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Improving the Online Design Education Experience

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Design education usually takes place in a studio setting, in which visual and spatial artefacts are produced, shared, improved, presented and commented. This specific setting comes with qualitative properties that allow for situated learning with object-oriented focus and interaction, combined with a rich collegial context in which ideas can flourish and certain values and ethics are cherished. Using our education platform for online learning, we noticed the lack of support for typical creative and social design studio aspects, while factual classroom education was well supported. This paper describes how we attempt to translate the qualities of the studio education setting into an online environment for design education. Our approach is not to build a Virtual Design Studio (VDS) from the bottom up, but instead, to build on top of our universities' online education platform of choice. The paper commences with a short description of design education in a studio setting. Then a number of basic principles of design studio education is applied to the development of two Massive Open Online Courses (MOOCs). In the last section we discuss the different setups and compare the online aspects with on campus design studio education.

Keywords: *Online design education, MOOC, Creative Learning Environment*

INTRODUCTION

This paper is the result of a collaboration between the Delft University of Technology (TU Delft) Faculty of Architecture instructors and Department of Education and Student Affairs support staff. This collaboration commenced four years ago and has already resulted in an earlier eCAADe paper about the 'MOOC-ability of Design Education' (Stellingwerff 2015). Since then more design-focused MOOCs have been developed at TU Delft and we have gained many new insights from these initiatives and from the rapid developments in the field of online edu-

cation. This paper is mainly about two MOOCs that now have run several times on the edX platform since 2016.

The first MOOC, 'IMAGE | ABILITY - Visualizing the Unimaginable' [1], focused on design and communication through different kinds of images including collages, photography and info-graphics. It initially integrated Pinterest, and later SketchDrive as a repository for sharing the creative assignment work from course participants.

The second MOOC, 'Models in Architecture' [2], deals with design and communication through dif-

ferent digital and physical models. It used SketchFab as an online model repository and Weebly as a digital portfolio site.

The two MOOCs containing all the platform prototypes and tests were developed over the past two years, and they were run several times with a total number of 25000 enrolments and over 1000 active participants. During several course iterations, we collected a massive amount of data and many new insights. Recently we reported specifically on the integration of SketchDrive by using the rich and quantitative feedback from learner enquiries (Ouwwerker et al. 2018). This eCAADe paper further describes the actual learning mechanisms and reasoning related to the course design.

During the whole process of course development, evaluations and iterations, we kept the real-world form of the design studio as a valuable reference.

DESIGN EDUCATION IN A STUDIO SETTING

When we observe student and tutor behaviour in their educational spaces, we encounter design in two forms: the design activities and the results of those activities, the design artefacts. Together these activities and artefacts play an essential role in the design process in education.

The whole collection of design artefacts, such as for example sketches, schemes, photographs and prototypes forms a reference at hand to the continuous design thinking process. These *'objects of thought'*, together with the physical presence of the design actors (the students and their tutors), the assignment and the studio environment form a place that can offer a sense of focus and inspiration. This specific setting comes with qualitative properties that allow for situated learning (Lave, Wenger, 1991) with object-oriented focus and interaction, combined with a rich collegial context in which ideas can flourish and certain values and ethics are cherished. The design studio is a place for situatedness. Clancey (1997) introduced the word situatedness to describe that human thoughts and actions are adapted to

their environment. Gero (1999) describes situatedness as *"where you are when you do what you do matters"*. We could add that it also matters *"who you do it with"*, as situated learning takes place in communities of practice in the sense described by Lave and Wenger (1991). It is a social process.



Figure 1
Chairs, designed by famous architects, provide reference to style, form, use of different materials and allow to study appropriate details.



Figure 2
Presenting for peers and tutors. Design drawings with magnets on the wall.

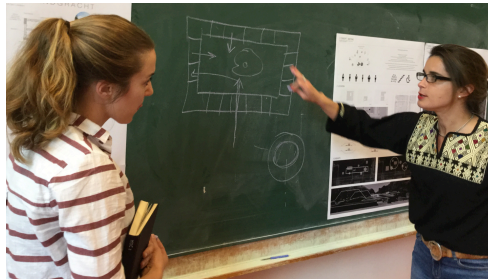


Figure 3
The blackboard is still a perfect way to quickly illustrate ideas.

Designers prepare their design studio in such a way that they can focus; they carefully control what they put in and what they keep out of their studio. Similar to the private or corporate design studio, the design studio in architectural education needs to be optimized for inspiration, collaboration and focus on the

design activities.

As illustrated in figures 1-3, education in the design studio can take many forms. Figure 1 shows a group instruction around a small exhibition of five chairs. The objects are selected from a larger chair collection and they are temporarily used as tangible references for a specific design task. Figure 2 depicts a midterm presentation for peers. The design drawings form the anchor point for each individual presentation and they display the progress of the individuals and of the group as a whole. Figure 3 shows an interaction between the tutor and a student on a specific aspect during the same midterm presentation session. The rest of the group is also engaged, so it is a learning moment for everyone.

Of course, many more individual and group processes can be found in a design studio. What appears to be a constant factor is that design is about actions and products: in each process the design actions are accompanied by design artefacts. This notion was key in the course design and the 'look and feel' of the two MOOCs.

BRINGING THE DESIGN STUDIO EXPERIENCE ONLINE

With the development of the two image-design and architecture related MOOCs we focused on one main research question: *'What didactic strategies, tools and techniques can we use to bring Architectural Design Studio experiences to anyone, anytime, anywhere?'*

In view of Anderson's theorem (2003) that deep and meaningful learning is supported as long as at least one of the three forms of interaction (student-teacher; student-student; student-content) is at a high level, we designed the massive open online courses with a focus on student-student and student-content. We have extended the available edX MOOC platform by adding external tools for student-student and student-content interaction. In addition, the look and feel of the course environment was adapted in such a way that there would still be a sense of the design studio environment.

Many processes in design education rely on vi-

sual presentation, shared viewing, commenting and making annotations. For online education we need to find, define, test and develop techniques that adopt, mimic or surpass traditional qualities in a design studio. For example, in campus education, we often make use of physical references such as a furniture collection. Students start by exploring tangible examples of high quality designs. They also visit urban case study areas and they take field trips to exemplary buildings. The confrontation with real design objects situates the students in order to analyse, evaluate, value, compare and compete with the good examples. Furthermore, in a design studio there is a continuous exchange of ideas. It can be a melting pot of creativity.

Online education can also bring a wealth of inspiration. Especially the MOOCs attract learners from all over the world with totally different levels of skills and different taste and backgrounds. In architecture and image design courses the diversity is an attractive added value for the exchange of ideas and the notion of locality versus globalization.

From the start, we placed design learning activities and design artefacts central in our new online courses. The new MOOCs should not just be *about* design, but the participants should also work *with and through* design. We created a consistent structure for each course week, in which theoretical introductions were followed by practical design activities.

Bringing the qualities of a real design education studio online challenged us in two major ways. We needed to highlight and support the social values of participants who work and learn together and we needed to represent the rich environment of a design studio, allowing them to study design precedents and to add and share their objects of thought.

Implementing course design

Course design starts with a description of learning objectives and finding the appropriate learning activities and assessment methods. In our design courses the focus is on creative 'learning by doing' activities. TUDelft uses the edX MOOC platform. EdX is

a rich course environment with a choice of learning tools built for interactivity and several ways to extend the standard functionalities. EdX has a robust back-office to manage enrolments, work with sub-groups and cohorts, keep track of learning progress and pace and enable analytics to view course data reports. Our courses not only provide theoretical units and quizzes; the main design studio experience results from the interplay of actions and artefacts. Below an overview of essential 'bits and pieces' is provided that together represent aspects similar to those in design studio education on campus.

Online creative design activities

The fragile conditions for creative endeavours were evocatively presented by John Cleese in his talk on Creativity in Management [3]. He mentions the importance of a playful process, for a specific time in a well-chosen space. To prepare such a demanding setting is always difficult, but creating it online is even more challenging. How to create the online social environment in which creative and personal design activities can flourish? Certain values and approaches were taken into account to make sure these conditions could be supported.

We first took a close look at the social values in our campus design studios and adopted some design studio procedures from the architecture faculty. We consider it important to create a safe place where learners can receive constructive feedback. In MOOCs peer review is often used to provide feedback, while instructor feedback is usually minimized to weekly email updates or feedback videos. We took care to explain the guidelines for using the tools on the online platform, emphasising the need for participants to understand and take into account that the design approaches and values of their peers can take many forms in such a global online setting.

Moreover, we aimed to show tutor presence in the forum by welcoming new learners, answering questions, stimulating discussions and thus creating space for learners to express themselves. Ultimately, as an online teacher and as a peer reviewer, it is im-

portant to be constantly aware that there are real people behind words and projects on a screen.

Apart from values and attitudes, rich content is of utmost importance. Creative assignments should be doable but also tempting and somewhat challenging. Participants need valuable and constructive feedback and most like to show their design products and appreciate some recognition. The course also needs a sense of continuity, it should be globally inclusive and technically sound, clear and responsive.

Example 1 - navigation in the course

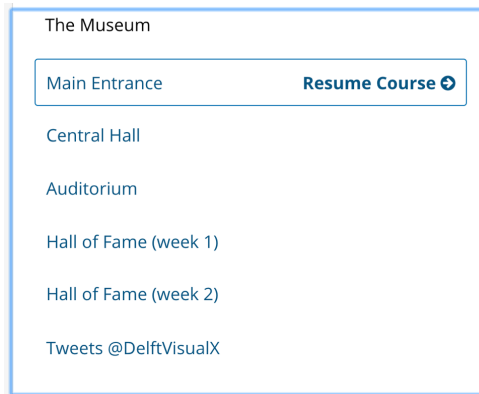


Figure 4
Example of IMAGE | ABILITY course with the museum metaphor implemented in the edX text menu.

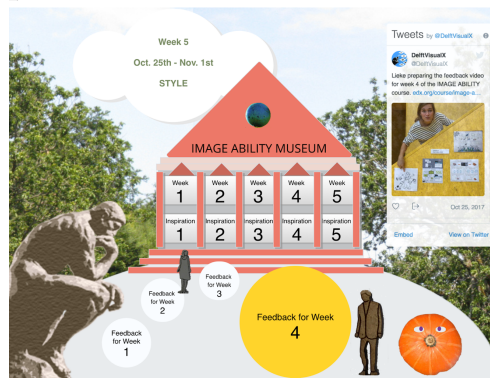


Figure 5
Example of IMAGE | ABILITY course with the museum metaphor implemented as an image with direct links to exhibition halls, feedback videos and a twitter timeline.

In order to give a sense of place and to stay in the image-focussed course theme, we used metaphors

such as *'the museum'*, *'the auditorium'* and the *'hall of fame'*. Later on we improved the interface by changing from a text based menu to an animated interactive image menu.

Example 2 - providing feedback

Figure 6
Feedback video about course results.

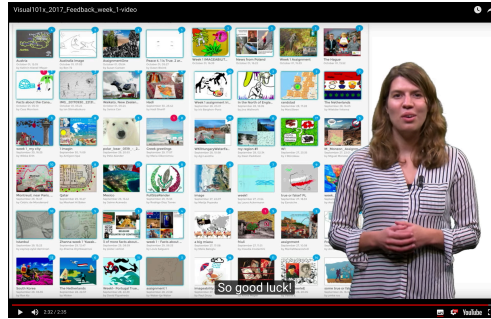
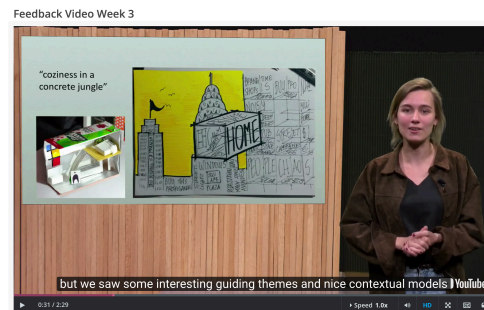


Figure 7
Feedback video in VR.



Figure 8
Feedback video with the background made from scale model materials.



Research has shown that providing timely feedback is essential in education, and especially for online learners it can strengthen the community feeling. It

is the moment they can get to know if they are on the right track and if they level with the rest of the participants. In the past two years we have experimented with different types of feedback videos in the various MOOC runs. Each course week the feedback video was either a new experiment or an improvement of a previous one. We considered it exemplary to take an experimental approach in order to express the open and creative atmosphere of a design studio, where it is no problem to fail as long as you attempt something new. Some videos were recorded in the real campus environment, some were done at home using a screen cast, however, most videos were recorded professionally by the TUDelft New Media Center, using green screen techniques. Figure 6-8 indicate three impressions of the videos. Figure 6 shows the use of the SketchDrive interface to simulate pictures on the wall. Figure 7 is from a feedback video in which we discuss a number of 3D models by course participants. The models are presented in Virtual Reality in the green screen studio. This allows us to overlay the presenter video channel as if we are standing within VR. Figure 8 is from a feedback video with a virtual background, made from scale model materials. In the feedback videos general comments are given which are applicable to the work of many participants.

Example 3 - participant introductions

Since MOOCs are globally available, participants can show and value local differences. Local aspects are an interesting added value to the courses, especially in cultural and contextual subjects like architecture, art and industrial design. Similar to the start of a new course in campus education the online courses also start with introductions. Learners are asked to provide some background about themselves on the course discussion forum. For example, based on the course theme, the first activity is to show a picture of a scale model from the participants' daily life and local background. We actively welcome participants in these introductory threads in order to create a sense of presence and ensure that learners feel acknowl-

edged. This initial course activity also reframes the view on the topic (Schön and Rein, 1994), as it is broadened by the diversity of participants from all over the world.

Although the edX discussion forums enable images to be included, they were only used for the first introductory discussions. It turned out that the discussion threads with images became very long and the lack of structure indicated a need for a more accessible and personal way to show images that belong to one person or to one specific design task. Therefore, only the topical discussions and preparations for the assignments were designated to the edX forum, while we used external tools to support for the larger week design challenges that rely on personal portfolio applications and dedicated image and model repositories.

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Online creative design artefacts

A useful tool for developing a course design is Bloom's (revised) taxonomy (Anderson et al., 2001). This hierarchical framework intends to help instructors align their learning activities and assessment using a common language. It represents the process of learning from the general idea that there are different levels of thinking that build on and support each other. Most online learning platforms can deal with the earlier stages in Bloom's Taxonomy [4]. However, in design education many learning activities focus on analysing, evaluating and creating artefacts, such as visuals and models designed by students. We found that when it comes to sharing and reflecting on these artefacts, the online learning platform does not provide suitable tools. However, we found sufficient ways to extend the platform with rich media

and connected applications.

Online tools, such as the blogging tool Weebly [5], image repositories such as Pinterest [6] (figure 9), and SketchDrive [7] (figure 10) and the 3D model repository Sketchfab [8] (figure 11) were integrated in the edX MOOC environment. The challenge was to integrate the tools in such a way that the technical burdens were ironed out, while constantly striving for real design studio qualities. In the ideal situation, the image platforms could provide views of the participants' drawings, models and prototypes as if they were laid out on the table or hanging on the wall.

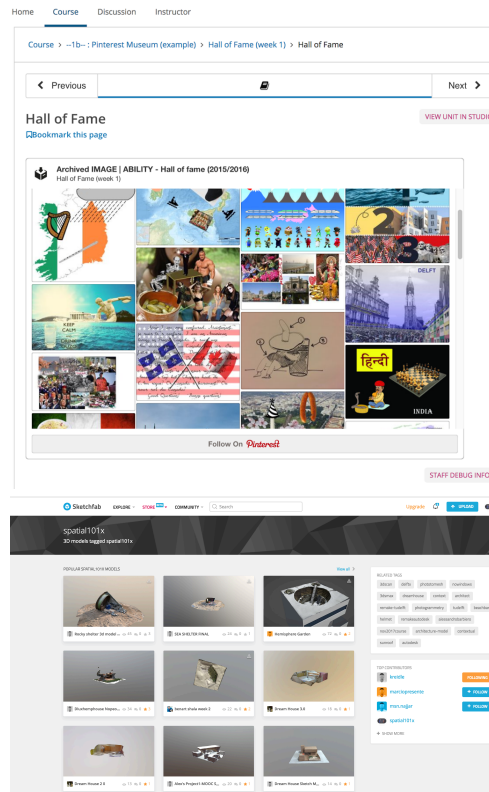


Figure 9
Example of IMAGE | ABILITY course with a hand-picked selection of work on a Pinterest board.

Figure 10
Example of the Models in Architecture course with a hashtag (#spatial101x) based selection of 3D models in SketchFab.

From a technical point of view we also strived for the

best ways to integrate the external tools within the edX course environment. Pinterest, SketchFab, HTML animations and YouTube allow the use of HTML in-line code to directly view the content framed within the course page in edX. For SketchDrive a link button was created that directly connected the edX user credentials in order to make the login process much easier. This was done through a Learning Tools Interoperability (LTI) component to ensure single-sign-on was possible.

ment. We now needed to create a long list of student portfolio URLs so participants could view each other's work. However, this was worth the effort, because the student-owned portfolios turned out to support personal expression and to creatively present the weekly design steps.

RESPONSES AND CONCLUSIONS

In the course surveys participants provided feedback on their course experience, for example: *The challenges involved and the creativity. I really enjoyed seeing how other people came up with their own solutions to the problems. The course motivates a lot. All the subjects that I reached to study were very interesting for me. The didactics of the course is very fun and easily understandable. The videos from tutors created an atmosphere that encouraged me to feel free and interest in the material and discussions more than i usually do. I did not expect it to be so interacting and enjoyable, I could see that the tutors were putting a lot of effort in updating to the learner. I also did not expect it to be so worldwide, it was amazing to see how people from all around the world were coming up with such great ideas and creativity.* This shows that the efforts to create an interactive and creative learning experience had paid off, but actually we were more focused on finding immediate or long term solutions to the more critical comments.

Some comments on what the course participants did not like: *Pinterest board wasn't allowing direct communication with the official course page. Organize the forum and encourage students to speak more with each other. I did not always understand the logic of TU Delft's Team behind highlighting (choosing to Like on Pinterest or to add to "Hall of Fame", or to weekly Feedback) some weekly student's images.* We tried to bring solutions to such reactions. SketchDrive replaced Pinterest in the rerun of the course and this improved the integration.

In the reruns we tried to solve some of these issues: SketchDrive replaced Pinterest in the rerun of the course and this improved the integration. However, providing specific personal constructive feed-

Figure 11

Example of IMAGE | ABILITY course with an overview of one specific set of assignment images in SketchDrive.

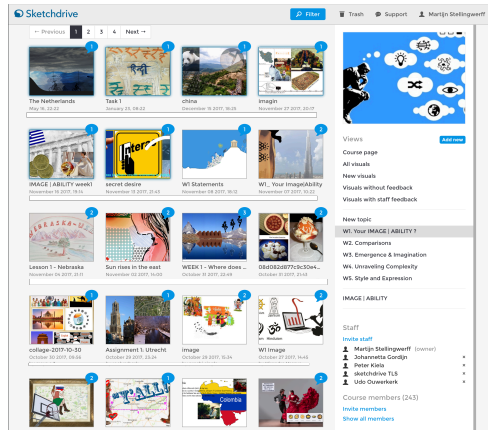
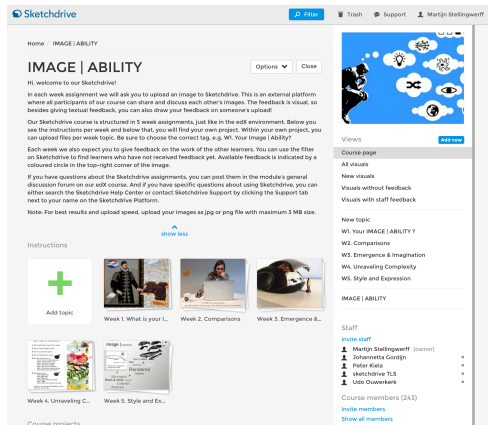


Figure 12

Overview of week assignments available from within SketchDrive. Learners can click on the appropriate assignment to upload their work. They can see what others have made and they can provide feedback and annotate the images.



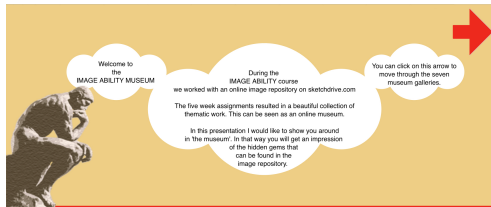
The Weebly integration still needs some improve-

back remains the most difficult part in a MOOC. The Hall of Fame turned out to be a somewhat deceptive concept as it gives a selection of work from the early participants a pedestal, while new participants are starting the course during the course run. This needs a new feedback mechanism in which participants can highlight each other's work in a more dynamic way.

Next steps will focus on improving feedback mechanisms, especially in new versions of the courses in which participants will be able to work 'self paced' in a constantly available course environment. Another challenge can be found in a new MOOC we are developing using AR and VR tools. This will shed a new light on collaboration in the online design studio setting.

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- [6] https://nl.pinterest.com/tudelft_ia_hof/
- [7] <https://www.sketchdrive.com/>
- [8] <https://sketchfab.com/tags/spatial101x>
- [9] <http://www.irrodl.org/index.php/irrodl/article/view/149/230>
- [10] <https://delftxtools.tudelft.nl/image-ability/feedbackweek5e.html>

Figure 13
This HTML animation adopts the idea of a presentation of student work on the walls of a museum. See online: [10].