure 1) analysis for every page, which shows us where users have clicked while on each one. Finally, we supplement these by making personal surveys to measure the subjective part of education efficiency. From first to last, these are the techniques which give us a strong base for curriculum measurement and development.

A STRUCTURE OF A LESSON

First, we review the knowledge that we already know and introduce the new knowledge needed in order to solve our "life-like situation" in the lesson. This latter material is demonstrated through smaller tasks and problems. This is the "sandbox stage", when students can experiment with the tools, try all of the functions, and get acquainted with the limits.

Once we have acquired the necessary knowledge, the next stage is to solve the situation challenges. We believe in learning by doing, because what students do and find out on their own lasts longer and is embedded deeper in their minds, so this second half of the lesson is an individual part. Every lesson is based upon an interesting "life-like situation". For example: We are attending a summer workshop at an architect studio which has won a competition concerning the bus stops in Budapest. First, we have to model the bus stop according to the preliminary standard plans; then, we have to adapt it to different site situations. (Figure 2) We practically simulate an office environment. That way, the students are motivated and remain focused on the curriculum, because they see the practical value of the information we teach throughout the semester.

After giving the task, we do not leave the students on their own to complete the job; instead, we have introduced the "strategy planning phase". When they see a problem which they think is unsolvable, it is usually because they see it as a huge complex mass, and they cannot get a grip on it. They have to break apart the problem into smaller pieces that they can deal with one by one, thus executing the solution step by step.

In practice, we give some time to think about the problem, analyze the materials, and identify the model parts and their relations. We encourage them to visualize it on paper using the mind-map technique, so it will help them understand the whole modeling process better. (Zampetakis et al. 2007)
When the time is up, we show our mind-map version of the modeling strategy (Figure 3). We discuss it out loud, so students can compare the two versions. They can refer back to this at any point during the lesson if they cannot determine the next step. Finally, they begin working on their own, at their own speed.

![Figure 3: Life-like situation](image)

![Figure 4: Smart video directory](image)

Video tutorials are widely used in many fields of education. When one would like to explain a complex process with many steps, the length of the tutorial will exceed the watching tolerance of many students. If they track an explanation - say, in 30 minutes - students will speed up the video. They will try to jump to the portion of the long content which they seek. Sometimes it is hard to find the most relevant part of an explanation. The user jumps back and forth to stop at the required detail. Using video tutorial in our project, we have introduced a so-called "smart video directory" system (Figure 4). We list the entry points with time code, practically labeling these indicators. This way, re-playing certain parts of the whole explanation of a procedure can be accomplished quickly. The effectiveness of using these tutorial videos has increased. In practice, if someone is stuck on a given step, the student does not have to watch the full video. Simply by clicking on the title of the step, students can jump ahead to that point in the time code.

At the end, we summarize what was learned in the session and preview the topic for the next lesson to stimulate interest beforehand.

In 2016, authoritarian education seems out-dated in our case. The CAD/CAAD softwares are becoming increasingly complex. They have so many functions and keep constantly changing with each new version. It is hard to catch up with it, and that is why sometimes, when students investigate a problem, they delve into it so deeply that their knowledge outlasts the teacher's. Hence, the teacher is no longer necessarily the greatest expert in the classroom. Nonetheless, he knows how to handle problems, where to get the required information, and can tell if students use the tools in the most professional and optimal way. Consequently, the role of teacher has changed from being the one who has exact answers for everything, to being rather a moderator of problem-solving. That is why during the individual life-like situation stage, in addition to answering questions, the tutor also observes, evaluating how professionally and how efficiently the students work and correcting them accordingly.

**RESULTS AND EXPERIENCES**

If we want to edit a hard-hitting curriculum, we have to build it the way software development works. As an article in WIRED magazine explains "We live in a beta world." [5] which is true in our case as well. It is an iteration process through versions which makes the curriculum better and better. That is why we have to get feedback constantly, which is now possible. Users and teachers are connected, not only in classrooms, but virtually after lessons as well.

We had 137 students complete the course with the new curriculum over 2 semesters. There was a survey taken, which was filled out by 75 students, where they could evaluate and tell us their opinion. We find that the content was a success, substantiated by the fact that students gave it 4.7 points out of 5. As for the usefulness of the frame system, they gave it 4.4 points. Over the course of the semester, they seemed to welcome this curriculum development.

When we introduced the strategic planning stage at the first lesson, the students were surprised. They looked confused as to why they could not open...
the software and begin the task. Instead, they had to put the computer aside and plan the entire execution process. Later, they became used to it and understood the reason. It strengthened their visual thinking, and the learning process became more efficient. When asked if they thought this strategy was useful, all of the students answered in the affirmative both semesters.

We wanted to know how much they would use the video tutorials. When asked, 75% of students replied that they did use them. Nonetheless, that did not mean that everybody watched every video. According to our analysis, 60 people out of 137 watched each video for a shorter or longer period of time on average. With an audience-retention analytics tool (Figure 5), we can see on a diagram how many times each video frame has been played, compared to the number of those who started to watch the tutorial. This diagram, as we can see, has many peaks, and it is very uneven.

From these facts, we conclude that students do not approach the situation task by watching the full video and following it step by step; rather, they only use it if they get stuck with a step. I find this very positive, because they use their problem-solving skills better. Instead of mechanically following the steps demonstrated by the tutor, they figure them out on their own. What they accomplish by themselves leaves a more lasting impression, so the acquired knowledge will be more effective in the long term. On the other hand, those who are not self-confident or who make slower progress followed the video tutorial from the start in the classroom as well. This is a positive development, because they are usually afraid of asking questions and are capable of getting stuck on a small problem. In this case, however, they can move on more easily and experience more success.

Students also took advantage of the various means of communication; they commented and sent instant messages. Hopefully, though, we will improve these numbers in future semesters. As one student expressed it nicely, "I think we are not used to such a system at the university, and that is why we did not use this opportunity as much as we could." Another student opinion was that the whole faculty should use the same frame system, because it is not efficient to log in and follow courses on different platforms.

**KEY RESOURCES**

While discussing the multiple benefits of MOOC in architectural education, Martijn Stellingwerff (2015) notes that creating such curriculum content demands plenty of effort. First of all, all the stakeholders must understand the MOOC frame system, and all faculty members need to be motivated to use it.

The course content has to be re-thought as well, and the variety of content needs to be edited - for example, texts, illustrations, tests, video recordings, and other interactive content. Of these, video content creation is very challenging. The audience has
to concentrate hard on listening to new information while watching the video tutorial. If the audio-visual content is lacking in quality, it tires and distracts them. It is the same case in an auditorium where the acoustics or the projector is not good enough, and people can only listen for the first 5-10 minutes before growing tired and giving up. This makes the learning process less efficient at the end of the day, so we have to strive for quality in ways that require plenty of professional and expensive equipment (cameras, lights, tripods, microphones), a room suitable for recording, and people capable of using the equipment and editing videos as necessary.

After the curriculum content has been completed, we are still not finished, because maintaining the system is just as important. Such a system must live, and that life must be sustained, which demands time and effort. It obliges us to be in constant contact with students, answering incoming questions, following their progress, and holding their attention. In order to manage this increased amount of work, we introduced "student tutors." The students who supply correct answers to other students’ questions in the forum become "student tutors." This is mutually advantageous for everybody, because the student who asks gets a correct answer, so he learns. The student tutor develops a deeper understanding of the topic while teaching, and the teacher can conserve his energy, investing it in curriculum development, for instance.

**CONCLUSION**

Based on our experiment, developing the curriculum in such a way is worthwhile. The benefits are appreciable, already in the short term. Moreover, it makes the learning process more efficient, enhancing the reputation of the faculty and the university as well. It improves the students’ respect for the institution, since it employs the latest and most developed technology to serve them. One glowing example of this is the Delft University of Technology, where a brand new faculty was established to create MOOC content as well, in a separate building especially built for that purpose. How can we achieve such results within the framework of a traditional education system? We believe it is attainable in small steps. Therefore, we have begun to establish and experience this system slowly but surely, in order to arrive at the most efficient mode of operation.

**REFERENCES**

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