Design Patterns for Open Online Teaching and Learning

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Design Patterns for Open Online Teaching and Learning

The rapid rise of massive open online courses (MOOCS) has renewed interest in the broader spectrum of open online teaching and learning. This “renaissance” has highlighted the challenges and potential associated to the design of such educational environments.

Arguably, the accelerated expansion of open online education creates risks for pedagogical quality and the learner experience. We are witnessing a wealth of different approaches to the delivery, pedagogy, functionalities and support mechanisms for Open Online Learning. Some have these been successful and others not so successful and consequently we find a pressing need to articulate, share and critique design knowledge in this field.

Design patterns and pattern languages have been proposed as effective means to facilitate rigorous discourse, bridging theory and practice. The patterns paradigm was proposed by Christopher Alexander as a form of design language within architecture. A design pattern describes a recurring problem (or design challenge), the characteristics of the context in which it occurs, and a possible method of solution. Patterns are organized into coherent systems called pattern languages where patterns are related to each other and thus offer a toolkit of interrelated design solutions that can be applied to novel problems.

Some of the key questions considered by the papers in this issue are underpinned by a desire to understand the design processes and mechanisms by which we come to create and deliver open online learning at scale and by extension how we can formulate this into sharable solutions that can be applied by others.

The papers in this issue respond to this challenge in a variety of ways. First, Hatzipanagou offers a review of the MOOC literature and asks what MOOCs contribute to discussions of learning design. He concludes by providing an example mapping of the identified learning characteristics with a number of MOOC design patterns. Salvador and Scupelli highlight the importance for collaboration in the pattern production process. They describe a data driven pattern production methodology and a supporting open repository for patterns in the domain of online learning system design. Lackner et al. use a learning analytics perspective of participant activity in MOOCs to suggest three design patterns to combat high drop-out rates. Next, Littlejohn and Milligan provide a view of MOOCs targeted towards professional learners. They identify a gap around self-regulated learning and in response provide a set of five patterns to help support MOOC design for self-regulation. Mor and Warburton then describe the outputs of the Design Patterns Project that utilised the participatory pattern workshop methodology. They demonstrate the usefulness of this approach through three practical patterns for active and collaborative learning. Koppe examines the value of using an externally hosted MOOC in a flipped classroom setting. The paper articulates three interlinked patterns to demonstrate how this can be achieved. In their paper on peer interaction, Liyanagunawardena et al. focus on discussion fora and draw from seven separate design narratives to present three patterns for facilitating meaningful discussion when the number of participants is very large. In the final paper Dacko takes an alternative but complementary design approach and draws on a particular design methodology to show how it can be used the sphere of inclusive e-learning to create a cohesive and unified solution.
It is clear from the papers presented within this issue that we have a rich community of researchers, developers and practitioners grappling with the design issues generated by the continued expansion in open online course development. It is exciting to see authors building on the roots of traditional distance education research and extending this into new territories that forefront sharing design knowledge as a mechanism to solve the particular challenges that are presented by learning and teaching at scale.

Tapio Koskinen, eLearning Papers, Director of the Editorial Board
Steven Warburton, Guest Editor, Professor and Head of Department of Technology Enhanced Learning, University of Surrey, UK
Yishay Mor, eLearning Papers, Editor in Chief
What do MOOCs contribute to the debate on learning design of online courses?

Learning design in MOOCs seems to follow particular approaches, as the claim is that the MOOC target audience, a ‘massive’ student body, will require different learning designs from those that work for small student numbers. For instance, ‘traditional’ online courses have a small in size target audience, whereas the MOOC is usually free, offers no accreditation and targets large (massive) audiences. Because, anyone with an Internet connection can enrol, academic staff cannot possibly offer personalised, one-to-one support to students. Consequently, learning design to support self-regulated learning is a significant consideration.

To address these issues, MOOC platform developers have looked at how the learning design of the format could scaffold learning in the MOOC space and encourage network formation between more participants to support each other. To achieve this some of the MOOC platforms dictate a more or less rigid template of a learning design, whereas other providers leave the design of the courses up to the individual customer institutions, within broad guidelines. Wherever the MOOC ‘experiment’ takes us, there is still an optimism that results will leave behind a digital trail of good practice to (a) show more clearly what a truly self-regulated learning environment might look like and (b) benefit other forms of formal and/or informal forms of instruction in higher education.

The paper explores the learning design characteristics of MOOCs, and particularly those elements that are essential for independent learning and student support. It assesses whether these are implicit or explicit in the design of MOOCs, and how they are embedded in the MOOC platform. It then explores the value of design patterns as an approach to solving the particular design challenges raised in the paper. Overall, it seems that the premise that guides several debates on how MOOCs work is that we should be spending more time when we design MOOCs to enhance those features that support the self-regulated learner.

1. Introduction

Massive Open Online Courses (MOOCs) have become a major focus of perceived innovation in online learning. Wikipedia (2015) defines a MOOC as “an online course aimed at unlimited participation and open access via the web ... this is possible only if the course is open, and works significantly better if the course is large; the course is not a gathering, but rather a way of connecting distributed instructors and learners across a common topic or field of discourse”.
The major innovations in MOOCs are not their learning design elements of limited or no access to academic staff, peer interaction, social media, fora, and automated assessment. These have been used elsewhere for years to support student learning in more ‘conventional’ online learning environments. The MOOC may share some of the conventions of an ordinary course, such as a predefined timeline and weekly topics for consideration, a space for communication and self assessment activities. However, it is the massive audience that dictates some of the teaching strategies and learning design features. The connectivity of social networking, the facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources are essential features in the MOOC environment. Perhaps most importantly, however, a MOOC builds on the active engagement of several hundred to several thousand “students” who self-organize their participation according to learning goals, prior knowledge and skills, and common interests.

What marks a MOOC out from conventional online learning is that no professional academic time (or virtually none) is allocated to guiding or supporting individual learners. This is probably the biggest difference between other forms of online learning and the element of support in MOOCs. Overall, it seems that the premise that guides several debates on how MOOCs work is: “should we be spending more time when we design MOOCs to enhance those features that support the self-regulated learner?”

This paper investigates the related literature and will highlight the key learning design features of MOOCs as they are discussed and evaluated in the literature. Liyanagunawardena et al (2013) refer to some of the MOOC literature as thinly disguised promotional material by commercial interests, and Daniel (2012) identifies a common trend in articles by practitioners whose perspective is their own MOOC courses. Our exploration assessed a collection of recent literature contributions on MOOCs and their learning design. In examining the relevant literature, we concluded that popular discourse in mainstream media and the Internet is still dominating the MOOC debates, rather than strong empirical evidence of impact on student learning.

2. MOOCs: Learning design features

Whether MOOCs represent a genuine innovation, or a reappraisal and reorganisation of previous achievements in open, distance and online learning, is a significant theme in the academic literature. The paper intends to contribute to the debate by considering the learning design approaches and features in MOOCs and their perceived value based on evaluations and evidence from the literature.

3. Content and course material

The use of (pre-dominantly) pre-recorded or live non-interactive video-based lectures is most common in MOOC learning design, whereas the more conventional approach of text-based or multimedia-based content material is not frequently used. This has led to a re-evaluation of the perceived value of non-interactive video in online learning content, which had frequently received criticism as non appropriate use in educational practice (University of Tennessee, n.d).

Overall, MOOCs allow students alternative routes through material and they allow automated feedback however, as Daniel (2012) points out, they do not provide a sense of being treated as an individual. Personalised learning has been achieved before in online learning, but it requires gauging student prior knowledge, an understanding of an individual student’s needs, intervention and presence in the form of discussion, feedback and encouragement. According to Daniel (ibid.), it is here that we find the greatest difference between the predominant xMOOC model and the earlier cMOOCs, the latter of which had a strong focus on online interaction. Whereas in a cMOOC environment, in which connectivism, a learning theory which explains how Internet technologies have created new opportunities for people to learn and share information (Siemens 2005), is the main influence, the participants embrace a cognitive approach, acting as both teachers and students, sharing information and engaging in a joint teaching and learning experience through intense interaction facilitated by technology (Haber, 2012), an xMOOC is characterised by a more or less prescriptive, behaviourist design (Yuan and Powel, 2013).
4. Connectivity (and connectivism): the influence of emergent technologies

Connectivity in MOOCs is usually provided through conventional computer mediated communication media such as discussion fora (mostly unmoderated or lightly moderated) and through social networking. Web and social media tools (such as wikis or blogs and social networking) are now as central to learning as the lecture theatre and campus infrastructure in a traditional university campus (Daniel, 2012). They take the form of discussions via fora, blogs, and microblogging (mainly, Twitter), Google+, and other forms of social media.

In such spaces, learners may have been compromised by lack of support and moderation, and this has led some researchers to recommend light touch moderation to prevent confusion, firmly intervene in cases of negative behaviour, and explicitly communicate what forms of unacceptable behaviour can impede learning in the network. However, the lesson drawn for learners is that some constraints may actually improve the learning experience. This reflects earlier debates in the literature about the requirements of interfaces designed to support learning (Fowler & Mayes, 1999).

Some findings (Scanlon et al in press 2015) on participants’ use of social media tools indicate that a greater proportion of those completing a MOOC rate their knowledge and understanding of social media tools as moderate to expert compared to those who started the course. However, prior MOOC experience did not show a similar advantage. Blake & Scanlon (2013) suggest that ‘this may be an indication that the suitability of present open and freely available tools for supporting large scale learning needs to be carefully considered.’

5. Vicarious learning

Collaborative creation of knowledge, the use of computer mediated communication and peer or self assessment are all staples of the MOOC design that support student learning, but there are other unintentional gains such as vicarious learning, occurring in the MOOC environment. Vicarious learning, drawing from the definition by Bandura (1986), refers to an instructional setup that occurs when students learn by watching another student at the front of the class interacting with the teacher. In the case of the MOOCs, it refers specifically to being involved in “seeing students guided to fumble their way towards sense-making” (Haggard, 2013). This seems to be a non-negligible, probably unexpected gain of the MOOC participant that has serious implications for learning design. It points towards gains in the MOOC environment for independent learners, however so far is not tangible and easily replicated.

6. Badges

The role of badging is to enable micro-certification and make visible skills and competences that have been developed as students learn. A badge is a digital representation of a skill, learning achievement or experience. Badges can represent competencies and involvements that have been recognized in online or offline life. Each badge is associated with an image and relevant metadata. The metadata provide information about what the badge represents and the evidence used to support it. The badges can be awarded by a tutor or teaching assistant or administrator in a semi automated fashion for achievements such as multiple choice quiz completion, however some of the badges, particularly the peer awarded ones can play a truly motivational role in engaging leaners. Learners can display their badges online and can share badge information through social networks, potentially outside the MOOC environment.

6. Who is the learner?

Active MOOC participants are considered those students who fully participate in the MOOC, for instance, ‘consuming’ content, taking quizzes and other forms of assessment, writing assignments and sharing artefacts and peer reviewing. Haggard (2013) identified four significant clusters of students in computer science MOOCs:

1. “Auditing” learners watch lectures throughout the course, but attempt very few assessments.
2. “Completing” learners attempt most of the assessments offered in the course.
3. “Disengaging” learners attempt assessments at the beginning of the course but then sometimes only watch lectures or disappear entirely from the course.
4. “Sampling” learners briefly explore the course by watching a few videos.
Despite the fact that such a taxonomy can lead to making unhelpful assumptions about the clientele of MOOCs and their learning behaviours, not dissimilar to the ‘digital native’ ‘digital immigrant’ paradigm, creating a distinction between learners who are “auditing”, “sampling”, “disengaging” and “completing” seems a sensible differentiation in how learners approach and interact with content, other learners and the MOOC environment.

7. Learning analytics

Evaluations of the MOOC environment focus on the registered learners’ expectations from a course; analysis of participation rates; use of course resources, use of badges and collaborative group working (Scanlon, in press 2015). Data sources used for evaluation include a range of qualitative and quantitative tools: pre- and post-course surveys, discussion fora, social media contributions of participants, public spaces of the course and blogs created by the participants. Buckingham Shum and Ferguson (2012) emphasize the importance of social learning analytics in considering such experiences.

Learner analytics technology, already theorised and explored in a mature and established debate rooted in the Open and Distance Learning literature, comes to its full potential with the scale and mechanisation of MOOCs. Theoretically, learning analytics assessments help to provide students more engaging material based on their individual profiles and learning behaviours. In this context, adaptive learning is claimed to be a real possibility and interventions can be targeted to secure completion and address low retention. Content trackers collect statistical data about traffic and aggregate the data into meaningful reports. Analysis of course metrics can be used to improve learning design and achieve higher rates of completion. For example, learner analytics, show that improvements to course discussion fora in particular, a good predictor of completion, could boost retention rates.

8. Disruption and constructivist vs. instructivist approaches

A useful survey of the ways in which MOOCs may act as disruptive innovations (Lawton & Katsomitros, 2012) and its related data argue that the disruptive nature of the MOOC technology is not found in one single innovation, but rather in the incremental effect of many changes in several areas of practice, from pedagogy to business model. This supports the view of the MOOC, not as a radical departure from the traditional open and distance learning environment, but as a learning space, where innovations are reusing older constructivist or behaviourist approaches in designing online courses. This allows evaluations that result in claims, positioning MOOCs in the constructivist-behaviourist scale. For instance, In MacLeod’s judgment, the Edinburgh MOOCs (Bayne and Ross, 2014), although hosted on Coursera (2015) platforms, which favour an xMOOC, instructivist learning model, were closer to the cMOOCs of the original constructivist school.

9. Learner autonomy and independent learning

Online autonomy, group formation and inclusion/exclusion feelings among learners are a vital dynamic in MOOC learning, and are probably insufficiently understood (Daniel, 2012). To start with, it is also likely that primary and secondary education curricula are not addressing these learning skills adequately, resulting in prospective participants arriving unprepared at the MOOC ‘gate’.

Mackness et al (2010) point out that participants value their autonomy in the MOOC, but do so at different levels depending upon language command, subject expertise, assessment for credit participation, personal learning styles and identity as well as the reputation of instructors and fellow participants.

Finally, the McAuley et al report (2010) identifies the main issues facing MOOCs as pedagogical and touches on independent learning triggers in the MOOC environment:

- deep learning: the extent to which they can support deep enquiry and the creation of sophisticated knowledge and the breadth versus the depth of participation;
- uptake: whether and under what conditions successful participation can extend beyond those with broadband access and sophisticated social networking skills;
- ‘lurking’: identifying the processes and practices that might encourage lurkers, or “legitimate peripheral participants”, to take on more active and central roles;
10. Assessment

The ability to evaluate vast numbers of learners in MOOCs is a big challenge (Yin and Kawachi, 2013). As Yousef et al. (2014) point out, assessment and related accreditation is an important factor for the future success of MOOC. They link the lack of systematic offerings of formal academic accreditation by most MOOC providers to issues around the quality of learning (Sandeen, 2013) or relevance of their MOOCs to traditional university courses (Sandeen, 2013). Currently, most MOOCs are only providing a non-credit certificate of completion, or attendance, or participation. In this context, beyond the standard e-assessment (e.g. the proliferation of multiple choice quizzes), peer assessment, and self assessment are significant innovations.

11. Peer assessment

Peer assessment has been used, predominantly in cMOOCs and less in xMOOCs to review student outputs: assignments, projects, individual and collaborative assignments. These assignments are not graded automatically by the MOOC engine, but learners themselves can evaluate and provide feedback on each other’s work and O’Toole (2013) highlights the suitability and added value of this approach in disciplines, such as Humanities, Social Sciences and Business studies, which do not have clearly cut right or wrong answers and where automated assessment is more difficult to implement.

12. Self assessment

Self assessment offers benefits in engaging the learner in learn-how-to-learn activities and reflection on performance. Sandeen (2013) and Piech et al (2013) have identified some self assessment techniques that include model answers as a tool to be used by students to cross-check if their self assessment is in tune with model answers set by the educators, and where learners can self-reflect on their achievements (Yousef et al., 2014).

13. MOOCs: Expectations and impact

The chasm between expectations and reality has been discussed in the literature. A standard point of reference is a comparison to ‘conventional’ online courses. Research has differentiated between MOOCs and typical online courses not only in terms of class size, but also with respect to learning design of the course. Given the expectation of peer learning in MOOCs, a certain critical mass is necessary for any learning design features to be successful. For example, Siemens (2005) defined massive as anything that is large enough that you can get sub-clusters of self-organized interests; three hundred plus students could be one benchmark. Another could be Dunbar’s number of 150 people (a suggested cognitive limit to the number of people with whom one can maintain stable social relationships), which is the maximum after which the group starts to create smaller fractions (ibid.). This numbers are vast in relation to the ideally sized online class of 20-25, hence the emphasis on any design approaches that achieve self regulation.

In general evaluation of MOOCs has included (Hollands & Tirthali, 2014):

- Pre- and post - assessment of skills and knowledge through formative assessment;
- Development of metrics to assess gain in cognitive and non-cognitive skills that can be applied outside of the MOOC environment;
- Comparison of skill or knowledge acquisition through MOOCs vs. regular online or face-to-face courses;
- Follow-up of post-MOOC outcomes such as sequential learning experiences or employment opportunities gained;
- Broadening the types of learners represented in studies of MOOC activity and impact in order to avoid the presentation of results that are not applicable to the majority of learners.

Discussion: towards a design patterns approach to enrich the MOOC learning design vocabulary
Overall, the findings of this exploration of the literature indicate (Table 1) that in terms of structure MOOCs plan learning activities which:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded</td>
<td>Structure-wise in a predefined timeline and include weekly topics/themes for consideration.</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Not based on prerequisites other than Internet access and interest, no predefined expectations for participation, and no formal accreditation.</td>
</tr>
<tr>
<td>Routes</td>
<td>Allow students alternative routes through the material.</td>
</tr>
<tr>
<td>Feedback</td>
<td>Allow automated feedback and support automated assessment.</td>
</tr>
<tr>
<td>Individuality</td>
<td>Do not provide a sense of being treated as an individual.</td>
</tr>
<tr>
<td>Support</td>
<td>Do not usually assign professional academic/tutor time to guiding or supporting individual learners.</td>
</tr>
<tr>
<td>Engagement</td>
<td>Enable students to be potentially served more engaging material based on their individual profiles using learner analytics technology.</td>
</tr>
<tr>
<td>Regulation</td>
<td>Support the self-regulated learner.</td>
</tr>
</tbody>
</table>

Table 1. Learning activities in MOOCs.

Finally, computer mediated communication seems to be a major feature in MOOC learning design, even though designer intentions and learner uptake of related opportunities is commonly aspirational. In this respect, MOOCs plan learning activities (Table 2) which:

<table>
<thead>
<tr>
<th>Media</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectivity</td>
<td>Support connectivity (usually provided through social networking).</td>
</tr>
<tr>
<td>Co-creation</td>
<td>Support co-creation, collaboration and peer interaction, or via discussion fora, blogs, wikis or other forms of social media.</td>
</tr>
<tr>
<td>Moderation</td>
<td>Incorporate moderation (usually light touch) to support learners.</td>
</tr>
</tbody>
</table>

Table 2. Computer mediated communication in MOOCs.

Other important considerations seem to include supporting vicarious learning, i.e. guiding learners to fumble their way towards sense-making and providing some constraints that may improve the learning experience. Finally, table 3 aggregates the learning design features that may support independent learning.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video-based</td>
<td>Non-interactive video-based lectures (predominantly) or other content</td>
</tr>
<tr>
<td>Communication</td>
<td>Computer mediated communication media</td>
</tr>
</tbody>
</table>

Table 3. A map of learning design features of MOOCs

14. Learning design in MOOCs and the patterns approach

Generating and sharing good practice in MOOC design seems to be as problematic as in more ‘conventional’ online learning, despite the open nature of the environments that offer glimpses of the learning design to educators and designers. If the intention should be for educators to engage in design, then methodologies that follow a design patterns approach will be valuable in articulating, validating and sharing design knowledge. In this section, a mapping is attempted between some of the learning design characteristics that were previously discussed against the set of patterns that were generated in a design patterns project that aimed to support the continued development of MOOCs (Warburton & Mor, 2015). In this mapping there has been a focus on the design solutions and good practice that the pattern methodology has generated and the support for self regulation the MOOC patterns offer (see table 4). The examination is intended to be complimentary to the emerging pattern language of shareable design solutions and validates the typology of MOOC design attributes. The informal language used in some of the offered solutions adds to the authenticity of the pattern methodology.
### Non-interactive video-based lectures or other content

- Do not expect students to be able to purposefully navigate excessive choice.
- Allow different languages and group people accordingly.
- Allow access to all materials at any time, online or offline.
- Signal core and discretionary activities but do not restrict access.
- Flexibly relate learning outcomes to pathways - by skipping [activity x] you will lose the opportunity to [outcome d and outcome f].
- You could have a visible basic schedule, but the platform could signal opportunities in response to your individual work (but this depends on being online).
- Give access the lecturer via online questions and up-voting.
- Allow different languages and group people accordingly.

Reference pattern: *Crowd Bonding*, MOOC Design Patterns (2015) at [http://www.moocdesign.cde.london.ac.uk/outputs/patterns](http://www.moocdesign.cde.london.ac.uk/outputs/patterns)

### Computer mediated communication media (Fora)

1. Determine natural or desirable groupings, which might be sought for this learning topic. For example, if the topic is about computer programming, perhaps grouping learners based on their operating system will be more useful because they are likely to have similar problems in installing software and running it.
2. Can be done by observing the nature of posts and posts seeking interaction in the opening days.
3. Forms forum threads or sub-forums, which are accessible to everyone on the front page of the forum.
4. Those threads should be informatively titled according to the groups defined.
5. Allow learners to form additional threads as needed.
6. Review for further weeks and phases of MOOC/ODL.
7. This will prevent students being isolated in dying threads as other learners drop out. Students have access to other discussions and can link discussions from multiple groups depending on similar themes.

Reference pattern: *Crowd Bonding*, MOOC Design Patterns (2015) at [http://www.moocdesign.cde.london.ac.uk/outputs/patterns](http://www.moocdesign.cde.london.ac.uk/outputs/patterns)

### Computer mediated communication media (Wikis)

Start the activity with an individual task to post an image (possibly accompanied by a short commentary) to a shared space such as a wiki. It is important that the wiki or similar collaboration tool is easily accessible from within the MOOC platform (ideally it will not require additional login) and will support the easy embedding of digital media (e.g. images, web links and videos). Then create a group task to identify another student’s image from the wiki and begin a discussion thread based on it. Then structure the discussion by asking students to reply to another’s initial posting by asking questions, providing a further example or contributing their own perspective on how the answer relates to the course content. This activity will encourage students to engage with others in a way that is easy and has immediate benefits. By encouraging students to create a resource together using digital media, the resulting collaborative product will be sufficiently stimulating to promote further learning.

Reference pattern: *Sharing Wall*, MOOC Design Patterns (2015) at [http://www.moocdesign.cde.london.ac.uk/outputs/patterns](http://www.moocdesign.cde.london.ac.uk/outputs/patterns)

### Non-interactive video-based lectures or other content

Induction to include learning journey, learning online (digital literacy), how to make the most of the platform. For example: FutureLearn provides a video on how to use the platform, how to orient around it. This generic video is good because if the learner is taking more than one MOOC from the same platform they need not repeat it. On the other hand, if the tutor wants to personalise the video for his/her course, this may be an opportunity to add ‘teacher presence’ and demonstrate the unique features of the course.

15. Conclusion: Do MOOCs innovate pedagogy?

The paper explored the learning design characteristics of MOOCs, and particularly those elements that are essential for independent learning and student support. It assessed whether these are implicit or explicit in the design of MOOCs, and how they are embedded in the MOOC platform. It then explored the value of design patterns as an approach to solving the particular design challenges raised in the paper. According to Daniel (2012), there is an opportunity to exploit the consensus that MOOCs drive innovation in learning by employing the digital toolset in learning, which has finally come of age.

Overall, it seems that the premise that guides several debates on how MOOCs innovate is that we should be spending more time when we design MOOCs to enhance those features that support the self-regulated learner. This makes approaches as the use of pattern language in MOOCs (Mor et al, 2012) significant as a tool for understanding the design processes and mechanisms by which we come to create and deliver open online learning at scale.
References


Bayne, S., Ross, J. (2014). The pedagogy of the Massive Open Online Course: the UK view, the University of Edinburgh.


Towards an open, collaborative repository for online learning system design patterns

Design patterns are high quality solutions to known problems in a specific context that guide design decisions. Typically, design patterns are mined and evaluated through four methods: expert knowledge, artifact analysis, social observations, and workshops. For example, experts discuss: knowledge, interpretations of artifacts, social patterns, and clarity of patterns. In this paper, we introduce a fifth method, a data-driven design pattern production (3D2P) method to produce design patterns and conduct randomized controlled trials as a means to evaluate applied design patterns. We illustrate the 3D2P method in the context of online learning systems (OLSs) that are difficult to create, update and maintain. To overcome such challenges, we propose an open repository for OLS design patterns, evaluation data, and implementation examples. On the repository, researchers can collaborate in the six stages of the pattern lifecycle (i.e., prospecting, mining, writing, evaluation, application, applied evaluation). The repository provides five benefits: researchers from different backgrounds can (a) collaborate on design pattern production; (b) perform distributed tasks in parallel; (c) share results for mutual benefit; (d) test patterns across varied systems and domains to explore pattern generalizability and robustness; and (e) promote design patterns to elevate OLS quality.

1. Introduction

Increasingly, online learning systems are gaining popularity. Allen and Seaman (2008) report that over 3.9 million students took at least one online course. Coursera, a massive open online course (MOOC), had over 12 million users taking 1,027 courses in May, 2015 (Coursera, n.d.). The Cognitive Tutor online tutoring system reported over 250 million student observations per year (Sarkis, 2004; Carnegie Learning, n.d.) and the ASSISTments math online learning system reported close to 50,000 students from 48 states in the United States using the system each year (Heffernan & Heffernan, 2014; Mendicino, Razzaq & Heffernan, 2009a; ASSISTments, n.d.).

Despite increasing popularity, online learning systems have shortcomings. For example, massive open online course (MOOC) usage statistics show low student engagement, low course completion rates, and high dropout rates (Jordan, 2014; Yang, Sinha, Adamson & Rose, 2013). Students experience emotions that hurt learning (e.g., frustration, boredom) and they sometimes “game the system” by exploiting help and system feedback to find the answer instead of learning. Three possible explanations for such maladaptive student behaviour includes: confusing learning system interfaces, poor design of subject content, and individual student traits such as, background knowledge, learning goals, motivation (Craig, Graesser,
Some online learning systems that addressed such interface, content, and student challenges significantly improved student-learning outcomes. However, the same developers had difficulty replicating their prior successes. For instance, many studies showed the effectiveness of Cognitive Tutor Algebra (Koedinger, Anderson, Hadley & Mark, 1997; Morgan & Ritter, 2002; Sarkis, 2004; Mendicino, Razzaq & Heffernan, 2009b), but the effectiveness of Cognitive Tutor Geometry, which was largely developed by the same team, was not as successful (Pane, McCaffrey, Slaughter, Steele & Ikemoto, 2010). Researchers tried formalizing lessons learned from existing design projects and studies using design principles, but encountered conflicts between design principles and had problems applying them in different contexts (cf. Mayer & Moreno (2002), Pashler et al. (2007), Kali (2008). Differing results from designs based on design principles and guidelines are attributed to the interpretation of design guidelines and principles into specific domains (Jones, 1992).

Design patterns are high quality solutions to known problems in specific contexts (Alexander, 1979). Design patterns can be used to overcome the limitations of design principles in various domains making it a good alternative (Mahemoff & Johnston, 1998; Van Welie, Van der Veer & Eliëns, 2001; Borchers, 2001; Chung et al., 2004; Kunert, 2009). Although design patterns can guide design decisions in online learning systems, they are relatively new and the currently available patterns mostly focus on pedagogy; notable exceptions include patterns for learning management systems (Ageriou, Papasalouros, Retalis & Skordalakis, 2003), person-centered e-learning management systems (Motschnig-Pitrik & Derntl, 2003), and MOOCs (MOOC Design Patterns, 2015). For instance, there are design patterns on content presentation, methods for feedback, learning activities, and assessment (Frizell & Hübscher, 2011; Derntl, 2004; Anacleto, Neto, & de Almeida Neris, 2009), but not much for OLS user interfaces, content and presentation of problems in online exercises, or automated student feedback for online exercises.

Some very popular online learning systems in the United States such as Cognitive Tutor (Ritter, 2011) and ASSISTments (Heffernan & Heffernan, 2014) were developed without design patterns, but collected over a decade of data describing students’ interactions with the system. Researchers developed a methodology called 3D2P (Data-Driven Design Pattern Production) that uses data collected from existing online learning systems to: inform the design pattern production processes, focus stakeholders on important design decisions, evaluate the quality of design patterns, and collaborate with other stakeholders to refine design patterns (Inventado & Scupelli, in press).

The methodology is run incrementally to ensure an online learning system’s quality as it evolves over time. Its first three steps (i.e., pattern prospecting, mining, writing and evaluation) use existing data collected from the system, while the last step (i.e., evaluation) requires conducting randomized controlled trials (RCTs) to verify the quality of patterns in implemented systems. One limitation of the methodology is that it may be difficult to conduct some RCTs to test and verify design patterns that require significant system modifications to test. Consequently, while some RCTs are difficult to conduct on a particular online learning system, other researchers could test the patterns in question with their own system and evaluate through RCTs. Analysis about a pattern’s effectiveness in a different system helps to verify the pattern’s quality and may provide insights to refine ineffective patterns.

Collaborating to evaluate design patterns provides many benefits to multiple communities ranging from design pattern authors, online learning system designers, students, and educators. Researchers can also contribute to design pattern production in four ways: (a) through data analysis (i.e., hypotheses from data can lead to the definition of new patterns); (b) pattern writing (i.e., patterns can be adapted and evaluated); (c) pattern application (i.e., variety of contexts for applying patterns describe its generalizability and robustness); and (d) pattern application evaluation (i.e., uncovered pattern definition issues can inform pattern refinement).

Collaboration between researchers to produce design patterns has five advantages. First, it can speed up the process of pattern prospecting, mining, writing, evaluation, application and application evaluation because it allows parallel work. Second, researchers from different backgrounds can contribute their particular expertise to design pattern production expanding the overall quality of pattern writing, data analysis, and evaluation. Third, pattern analyses, evaluations, and refinements are available in one central location. Fourth, a pattern’s robustness and generalizability can be evaluated as different researchers apply the pattern in different contexts (e.g., different
technological platforms – mobile, desktop; different domains – Math, Physics, Geometry). It follows that patterns tested in one system or domain can be modified to generalize across domains or systems. Finally, the methodology can foster a community of researchers working together to create high quality patterns, which in turn can promote the use of quality patterns and elevate the standard of online learning systems.

An open-source type collaboration managed through the creation of a central repository could help researchers to: find online learning system patterns, collaborate with others to refine design patterns, and support the application of patterns in other contexts. Furthermore, patterns in a central repository can also be linked to patterns in other design pattern repositories (e.g., Pattern Educational Resources for E-Learning Systems - (PEARLS) - (Frizell, 2003), Person - Centered e-Learning (PCeL) pattern repository (Derntl, 2004) and educational data repositories (e.g., PSLC DataShop (Koedinger et al., 2010), ASSISTments (Heffernan & Heffernan, 2014).

The following sections of the paper present a review of related literature, the ASSISTments math online learning system, the data-driven design pattern production (3D2P) methodology and its application on ASSISTments data, a collaborative framework for producing online learning system patterns, and the current state of a pattern repository being conceptualized for supporting the collaborative framework.

2. Literature Review: Design patterns and data-driven approaches

Design patterns provide quality solutions for known problems situated in a particular context (Alexander, 1979). Applying design patterns to projects can result in lesser implementation issues and future complications. Design patterns have also been used to share successful solutions between designers (Gamma, Helm, Johnson & Vlissides, 2005), and used as a medium for communication and collaboration between designers and users (Borchers, 2001; Erickson, 2000).

Some examples of patterns for online learning systems include a pattern language for learning management systems (Avgeriou et al., 2003), a pattern language for person-centered e-learning (Motschnig-Pitrik & Derntl, 2003), a pattern language for adaptive web-based educational systems (Avgeriou, Vogiatzis, Tzanavari & Retalis, 2004), and MOOCs design patterns (MOOC Design Patterns, 2015). Some design patterns that were not specifically designed for online learning systems, but address similar problems and contexts can also be adapted. For example, there are design patterns for learning (Iba, Miyake, Naruse & Yotsumoto, 2009; Köppe, 2012; de Cortie, van Broeckhuijsen, Bosma & Köppe, 2013), pedagogy (Eckstein, Manns, Sharp & Sipos, 2003; Sharp, Manns & Eckstein, 2003; Bergin et al., 2004; Kohls, 2009; Köppe & Schalken-Pinkster, 2013), and assessment (Mislevy et al., 2003; Gibert-Darras et al., 2005; Deloanze, Le Calvez, Merceron & Labat, 2007; Wei, Mislevy & Kanal, 2008).

There are four methods commonly used for identifying or mining patterns namely: introspective approach, social approach, artifactual approach, or pattern-mining workshops (Kerth & Cunningham, 1997; DeLano, 1998; Kohls, 2013). Pattern mining is often implicitly followed by pattern writing, which gives form to the design pattern. In the introspective approach, pattern authors use their own experiences to identify patterns. In the social approach, pattern authors use their observations of the environment or draw experiences from other experts to identify patterns. In the artifactual approach, pattern authors compare and contrast existing artifacts (e.g., successful projects, effective solutions) to uncover underlying patterns. Finally, in pattern-mining workshops, pattern authors analyse the experiences of different experts in focus group discussions to uncover design patterns. Unlike the social approach, pattern authors can easily communicate and collaborate with experts in pattern-mining workshops so they can get more ideas and feedback faster.

Patterns are usually evaluated through peer review in focus groups or pattern writing workshops to assess their quality and refine patterns when needed (Chung et al., 2004). However, the application and usage of patterns are also being evaluated. For example, Borchers (2002) reported the effectiveness of using design patterns for teaching Human Computer Interaction (HCI). Dearden, Finlay, Allgar, and McManus (2002) reported that design patterns empowered users to communicate and collaborate with designers, and to develop complete designs in a participatory design setting. Chung et al. (2004) conducted an empirical study on using a pattern language in a simulated design activity with experienced designers, which showed that the pattern language helped designers understand unfamiliar domains, communicate ideas, avoid design problems, and accomplish tasks more quickly. Riaz, Breaux and Williams (2015) presented a survey on commonly used measures for evaluating software design pattern applications, which included efficiency,
quality, correctness, completeness, complexity, usability, communication, creativity, modularity, and size.

Evaluation is fundamental for online learning systems because it guides the feedback that helps students learn. The goal of helping students learn is shared by design patterns for online learning systems and educational design patterns. Therefore, in the learning domain, design patterns are evaluated in two ways: first, as design patterns, and second, how well the design patterns improve student learning. In short, the design patterns for online learning systems need to improve the end goal of improving student learning outcomes. Limited evaluation of patterns for online learning systems without validation of the patterns in use may explain why some design solutions succeed in some contexts but fail in different contexts (e.g., different subject content, presentation medium – desktop vs. mobile, student background knowledge, student motivation).

Educational data mining and learning analytics provides teachers, researchers, and other stakeholders with methodologies and tools to better understand how design decisions affect student learning and performance (Baker & Inventado, 2014; Mor, Ferguson & Wasson, 2015; Persico & Pozzi, 2014). Insights from student data analysis can help to: identify student needs, develop better pedagogies, and implement better learning systems (i.e., improvements in system design and feedback). For example, educational data mining and learning analytics were commonly used for three main reasons to: (a) identify student behaviours that hurt learning (e.g., Craig et al. (2004), Baker et al. (2008), Baker et al. (2010), Hawkins et al. (2013); (b) help teachers gain insights about student behaviour, performance, and assess possible interventions (e.g., Arnold and Pistilli (2012), Dietz-Uhler and Hurn (2013), Heffernan & Heffernan (2014), Haya, Daems, Malzahn, Castellanos and Hoppe (2015); and (c) to improve system design and feedback (e.g., Cho, Gay, Davidson and Ingraffea (2007), Kim, Weitz, Heffernan and Krach (2009), Robison, McQuiggan and Lester (2009), Heffernan & Heffernan (2014).

Ensuring the production of high quality patterns is challenging for four reasons: first, it is expensive (e.g., face-to-face meetings in international conferences); second, it lacks incentive for evaluating, critiquing, improving, and evolving existing pattern languages; third, author attribution is an issue; and fourth, stakeholders, especially designers and end-users who are the primary beneficiaries of patterns, are often not part of the process (Dearden & Finlay, 2006). There have been calls for a widespread collaboration between stakeholders in the production of design patterns (Bayle et al., 1998; Dearden & Finlay, 2006). Producing online learning system patterns can benefit significantly from collaboration. Much work is needed for a domain that evolves rapidly over time as new content is added, new functionalities are implemented, new technologies are supported, and new stakeholders get involved in its development. The Pattern Language for Living Communication Project is a good example of a broad collaborative effort for proposing, critiquing, and editing patterns online, which currently hosts 3 pattern languages about the public sphere and contains over 240 patterns designed by more than 120 authors from approximately 20 countries (Schuler, 2002; Schuler, 2004; Public Sphere Project, n.d.).

3. ASSISTments

ASSISTments is a learning platform that allows teachers to create exercises with associated questions, hints, solutions, videos, and the like, that can be assigned to their students. It gives teachers immediate feedback about their students’ performance (Heffernan & Heffernan, 2014). ASSISTments puts teachers in charge of the learning process by helping uncover confusing topics that require further in-class discussions, gauging how prepared students are for lessons, and identifying students who need support and the type of support the student needs.

ASSISTments was built using architecture and interface development best practices with the help of expert advice and content (i.e., problems, answers, hints, feedback) from math teachers. Over time, more content was added into ASSISTments from math textbook questions and teacher-contributed variations of existing questions in ASSISTments (Heffernan & Heffernan, 2014). New features were also added into ASSISTments such as adding grading flexibility for teachers and giving parents access to their children’s grades (Heffernan & Heffernan, 2014). Researchers were granted access to student data and allowed to run randomized controlled trials that varied content, system feedback and others (e.g., Broderick, O’Connor, Mulcahy, Heffernan and Heffernan (2012), Li, Xiong and Beck (2013), Whorton (2013).
ASSISTments has been collecting data since 2003 from close to 50,000 students each year in 48 states of the United States (Heffernan & Heffernan, 2014; Mendicino et al., 2009b; ASSISTments, n.d.). Student learning experience is represented in the data using multiple features such as the number of hint requests, the number of attempts to solve a problem, answer correctness, action timestamps and affect predictions (i.e., concentration, frustration, confusion, boredom) (Heffernan & Heffernan, 2014; Ocumpaugh et al., 2014). Student affect was predicted by a machine-learning model built using previously collected expert-labelled data of students using ASSISTments. Some features used for prediction include the number of incorrect answers, time duration for answering a problem, and hint requests (Baker et al., 2012; Ocumpaugh, Baker, Gowda, Heffernan & Heffernan, 2014).

4. Data-driven design pattern production (3D2P)

ASSISTments was used to test the methodology because it has a large data set available (i.e., 6,123,424 instances using data between September, 2012 to September, 2013), it is actively being used, its design is often upgraded, and it allows randomized controlled trials to be run easily. Discussions related to the methodology in this paper were based on our experience in applying the methodology on ASSISTments data. More details can be found in Inventado and Scupelli (in press), and Inventado and Scupelli (2015).

The data-driven design pattern production (3D2P) methodology uses an incremental process of prospecting, mining, writing and evaluating patterns. The goal of pattern prospecting is to identify interesting learning outcomes to investigate and to limit the size of the data to investigate (i.e., step 1 & 2). The goal of pattern mining is finding interesting relationships within the set selected by pattern prospecting (i.e., step 3 & 4). The goal of pattern writing is the specification of design patterns that describe problem-solution patterns identified by pattern mining and consulting with stakeholders to ensure their quality (i.e., step 5 & 6). Finally, the goal of pattern evaluation is to assess the quality of design patterns by conducting actual tests for effectiveness (i.e., step 7 & 8). Figure 2 illustrates the transitions and components of the methodology.

In the first step, data from the online learning system is retrieved and cleaned by removing erroneous data instances and recovering lost information from instances with missing features. The data could be further processed by: transforming its representation (e.g., changing the granularity of the data), adding and deleting new features, or merging it with other data.
sources, which makes it is easier to manipulate or to satisfy the requirements of algorithms that will use the data.

Data analysis is challenging because people have difficulty going through every instance of the data and analysis tools could fail especially if a large data set is used. The goal of step 2 is to investigate only a subset of the data by filtering it using different measures (e.g., answer correctness, answer speed, frustration) according to existing literature or background knowledge to reveal evidence of interesting relationships in the data. It is also a good idea to try different measures and conduct initial explorations on data subsets because they may reveal unexpected relationships in the data.

In step 3, different techniques can be used to find relationships between the features of the filtered data set (e.g., analysing problem text, finding minimum and maximum feature values, measuring correlation between features). It is important to find relationships that occur frequently in the data because design patterns usually refer to quality solutions that address recurring problems in the domain. Analysing the data in step 4 can provide a deeper understanding of the uncovered relationships and can provide insights for formulating hypotheses about student behaviour, learning outcomes, and design decisions. It can also uncover new relationships that can be further investigated, and reveal existing design patterns or related design patterns that are relevant to the system design.

The resulting hypotheses can be used to guide the definition of design patterns in step 5. When a design co-occurs with a desirable learning outcome, it could describe a design pattern solution. Further data analysis could help the pattern author identify the solutions’ corresponding problem, context, forces, consequences, and other properties. On the other hand, designs that co-occur with undesirable learning outcomes indicate the problem that could be addressed by the design pattern. Possible solutions can be identified using the author’s own knowledge, existing literature or suggestions from other stakeholders. Data analysis and the hypothesis can also be used to identify the solution’s corresponding context, forces and consequences, and other properties. Design patterns will need to be evaluated in the succeeding steps of the methodology to ensure their quality.

In step 6, other stakeholders can help evaluate and refine design patterns through shepherding or writing workshops. The data and resulting hypotheses from the previous steps will provide stakeholders with more context, which they can use with their expertise to gauge the quality of design patterns. The pattern author and the stakeholders can work together in continuously refining the pattern until the pattern’s quality is acceptable. It may also be a good idea to collect a significant amount of design patterns before consulting with stakeholders to make better use of time especially when discussions are scheduled in international venues such as workshops or conferences.

Design patterns verified by other stakeholders will probably lead to better outcomes, so in step 7 these patterns are used to change the system’s design. It may be easier to implement related system changes so it helps to collect a few related design patterns before performing the change.

Randomized controlled trials or other similar tests can be conducted in step 8 to compare student performance and learning behaviour with and without the design pattern applied to the system. Design patterns that lead to desirable learning outcomes can be accepted and those that do not can be further refined.

In our experience, some RCTs could not be easily implemented because of system limitations. One such example was the worked examples pattern (Inventado & Scupelli, 2015) (see Appendix A), which could not be tested because it needed significant changes in the interface and underlying architecture of ASSISTments to run. However, the pattern could be applied in other similar systems, which would allow the RCT to be conducted. In the next section, we explore the possibility of incorporating collaboration in the pattern production process to overcome limitations encountered by an individual or a small group of researchers bound by the limitations of the online learning system they are using.

5. Encouraging collaboration in the production of OLS design patterns

Design patterns are often developed by an individual or a small group of individuals, which could be evaluated and refined through writing workshops or focus groups. However, Dearden and Finlay (2006) point out drawbacks in the way design patterns are developed. First, writing workshops usually involve face-to-face meetings, which are expensive especially when they are hosted in international events. Second, incentives are low for evaluating, critiquing, improving and evolving pattern languages. Third, there are issues regarding the ownership of
patterns whenever other authors improve or distribute patterns. Fourth, workshops often involve design pattern authors, but not the stakeholders who will benefit from the patterns (e.g., end users, designers). Bayle et al. (1998) emphasized the need for a genuine community effort, which could address the drawback in current approaches.

Pattern authors usually start defining patterns by pattern mining. There are four methods often used for pattern mining:

- **Introspective approach**: Pattern authors implicitly perform pattern prospecting when they identify interesting experiences that they feel can lead to the definition of patterns. The author then mines for recurring problems and effective solutions from his/her selected experiences, and writes the pattern. Authors are likely to unconsciously switch between pattern prospecting and pattern mining when they could not identify patterns from their initially identified experience. They also evaluate the quality of their patterns and refine them when necessary.

- **Social approach**: The social approach is quite similar to the introspective approach, but takes more time because instead of authors mining their own experiences, they observe the environment or interview experts. Pattern prospecting is also more explicit because authors need to identify the type of pattern they want to mine so they know which environment to observe or who they will interview. They still switch between pattern prospecting and pattern mining when they could not identify patterns from their initially identified experience. They also evaluate the quality of their patterns and refine them when necessary.

- **Artifactual approach**: The artifactual approach also requires authors to explicitly perform pattern prospecting to identify the type of patterns they want to mine, so they know which artifacts or projects they will mine patterns from. Authors could switch between pattern prospecting and pattern mining when they could not identify patterns from their initially identified experience. They still switch between pattern prospecting and pattern mining when they could not identify patterns from their initially identified experience. They also evaluate the quality of their patterns and refine them when necessary.

- **Pattern-mining workshops (DPM)**: Prospecting in pattern-mining workshops could involve the identification of experts to interview and the experiences to investigate. Pattern authors can switch between prospecting and mining as they communicate with experts, and then write and self-evaluate their patterns.

- **Shepherding and pattern writing workshops**: Shepherding and pattern writing workshops can provide better evaluations of the resulting patterns from the aforementioned approaches. External evaluation and feedback can be used to refine design patterns using varying perspectives from different stakeholders.

The discussion on the data-driven approach (i.e., 3DPD methodology) described how each of the 6 steps could be applied on collected data. The addition of the pattern application step and the applied evaluation step allows patterns to be evaluated in specific contexts that could reveal properties that need to be considered. For example, online learning system design patterns produced before the popularity of mobile devices may need to be revised to address changes in the context and forces when a student uses his/her phone to access the online learning system. Explicit feedback about pattern applications can help designers validate their design decisions and help pattern authors continuously refine their patterns.
Exposing the different steps involved in pattern production reveals how pattern authors and other stakeholders can collaborate in the production of patterns. Stakeholders do not need to perform all six steps to produce patterns because other stakeholders can continue performing the remaining steps. For example, stakeholders with expertise in learning and pedagogy (e.g., teachers, learning analytics experts) can help in the pattern-prospecting step by identifying interesting concepts to investigate. Data repositories, such as the PSLC DataShop (Koedinger et al., 2010), contain data and research results that can also be consulted for pattern prospecting. Learning analytics experts can analyse the data to uncover recurring problems and design solutions that can be used by pattern authors to define patterns. Existing design patterns such as, e-learning patterns (Frizzell & Hübischer, 2011) or MOOCs patterns (MOOC Design Patterns, 2015) can be applied to existing online learning systems by system designers and developers. Learning analytics experts could then run RCTs to compare the effectiveness of the system (i.e., based on learning outcomes or other measures) with and without using design patterns. Pattern authors can use results from applying their patterns, and evaluations of their patterns in specific contexts to refine pattern definitions. Results from applied pattern evaluations can also help identify new patterns to mine.

Currently, a Wiki is being conceptualized and developed as a repository for fostering collaboration between stakeholders in the production of online learning system design patterns (Open Pattern Repository for Online Learning Systems, 2015). A Wiki was used because it provides a simple mechanism for adding and updating content, managing access, managing changes, communication, and many people are familiar with its functionalities. This is probably why many patterns have been published in Wikis (Kohls, 2013).

In its current state, the repository is serving as a hub for stakeholders to: (a) view and modify contributed online learning system design patterns; (b) track the progress of a pattern; (c) discuss the development of a pattern; (d) contribute to the production of the pattern (i.e., sharing online learning system data, data analysis results, pattern evaluations, observations from pattern applications, evaluations of pattern applications in different environments and domains); and (e) post calls for collaboration in producing a pattern.

6. Discussion

The data-driven design pattern production (3D2P) methodology has many advantages, but also has some limitations. First, it requires more work to perform additional steps for prospecting and evaluating data compared to traditional design pattern processes. Second, it takes more time because there is a need to analyse large data sets to uncover design patterns. Third, the data collected from online learning systems are often incomplete so the patterns uncovered by the platform are bound by the data available. Finally, context plays a very important role because the data collected is very specific. There might be a need to generalize some patterns so they can be used in other systems or domains.

Despite the mentioned limitations, the methodology complements and augments traditional design pattern methods. There are five advantages for using the 3D2P methodology: (a) pattern authors can find interesting relationships in the data more easily compared to searching for it by hand; (b) patterns are not only based on background knowledge and literature but also actual data; (c) feedback from multiple stakeholders are used to refine patterns; (d) pattern quality is validated in actual use; and (e) the methodology can be used incrementally so patterns can be continuously mined and refined as the online learning system evolves over time.

Introducing collaboration in design pattern production provides many advantages. First, when multiple researchers collaborate in writing and refining patterns, they work in parallel, which speeds up the process of generating patterns. This is particularly useful when dealing with large systems or large data sets because the work can be divided among researchers. Using an online repository or similar tools can also make collaboration easier between stakeholders, which can minimize the need for constant face-to-face meetings.

Second, researchers are not required to possess all the skills needed to perform the different steps in the process. For example, some researchers may have expertise in data analytics, but possess minimal knowledge of design patterns. These researchers can focus on data analysis and contribute their hypotheses, which pattern authors can use to mine and write patterns.

There are existing platforms that provide access to data that can be used to define design patterns. For instance, the PSLC DataShop (Koedinger et al., 2010) contains a huge amount of
data from various online learning systems and provides tools to access and analyse the data. ASSISTments grants researchers access to its data and the ability to run randomized controlled trials (Heffernan & Heffernan, 2014).

Moreover, when patterns are applied and evaluated in existing systems, other stakeholders become more involved. For example, teachers can be asked to use patterns when creating content and students can use versions of the system with the adapted design patterns. Evaluations based on teacher comments, and resulting student behaviour and performance can be used to refine design patterns further.

Third, any pattern analysis, evaluation or refinement is shared between all researchers investigating that pattern. There is more incentive for researchers to collaborate because they will mutually benefit from each other’s work and their effort will result in research and design patterns that are up-to-date. Collaborating with a team of researchers also promotes feelings of belongingness, which could motivate researchers to contribute their work, and could shift pattern authors’ views from pattern ownership to pattern co-authorship.

Fourth, the frequency of pattern usage in different systems could describe its generalizability, and patterns with good evaluations would indicate its robustness. Pattern authors or other researchers can decide to refine the patterns to make it more robust or decide to create a parent pattern if needed. Patterns tested in one system or domain can be modified to generalize across domains or systems.

Finally, online learning system designers will have access to more patterns, which they can use to create and maintain their systems. As more designers get involved and use design patterns, the standards of online learning system quality can also be elevated.

Developing an open repository to foster the collaboration between stakeholders offers many advantages. First, it can serve as a hub for locating and contributing patterns. Metadata about the patterns could even allow searching for patterns outside the repository (i.e., through links to related patterns in literature or other repositories). Second, it can serve as a common ground for researchers to talk about: (a) patterns to write (i.e., using hypotheses from data analysis), (b) patterns to evaluate (i.e., using unevaluated patterns), and (c) patterns that can be used to design a system or resolve system issues (i.e., using information about pattern applications). Third, it can give a richer description of design patterns, which can help designers select and apply appropriate patterns to their projects (e.g., evidence used to define the pattern, known successful applications of the pattern, issues in applying the pattern). Fourth, the pattern repository could describe the evolution of each pattern as it is refined over time. Proper documentation could also provide proper attribution to authors who contributed to its development.

7. Summary and future work

Producing design patterns for online learning systems is challenging because of its multi-disciplinary nature, design complexity, continuously changing components and content, and the diversity of its users. The 3D2P approach addresses these challenges by using data to perform pattern prospecting, pattern mining, pattern writing, pattern evaluation, pattern application, and pattern application evaluation. It uses an incremental process so that design patterns can be produced and refined as the system and its stakeholders evolve.

Promoting collaboration in pattern production allows researchers to divide the workload and speed up the process of producing design patterns. It does not require researchers to learn specific skills to collaborate, so they can just utilize the expertise they already possess. Researchers benefit from each one’s contribution because they share in the development of the design patterns and their contributions can be properly attributed. Collaboration also encourages patterns to be applied in different domains, which allows designers to assess the generalizability and robustness of patterns across systems and domains. Most importantly, promoting the use of design patterns in online learning systems elevates the standards of online learning system development.

Although the platform is being tested for online learning system design patterns, it can easily be used in other systems and domains. For instance, design patterns can be produced for online services to improve and maintain the quality of user experiences across different platforms and devices.

Currently, an open pattern repository is being developed to facilitate collaboration between stakeholders (Open Pattern Repository for Online Learning Systems, 2015). We are inviting other researchers to help us develop this repository and build a community that will contribute to the pattern production process through pattern prospecting, mining, writing, evaluation, application, and applied evaluation.
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Appendix A: Design Patterns

Worked examples (Inventado & Scupelli, 2015)

Platforms tested: ASSISTments

Problem type: Mathematics word problem or equation solving

Evidence: Data showed that students gamed the system when they did not know how to answer a problem.

Context: Teachers use ASSISTments to select the problems in an assignment, specify the sequence and conditions for presenting questions to students, and assign the homework or activity to their students.

Forces:

1. Teachers and content experts add problems into ASSISTments with corresponding answers and feedback (i.e., hints, scaffolds, bug messages).
2. Students can have sufficient background knowledge to solve a problem, but have no idea how to apply it (e.g., a student understands the concept of division but may not know how to split the bill at a restaurant).
3. Problem definitions (e.g., difficulty, presentation, wording, sequence) affect students’ learning experiences.

Problem: To instruct students how to solve a problem that they do not know how to solve.

Solution: Present a worked example similar to the problem that the student is solving.

Consequences:

Benefits:

• Students will learn how to solve problems of the same type as the worked example.
• Students will less likely game the system or disengage from the homework because they know what to do.

Liability:

• Teachers or content experts will need to provide a worked example for the problem aside from other feedback.
• ASSISTments will need to be modified to provide an interface for showing worked examples (i.e., as opposed to requesting for multiple hints)

Example:

When a teacher creates a math problem in ASSISTments, he/she will be asked to provide the math problem, the correct answer, the hints, and also a worked example. In the interface, students who do not have an idea how to solve a problem can click a “worked example button”, which will then show the worked example provided by the teacher. The student can study the worked example to help him/her solve the next questions more easily.

Related Patterns: Worked examples organize the solution into a series of steps much like Wizard (Tidwell, 2011).

References: D’Mello & Graesser (2012), Sweller and Cooper (1985)
References


Borchers, J. (2002). Teaching HCI design patterns: Experience from two university courses. Position paper for “Patterns in Practice” workshop at CHI.


Coursera - Free Online Courses From Top Universities. (n.d.). Retrieved February 1, 2015 from https://www.coursera.org/


Gamma, E., Helm, R., Johnson, R., and Vlissides, J. (1995). Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley, Reading, MA.


Hawkins, W., Heffernan, N., & Baker, R. S. (2013, September). Which is more responsible for boredom in intelligent tutoring systems: students (trait) or problems (state)? In Affective Computing and Intelligent Interaction (ACII), 2013 Humaine Association Conference on (pp. 618-623). IEEE.


MOOCs as granular systems: design patterns to foster participant activity

MOOCs often suffer from high drop-out and low completion rates. At the beginning of the course, the audience is indeed “massive”; thousands of people wait for the course to begin, but in the end only a low number of participants stay active and complete the course. This paper answers the research question “Is there a specific point during an xMOOC where learners decide to drop out of the course or to become lurkers?” by identifying MOOCs as a challenging learning setting with a “drop-out problem” and a decrease in participant activity after the fourth to fifth course week. These are the first results of a Learning Analytics view on participant activity within three Austrian MOOCs. This “drop-out point” led the paper to introduce a design pattern or strategy to overcome the “drop-out point”: “Think granular!” can be seen as an instructional design claim for MOOCs in order to keep participant activity and motivation high, and that results in three design patterns: four-week MOOCs, granular certificates and suspense peak narratives.
1. MOOCs: a challenging learning setting with a drop-out problem?

The MOOC phenomenon was born in Canada in 2008 and has since then become a worldwide movement (Hay-Jew 2015, 614; Hollands & Tirthali 2014, 25f.; Jasnani 2013). MOOCs can be seen as an expression for a modern orientation towards learning as learning can no longer be seen as a formal act that depends only on universities, schools and other institutions within a formal education system. Learning has to be seen as a lifelong process that has become flexible and seamless, as Wong (2012) and Hay-Jew (2015) resume. It encompasses formal and informal learning and physical and digital (learning) worlds (Wong & Looi 2011; Wong 2012). MOOCs – in our short research study, mainly xMOOCs – are open (Rodriguez 2013) and conducted online, with only an internet connection and registration on an xMOOC platform. The American providers Coursera (www.coursera.org), edX (www.edx.org), the German platforms iversity (www.iversity.org) and MOOIN (www.mooin.oncampus.de) or the Austrian iMooX (www.imoox.at), for example, are necessary for attending courses from different fields. Therefore, the audience is very heterogeneous and cannot be predicted in advance, as it can be for traditional learning settings. It can nevertheless be stated that “the majority of MOOC participants are already well-educated with at least a B.A. degree” (Hollands & Tirthali 2014, 42). They have a certain experience within the learning or the educational context (Gaebel 2014, 25). There are almost no limitations regarding location, age, sex and education, to name a few variables. Thus, MOOC design has to respect this unpredictable heterogeneity, which results in a balancing act between multiplicity and unity regarding, for example, resources and prior knowledge or further information. As a consequence, MOOCs need to have a special instructional design (Jasnani 2013; Kopp & Lackner 2014) that focuses on different framework conditions.

Jasnani (2013, 7) thus mentions a “lack of professional instructional design for MOOCs” which can be cited as one of the reasons for the low completion rates MOOCs suffer from. If we assume “an average 50,000 enrollments in MOOCs, with the typical completion rate of below 10%, approximately 7.5%, that amounts to 3,700 completions per 50,000 enrollments” (Ibid., 6) or even less: “Completion rates for courses offered by our interviewees ranged from around 3% to 15% of all enrollees.” (Hollands & Tirthali 2014, 42) Several investigations (Khalil & Ebner 2014) have already been conducted to identify reasons for these high drop-out rates that lead to low completion rates such as Khalil and Ebner (2013a,b), who worked out the importance of interaction for guaranteeing participant satisfaction with MOOCs and increasing the probability of course completion. Colman (2013) conducted a web-survey and asked for reasons why participants would drop out of a MOOC; amongst others, the following six were given:

<table>
<thead>
<tr>
<th>Reason</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takes too much time</td>
<td>personal/external</td>
</tr>
<tr>
<td>You’re just shopping around</td>
<td></td>
</tr>
<tr>
<td>You’re there to learn, not for the credential at the end</td>
<td></td>
</tr>
<tr>
<td>Assumes too much knowledge</td>
<td>imposed/external</td>
</tr>
<tr>
<td>Lecture fatigue</td>
<td></td>
</tr>
<tr>
<td>Poor course design</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Reasons for dropping out of a MOOC

The reasons for dropping out of a MOOC can thus be classified within two categories: personal or internal, and imposed or external. With regard to the second category, it can be observed that some MOOCs “are headlined by prominent professors in their respective fields” (Hay-Jew 2015, 614). It is then the university’s or the professor’s prestige that leads to high registration rates; but it is neither the institution’s nor the professor’s name that helps to engage and activate the participants over a longer time period. As Hattie (2009, 108) states, “not all teachers are experts, and not all teachers have powerful effects on students”; it is ultimately the course design and the course content that influence participants’ motivation to stay active within a course (Hay-Jew 2015). As mentioned above, an inappropriate course design or the lack of a clear course structure can be identified as main reasons for dropping out.

Regarding the first category, it has to be stated that when it comes to adult learning, “it is necessary to distinguish between learning for personal and for professional purposes” (CEDEFOP 2009, 44). Whereas professional purposes are often extrinsically motivated and “normally closely linked to enterprises and the labour market and can be more readily identified as further education or continuing vocational training” (Ibid.), it is more difficult to identify and validate the personal purposes as they are personal motivations. Sometimes MOOC participants just “shop around” and pick up different elements of a course but do not want to finish the course itself; sometimes it is not the...
whole course that seems to be interesting but only parts of it that are new, innovative or simply appealing. It has already been stated that for informal learning settings willingness to learn and competences such as discipline, to cope with autonomous, self-directed, self-organised and self-paced learning processes and good time management, play an important role in achieving one’s own learning goal. Thus, this learning goal can differ from the objectives or learning outcomes set up by the institution or the professors (Kyndt et al. 2009).

This paper aims to answer the research question “Is there a specific point during an xMOOC where learners decide to drop out of the course or to become lurkers?” and introduces strategies to overcome the “drop-out point” in order to keep course interaction high.

### 2. xMOOCs: their traditional instructional setting

There have been several researchers so far that have analysed different instructional settings for MOOCs. They have deduced MOOC design patterns or have formulated and presented tips and tricks to design MOOCs (Guàrdia et al. 2013; Jasnani 2013; Kopp & Lackner 2014; Richter 2013; Scagnoli 2012; Siemens 2012). In an xMOOC, some almost traditional components can be found: video lectures and readings, at least one discussion forum, and an assessment element, mostly a multiple-choice quiz or a peer-review assessment (Jasnani 2013: 11; Lackner et al. 2014; Wedekind 2013). These components can be used in different ways. The course forum posts can be compulsory for obtaining a certificate; the forum can be a platform to exchange ideas within the learning community, to talk about problems that arise within a course or to handle administrative and organisational issues. The quiz can be part of the video lectures, with integrated questions that stop the video and have to be answered for the lecture to continue, or it can be a stand-alone assessment with a flexible number of questions. Most MOOCs are set up as a four to eight-week course, with some MOOCs lasting twelve weeks (Jasnani 2013, 15; Richter 2013). Thus, Jasnani (2013: 15) highlights that “smaller, modular units of learning” should be the core of a MOOC, addressing different groups of people, i.e. taking the heterogenic audience into account. As Scagnoli (2012, 2) emphasises: “The only thing that all participants have in common is their interest for the topic of the course. This interest, however, is diverse as well and although all may be interested in the topic not all the participants enrolled have the same commitment or motivation for learning about that topic, and their interest has perspective.” The course design should – not only in terms of the course structure but particularly in terms of content – cope with this heterogeneity: “The interest may go from learning more about a topic, to confirming concepts, to being curious, to finding a community to host discussion and concerns.” (Ibid.) This diversity has led to a phenomenon called “MOOC Derivatives” (Hollands & Tirthali 2014, 48), that is to say the birth of different types of MOOCs such as the POOC (Personal Open Online Course), the Mini-MOOC, or the SPOC (Small Private Online Course). All these courses tend to cover different orientations or intentions towards the MOOC phenomenon. The question that remains is how to design an xMOOC that does not have the above-mentioned completion problem.

### 3. Learning Analytics: a way to understand the logic of xMOOCs

Due to the huge amount of data that arises when thousands of learners attend an xMOOC, new techniques and automated processes are necessary. Nowadays, in business, automated data processing is simply called Big Data; in education, the term Learning Analytics (LA) has been used for several years now. Learning Analytics can be summarised as an interaction analysis of educational data to understand and finally to improve learning behaviour (Greller et al. 2014; Retalis et al. 2006). In terms of MOOCs, LA is done behind the scenes by gathering data from different sources, from simple log files to tracking how often videos are watched or written posts are read. In our research study, we implemented a comprehensive automatic tracking system for user activities within each single course. The data was then thoroughly processed and interpreted.

#### 3.1 First results

Within the Austrian MOOC platform iMooX, we scrutinised three different MOOCs focusing on student activity and completion rates: Gratis Online Lernen (‘Free Online Learning’), Lernen im Netz (‘Learning Online’) and Soziale Medien & Schule (‘Social Media & School’). All three courses were held in German, were delivered on iMooX and were each eight weeks’ long. The workload was defined before the beginning of the course: Gratis Online Lernen (2 hrs/week), Lernen im Netz (5 hrs/week) and Soziale Medien & Schule (3 hrs/week). All three courses were
structured in a similar way and consisted of video lectures, readings, a discussion forum and a final multiple-choice quiz. Participants who passed every quiz with at least 75% could obtain a certificate at the end of the course. However, Lernen im Netz was a special course as it was not only a MOOC but also a university lecture at the University of Graz. Students of the University of Graz could attend the MOOC as a free course worth 4 ECTS but had to pass a supplementary electronic exam at the end of the semester.

Regarding the course participants, differentiation has to be made between those who have registered, those who are active students, those who have just completed the course, and those who are certified, as figure 1 shows:

![Figure 1: Different types of participants](image)

As figure 1 illustrates, an obvious gap between registered and active students can be observed in all three courses. Active students are those who wrote at least one forum post or did at least one quiz. In Gratis Online Lernen, 1,012 students registered, but only half of them, 479 students, were active (47.33%). Lernen im Netz shows a higher percentage concerning the correlation between registered and active students (64.16%); Soziale Medien & Schule, a lower percentage (37.9%). As in “traditional” lectures at brick-and-mortar universities, the number of interested people who “pass by” and do not start a course is high. Whether they register without planning to do the course, want to get to know the teacher or the course or are interested in just one unit or aspect of the course, they can be compared to tourists that “shop around”, as Colman (2013) showed in his web-survey. Calculating the completion rates on the basis of these registration rates, Gratis Online Lernen had a completion rate of 21.44% and a certification rate of 17.49%, 25.24% completed Lernen im Netz and 19% certified, whereas Soziale Medien & Schule had a completion rate of 14.2%, and 11.95% certified. If we calculate the completion rates on the basis of active participants, the numbers increase:

<table>
<thead>
<tr>
<th>Course</th>
<th>Active &amp; completed</th>
<th>Active &amp; certified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gratis Online Lernen</td>
<td>45.30%</td>
<td>36.95%</td>
</tr>
<tr>
<td>Lernen im Netz</td>
<td>39.33%</td>
<td>29.72%</td>
</tr>
<tr>
<td>Soziale Medien &amp; Schule</td>
<td>37.58%</td>
<td>31.54%</td>
</tr>
</tbody>
</table>

Table 2. Active participants who completed or certified

Table 2 illustrates that the completion rates are on a level that is comparable to our experienced traditional university lectures. It shows nevertheless that more than half or two thirds of the active participants at a certain point of the MOOC lose interest, start lurking or become passive consumers. To identify this point, the participants’ activity should be taken into account. For the three Austrian MOOCs, the quiz trials, the reading of forum posts and the writing of forum posts can be investigated.

Figure 2 shows the number of quiz trials within the three courses as quiz completion is crucial for obtaining a certificate:

![Figure 2: Quiz trials per week](image)

The participants’ quiz activity shows a tendency for the “drop-out point” to be between weeks 4 and 5. Week 8 in Lernen im Netz has to be seen as an outlier. The topic of the final week of this course was MOOCs, and it can therefore be presumed that the participants were highly interested in this topic or that the
quiz was very difficult, so more trials were needed. This split in the middle of the course can also be found within the forum reads and the forum posts, as figures 3 and 4 show, using Gratis Online Lernen as an example:

Figure 3: Forum reading: Gratis Online Lernen
The participants read the forum postings, but the frequency diminishes after the third week. Whereas in the first week there are 6,706 reads, in week 4 there are only 1,760. Lernen im Netz has 1,714 reads in week 1 and 465 in week 4 as the course offered a “pre-week” for the participants (Salmon 2007) to become familiar with the platform and to get to know one another; the readings in this pre-week are extremely high (2,970 reads). Soziale Medien & Schule has 186 reads in the first week and 153 in the fourth week; weeks 2 and 8 can be seen as outliers as the forum reads are significantly higher than in the other weeks (e.g. 299 in the final week).

Figure 4: Forum posts: Gratis Online Lernen
If we consider active forum participation in terms of writing forum posts, the “drop-out point” in Gratis Online Lernen can be identified after the fourth week, with 95 posts, whereas week 1 had 251 posts. In the final week, 50 posts were added to the forum. In Lernen im Netz, the gap is even clearer: in the first week, the participants posted 169 entries, in the fourth week 20 and in the final week 9. Soziale Medien & Schule cannot be scrutinised in this context as the number of posts is too low: one post in the first week, five in week 2, two in week 4 and no more posts after the fifth week.

The role of forum activities for MOOCs have already been subject to research, providing a deeper understanding of the communication and collaboration processes within the courses and their participant community (Gillani et al. 2014; Khalil & Ebner 2013a). The quality of the forum activity as well as the quiz trials has to be further analysed for the above-mentioned courses. These first results, on a quantitative basis, help to identify a tendency within xMOOCs regarding the probable “drop-out point”. All shown figures recall the so-called long-tail effect often discussed in terms of Web 2.0 (Bahls & Tochtermann 2012). Many learners begin a MOOC, but only few of them complete. On the basis of the data presented, the “drop-out point” for these three courses can be identified between the fourth and fifth week. At this point, participant activity decreases and stays more or less constant. This implies that participants who are still active in week 5 are more likely to complete the course.

4. Design Claim: Think granular!

As we saw in Table 1, there are two main categories of reasons why participants do not finish, or drop out of, a MOOC: internal and external forces influence their decision. The crucial point of decision whether to become passive or leave the course can be seen in course week 4. Indeed, course developers should react to this phenomenon and adjust the instructional design of their MOOCs: As a “pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice” (Alexander et al. 1977, X), an instructional design pattern is hence “[c]ombining a clear articulation of a design problem and a design solution, and offering a rationale which bridges between pedagogical philosophy, research based
In the case of MOOCs and their completion rate, a design solution should be found in terms of a mental shift. The completion rate is not significant when it comes to measuring reached learning objectives. As the first results of the iMooX–MOOC analysis, in compliance with the results of Colman's (2013) web-survey show, the data basis has to be clear, and a difference between registration and activity has to be drawn. Virtual participants as well as traditional students often register for a course out of curiosity; they “shop around”; they want to see the professor for the first time. Yet, in the first lecture, they realise that the topic is not as interesting or appealing as they thought it would be or that they have registered for too many courses, so they have to drop out of some to manage their work–life balance. It might also be the case that only parts of a course, one or two topics/units, are interesting but the course as a whole isn’t.

The same holds true for online courses, hence for MOOCs. When dealing with adult learners, who form the main MOOC audience, it is necessary to think in different patterns. Adult learners often do courses in their free time, struggle with self-organisation or time management or a lack of similar competences. They attend courses out of an intrinsic motivation, and the certificates do not influence their activity. As Scagnoli (2012, 2) points out, their interest or motivation differs “and although all may be interested in the topic not all the participants enrolled have the same commitment or motivation for learning about that topic, and their interest has perspective. The interest may go from learning more about a topic, to confirming concepts, to being curious, to finding a community to host discussion and concerns.”

MOOCs can address this heterogeneity with a modular course design which can be understood under the main claim “Think granular” and results in three patterns that are displayed according to the structure used by Goodyear (2005). The main point of these three design patterns is their granularity. At the microscopic level, granularity has already been postulated regarding video content (Guo et al. 2014; Jasnani 2013, 14); at the macroscopic level, it should also be considered for the course itself.

4.1 Design Pattern: four-week MOOCs

Four-week MOOCs

This pattern deals with the overall structure of a MOOC on a macro level and describes the administrative structure of a MOOC.

A granular structure addresses why the main drop-out point can be seen in the fourth course week. The choice of the course length is crucial in determining how likely participants are to finish a course.

As mentioned above, MOOCs tend to last four to eight or even twelve weeks. If participant activity decreases dramatically up until week four, course developers should consider planning and designing topic-related MOOC series (in analogy to podcast series) instead of longer courses, following a “concept of ‘modularity’” (Hollands & Tirthali 2014, 92). An eight-week course could be split into two courses of four weeks, a step that could help developers as well as participants as “shorter courses are both easier to create and to complete” (Ibid.). As Jasnani (2013, 14) resumes, “granular courses are more digestible”; the learning process becomes a micro-learning process that seems to be less challenging in terms of the required competences (e.g. self-regulated learning, time management or self-organisation). The granular structure of a MOOC could address the identified motivation loss in longer courses.

- Three- to four-week-courses allow participants to see the “light at the end of the tunnel”.
- Longer courses can be broken down into several courses focusing on different aspects of a topic, just as the BBC does for the general topic of World War 1 on the FutureLearn platform (https://www.futurelearn.com/organisations/bbc).
- It is easier to time shorter MOOCs around holiday periods.

Therefore:

Design MOOCs that last three to four weeks and that focus on a specific topic. Add a link word to these MOOCs to create a series of MOOCs that connect to one other in the way a podcast series, for example, does. Devise a marketing strategy for the courses that makes the link between the different short MOOCs of a series visible. Allow the MOOC to start in a way that respects longer holidays such as Christmas or Easter.
Patterns tied to this pattern include: Know your audiences\(^1\), Bring them along\(^2\), Induction\(^3\), Six-minute video\(^4\).

4.2 Design Pattern: Granular certificates

Granular certificates

This pattern deals with the visibility of learning achievements.

A granular certification process makes specific learning achievements visible. It answers participants’ need to be able to select different topics and units that are important for their personal non-formal learning process.

In response to the different orientations and motivations towards any learning systems, a different certification process or attitude should be developed, e.g. by awarding badges (Schön et al., 2013). These badges can be seen as a way of making informal learning processes visible as they can be displayed in professional social networks, e.g. LinkedIn (www.linkedin.com). Within a longer MOOC, different badges – according to topics, projects or special achievements – can be acquired; the collecting process and the prospect of the next badge could increase or renew motivation. Participants decide whether they want to display these badges and if so, which badge should be visible according to their (digital) identity or needs. A further advantage of a badging system would be that participants are not forced to follow the mostly linear structure of MOOCs (Jasnani 2013, 15); instead, they determine the work order according to their prior knowledge and interests, i.e. to an individual framework. An example of a badging system can be seen in the German HanseMOOC (https://mooin.oncampus.de/mod/page/view.php?id=24), provided by MOOIN (https://mooin.oncampus.de).

Therefore:

Design MOOC certifications for different types of learners, e.g. active and passive learners, so that they can make their specific learning achievements visible. Keep in mind that the MOOC audience is very heterogeneous, which results in different learning goals. Provide granular certificates, e.g. badges or statements of accomplishment of different MOOC units, that can but not necessarily lead to the statement of accomplishment or certificate for the entire course. Help participants to make their learning visible.

Patterns tied to this pattern include: Bend don’t break\(^5\), Know your audiences\(^6\), Six-minute video\(^7\), Checkpoints\(^8\), Showcase of Learning (Bauer & Baumgartner, 2012).

4.3 Design Pattern: Suspense peak narratives

Suspense peak narratives

This pattern deals with the narrative structure of longer MOOCs.

A granular narrative structure with several tension or suspense peaks can be essential in longer lasting MOOCs in order to keep motivation and activity high. If they don’t know what is going to happen next, participants will be more curious and stay attentive.

Since the Middle Ages and its oral literary tradition, it has been known that the narrative structure of a text or a play is important for engaging the audience. If the writer or singer is able to create suspense and curiosity, the audience is more likely to come back to listen to the next episode (Bakker 1993). In modern soap operas or novels, this literary phenomenon is called cliffhanger: “Cliffhanger plot device ensures readers will buy the next installment in order to read and find out what happens.” (Literary Device 2015: s.v.) Following a storytelling approach, the structure of a MOOC could be organised in granular portions using cliffhangers and moments of suspense to engage and motivate participants to stay active. These cliffhangers can be topic-related or interaction-related, for example in the form of supplementary or informal learning activities (Fidalgo-Blanco et al. 2014). An example of this pattern can be seen in Introduction to Forensic Science (https://www.futurelearn.com/courses/introduction-to-forensic-science), provided by FutureLearn (www.futurelearn.com), or the German HanseMOOC (https://mooin.oncampus.de/mod/page/view.php?id=24) or Mein Digitales Ich (“My Digital Me”) (https://mooin.oncampus.de/mod/page/view.php?id=221), both provided by MOOIN.

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Therefore:

Design your MOOC using a consistent story. Plan different suspense peaks so participants become curious about what is going to happen next. Add questions or assignments at the end of the unit that will be answered in the next session. Add quizzes and deliver the answers in the following week's unit. Use a storyteller who tells a story and ties a narrative knot. Create different strands to treat parallel topics. Dissolve the narrative knots in different units. Don’t use too many lines of action: participants could have difficulty in following.

***

Patterns tied to this pattern include: Knowing the story⁹, Storytelling, Drumbeat¹⁰.

5. Conclusion

MOOC critics often use the low completion and high drop-out rates as a killer argument when disputing xMOOCs. As research has proven, at the beginning of a course the number and motivation of participants is higher than at the end. In using Learning Analytics to get a deeper understanding for the logic of xMOOCs, this paper has shown that the fourth and fifth week of an eight-week course are crucial in terms of participant motivation and orientation towards course completion. This so-called “drop-out point” adjudicates on whether participants continue, and most likely complete, or whether they drop out of the course. MOOCs, above all informal learning settings that are mostly for adult learners, have to take into account that participants’ motivation to attend and complete a MOOC depends on personal and external reasons. To address these reasons and to foster activity throughout the course, the course design should be adapted: “Think granular!” is introduced as an instructional design claim for MOOCs, offering different approaches to engage participants to complete courses, or parts of them, and make their learning achievements visible. Three design patterns – four-week MOOCs, granular certificates and suspense peak narratives – can be deduced from the design claim, and have been presented in this paper. In this way, the granularity that has already been postulated regarding video content, e.g. in the design pattern Six-minute video, at the microscopic level (Guo et al. 2014; Jasnani 2013, 14) should be transferred to the macroscopic level – the course itself.

⁹ http://ilde.upf.edu/moocs/v/b7c.
¹⁰ http://ilde.upf.edu/moocs/v/byh.
References


Designing MOOCs for professional learners: Tools and patterns to encourage self-regulated learning

Employers are becoming aware of the potential of Massive Open Online Courses (MOOCs) as a significant form of learning for work. MOOCs have the potential to transform professional learning, but require learners to be self-regulated. Most MOOCs are not designed in ways that encourage self-regulated learning. Therefore there is a need for design tools that can guide instructional designers and teachers in designing MOOCs that promote self-regulation. This paper presents two toolsets to guide MOOC design. MOOC-SRL (Self-regulated learning) patterns allow the sharing and reuse of MOOC designs that encourage self-regulation. These design patterns demonstrate ways in which courses can take advantage of the knowledge and expertise that professional learners bring to their formal learning experience, and highlight the importance of course design that engages professional learners and meets their individual needs. The MOOC-DTQ (Design Team Questionnaire) is an audit tool that guides instructional designers in pedagogic design decisions made at platform (macro) level as well as at course (micro) level. The tool enables instructional designers to question their design decisions and provides possible interventions that may improve their design. These tools were developed as part of a larger study funded by the Bill and Melinda Gates Foundation MOOC Research Initiative.

Editorial note:
The design tools presented in this paper are outputs from a larger study on Professional Learning in Massive Open Online Courses http://www.gcal.ac.uk/academy/pl-mooc/.

The paper includes links to several open research instruments:

- An online survey instrument designed to measure self-regulated learning: http://dx.doi.org/10.6084/m9.figshare.866774
- A script for follow-up interviews: http://dx.doi.org/10.6084/m9.figshare.866773
- Design recommendations: http://dx.doi.org/10.6084/m9.figshare.1420557
- MOOC Design Team Questionnaire: http://dx.doi.org/10.6084/m9.figshare.907150

1. Introduction

Employers are becoming aware of the potential of Massive Open Online Courses (MOOCs) as an emerging form of professional learning, or learning for work (Radford, Robles, Cataylo, Horn, Thornton, & Whitfield, 2014). Massive Open Online Courses (MOOCs) have the potential to provide unlimited learning opportunities through online, open access. As such, they offer learning that complements other forms of professional development, such as training or on-the-job learning (Milligan & Littlejohn, 2014).
In an era when knowledge and job roles are changing continually, companies are constantly seeking new ways to enable their workforce to upskill quickly, (Littlejohn & Margaryan, 2014). Yet conventional forms of professional learning, such as classroom-based training, are becoming less effective as a means of learning in knowledge-intensive domains (Fiedler, 2014). Conventional training was developed as a means of training large numbers of people for specific jobs. However, as work roles evolve, learning for work becomes continual and personalized and people have to be able to determine their own learning pathway through self-regulation (Littlejohn & Margaryan, 2014). Yet, established forms of professional learning generally have not taken advantage of the affordances of social, semantic technologies to support personalised and self-regulated learning.

MOOCs have the potential to transform professional learning by utilizing social, networked technologies to support personalised and self-regulated learning (Milligan & Littlejohn, 2014). However, successful innovation requires good design choices. A study of the design of 76 Massive Open Online Courses concluded that the instructional quality of almost all of the MOOCs examined was low (Margaryan, Bianco & Littlejohn, 2014). Most of the 76 MOOCs scored highly on the organisation and presentation of the course material, but few designs supported interaction and feedback, a key principle of effective instructional design (ibid). Many teachers are experts in a specific discipline or skills area, rather than in pedagogy (Goodyear, 2005). This mismatch in expertise makes it difficult for teachers to design effective MOOCs. This design problem is intensified in professional contexts, where MOOC designs should encourage professionals to actively self-regulate their learning, so that they may tailor their learning to specific work problems (Milligan & Littlejohn, 2014).

MOOC design could be improved using design support tools, such as the pedagogical patterns pioneered by Eckstein, Bergin & Sharp (2002) and Goodyear (2005). These patterns guide teachers and instructional designers in course design, which is particularly important while developing (relatively) new course formats, such as MOOCs. Initiatives such as the MOOC Design Patterns Project (http://www.moocdesign.cde.london.ac.uk/) have sought to articulate emerging MOOC design principles through a pattern approach. This paper outlines the development of patterns to support the design of MOOCs for professional learners.

This work was funded by the Bill and Melinda Gates Foundation MOOC Research Initiative (‘Professional Learning in MOOCs’ http://www.gcu.ac.uk/academy/pl-mooc/). The research addresses the research question How can Massive Open Online Courses be designed to support self-regulated learning? Toolsets to support MOOC design are outlined. The first is a set of design patterns to guide teachers in designing MOOCs environments that encourage self-regulated learning and meet the needs of professional learners. The second toolset, the Design Team Questionnaire (MOOC-DTQ), can be used post-design to audit MOOC designs against principles of self-regulated learning to identify effectiveness and potential scope for improvement.

The article outlines the development of these toolsets. The paper begins by problematizing MOOC design. The tool development methods are then presented. Finally the tools are described and discussed.

2. Problems with MOOC design

MOOC learning is suited to the networked society, founded upon the near ubiquity of digital, networked connections (Castells, 1996). Rather than viewing learning as the transmission of expert knowledge from an instructor to learners, MOOCs were originally conceptualised around connectivist principles, based on the idea that learning occurs through network connections, as learners connect with their peers and with knowledge resources (Siemens, 2005; Downes, 2009). As such, MOOCs seem to offer a powerful means of professional learning, where considerable knowledge and expertise resides with the learner as well as with the instructor.

In professional learning each learner brings a unique knowledge set to the learning setting, along with their professional and personal networks (Littlejohn, Milligan & Margaryan, 2012). The networked environment acts as a catalyst for the formation of heterogeneous, dynamic learning communities that facilitate knowledge exchange. From this perspective MOOCs appear to offer a useful environment to support and encourage professional learning. However, although digital networks provide environments that connect work and learning, established forms of professional learning largely have not taken advantage of the multiple ways in which people and resources can be brought together to enhance learning (Littlejohn & Margaryan, 2014). There are untapped opportunities around how people collaborate and how feedback can be generated and exploited for learning.

In conventional face-to-face teaching the teacher has a better view of the learner’s progress and pathway than in a MOOC.
Metrics of success range from registration, participation, retention and progression to completion or assessment data and pass rates, with the assumption that these indicators indirectly signify learning. These conventional metrics are being applied to Massive Open Online Courses as a measure of ‘success’. However learners have fewer opportunities to be seen by and to interact directly with instructors, so the responsibility is on the learner to remain active throughout the course. An assumption underlying MOOC design is that learners have the necessary ability to learn autonomously. However, MOOCs attract a broad range of learners and not all of them self-regulate their learning (Milligan, Littlejohn & Margaryan, 2013; Milligan & Littlejohn, 2014).

Self-regulation is a critical aspect of professional learning, as learning for work becomes continual and individualised (Eraut, 2000; Tynjälä, 2008). In many organisations people’s work roles are fluid and constantly changing, people have to draw continuously from knowledge across disciplinary or sectoral frontiers, working within the complex networks found in knowledge intensive workplaces (Veen, van Staalduijen & Hennis, 2011). Self-regulation is critical under these circumstances (ibid). Self-regulated learning enables people to ‘future-proof’ their skills, making them more flexible as workers (Lefrere, 2007), allowing them to plan, share and co-develop their learning goals to learn within and from their professional networks (Siadaty Jovanović & Gašević, 2013).

Self-regulation includes ‘self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals’ (Zimmerman, 2000, p. 14). Zimmernmann’s theory describes learning in three phases (planning, performance and self-reflection) interconnected through affective, behavioural and cognitive sub-processes. Sub-processes range from cognitive factors such as motivation, and interest, self-reflection and self-evaluation, to behavioural factors such as goal-setting and learning strategies, to cognitive factors including self-efficacy and self-satisfaction (Fontana Milligan, Littlejohn & Margaryan, 2015).

Previous research examining how professionals learn in MOOCs provide empirical evidence that learners with high self-regulation have different cognitive, affective and behavioural responses to learning in a MOOC than those displaying low self-regulation (Milligan & Littlejohn, under review; Hood, Littlejohn, & Milligan, under review). Self-regulated learners tend to follow the parts of a MOOC that help them solve a problem. They link their participation in the MOOC to work performance or personal interest. This motivation impacts learners’ goal-setting, self-evaluation, and self-satisfaction. There is evidence that highly self-regulated learners self-evaluate their performance against their own benchmarks, measuring their progress in relation to their intended goals and ambition. This strategy has a positive impact on self-satisfaction. By contrast low self-regulators tend to follow the instructional pathway of the course. Self-evaluation is more challenging, because these learners self-evaluate their progress against externally prescribed benchmarks set by the course designers. This situation impacted on their self-satisfaction (Hood, Littlejohn, & Milligan, under review) Self-regulated learning is not a ‘learning style’ rather; it is a response to a learning situation. A learner’s ability to self-regulate is context dependent - influenced not just by their personal dispositions, but also by factors associated with the environment in which they are learning. There is evidence that learning strategies in MOOCs are influenced not only by learners’ motivation and confidence, but also by the structure of course, the delivery environment and the perceived value of learning (Kop, 2011). In formal learning contexts, Cho and Kim (2013), Barnard, Paton and Lan (2008) and others have explored the role of self-regulation in learner behaviour online. In these studies, a clear link between self-regulation and learning success in online environments is established focusing on self-efficacy, interactions with others, and strategies for regulation.

Some cognitive, affective and behavioural factors associated with self-regulation can be encouraged through the design of the learning environment (see Bernacki, Aguilar & Byrnes, 2011 for a comprehensive overview of how online course environments promote self-regulated learning). Factors that are relatively easy to influence include help-seeking or learning strategies while other factors, such as self-efficacy, are more difficult to impact. Nevertheless there is opportunity here to design MOOCs that promote self-regulated learning behaviour.

The following section describes the method used to develop pre and post design tools developed to support MOOC design. These design tools are outputs from a larger study on Professional Learning in Massive Open Online Courses http://www.gcal.ac.uk/academy/pl-mooc/

3. Method

The study of ‘Professional Learning in MOOCs’ was contextualised within ‘Fundamentals of Clinical Trials’, a MOOC for health
professionals designed and run by the Harvard Medical School, Harvard School of Public Health, and Harvard Catalyst, the Harvard Clinical and Translational Science Center. The course was offered on the edX platform from October 2013 until February 2014, providing an introduction to the scientific, statistical, and ethical aspects of clinical trials research. Weekly video lectures and course readings were presented, accompanied by multiple-choice, computer-marked assessments. To gain a certificate of completion, participants had to pass the assessments (80%) and participate in two moderated case study discussions in an online forum on the edX platform. Opportunities for learners to interact and learn together largely were limited to the focus activity, though learners found other ways to interact outside the MOOC environment, either online and at a distance (e.g. via social network sites such as Facebook) or face-to-face in local meeting places in different countries. The reason for selecting this MOOC was because the course was likely to attract a high number of participants working in the health domain with a professional interest in the topic. The course was intended for people interested in clinical trials and who had foundations in epidemiology and biostatistics. Over 22,000 learners from 168 countries registered prior to the start of the course, including medical students and medical and health professionals.

3.1 Pre-design guide: SRL-Patterns

The patterns reported here emerged through synthesis of the findings from the ‘Professional Learning in MOOCs’ study. The study used qualitative and quantitative instruments to collect data regarding learners SRL profiles, their expectations and goals, and their experience of learning in the Fundamentals of Clinical Trials MOOC. Ethical standards for the study were adopted in accordance with local regulations.

An online survey instrument designed to measure a range of SRL sub-processes across three phases of self-regulated learning (Zimmerman, 2000) was circulated in week three of the course. The instrument is available at http://dx.doi.org/10.6084/m9.figshare.866774. A total of 350 participants from 76 countries completed the instrument, and the data collected was used to generate an individual profile of how each individual self-regulated their learning.

Participants who completed the survey instrument, and who identified as healthcare professionals (n=126), were invited to participate in a semi-structured interview to explore in detail how and why they approach, enact and reflect on their learning during MOOC participation. The interview script is available at http://dx.doi.org/10.6084/m9.figshare.866773. 35 participants (16 male and 19 female) from 23 countries agreed to be interviewed. Transcripts were analysed and coded using codes corresponding to the sub-processes of self-regulated learning described by Zimmerman (2000).

Interviews were conducted and recorded via Skype during November and December 2013. Each interviewee was emailed in advance and prompted to recount a scenario of how they learned in the MOOC to help illustrate their learning strategies. The interview questions were designed to probe self-regulated learning sub-processes, and the scenarios detailed by the participants illustrated most but not all of those probed. The qualitative data was integrated with the quantitative data to illustrate how learners self-regulate their learning in each of the SRL sub-processes. The development of these instruments has been described in Milligan, Littlejohn & Ukadike, (2014), and study findings reported in Milligan & Littlejohn (2014) and Milligan & Littlejohn (under review). The quantitative and qualitative data was analysed to identify key design features of MOOCs that could encourage self-regulated learning behaviours and would meet the learning needs and expectations of professional learners. The findings were synthesised as design recommendations (available from: http://dx.doi.org/10.6084/m9.figshare.1420557) and as MOOC design patterns in this paper.

3.2 Post-design audit tool: MOOC-Design Team Questionnaire

The MOOC Design Team Questionnaire (MOOC-DTQ) tool was designed as an audit instrument to examine the design decisions underlying the MOOC environment and learning design. The tool development process was carried out in four phases:

Phase 1 involved desk research. A literature review of self-regulated learning in online contexts was carried out. The literature review identified empirical articles providing evidence of interventions (online learning activities) that support self-regulated learning. These findings were used to develop the questions for the analytic instrument.

Phase 2 was a MOOC design document review. Course design documents from the Fundamentals of Clinical Trials MOOC were analysed to identify the rationale behind pedagogical design decisions of the MOOC instructional design team.
In Phase 3, members of the instructional design team were interviewed to elucidate their design decisions. Questions in the interview instrument were structured around SRL subprocesses.

The final phase was instrument development, resulting in the 54 item questionnaire detailed below.

4. MOOC Design Tools

This section describes pre and post design tools developed to support teachers with MOOC design. First, the MOOC-SRL patterns were designed to guide teachers and instructional designers on MOOC design features that encourage self-regulated learning. Second, the MOOC Design Team Questionnaire (MOOC-DTQ) tool is a post-design audit instrument to examine the design decisions underlying MOOC environment and learning design.

4.1 MOOC-SRL patterns

1. ADAPTABLE COURSE GOALS/OBJECTIVES

You want to make sure professional learners are engaged in the course, but you find the learners do not need to learn all the course objectives, so you enable the learners to set their own objectives.

Learning objectives are used as a key organiser of course content, yet they can limit professional learners who bring different levels of knowledge and expertise, and who have a clear and precise understanding of the gaps in their knowledge (compared with undergraduate learners).

Professional learners have high self-efficacy and confidence (Hood, Littlejohn & Milligan, under review). Many are able to adapt course objectives to their own learning context. In fact professionals often enter study with specific learning goals in mind, focused on their learning needs at work. Research has shown that highly self-regulated professionals often follow their own goals, rather than following the objectives of the MOOC (Milligan & Littlejohn, 2014). Following self-organised goals is recognised as motivating for highly self-regulated learners. Several studies (e.g. Chang, Tseng & Liao, 2013) highlight the importance of goal-setting in improving motivation, increased persistence, and academic achievement.

Instead of setting rigid course objectives and content, courses can be designed flexibly to allow learners to personalise their learning goals. In this way the course can helping learners to gain specific knowledge they need for work. Tasks could be set encouraging learners to reflect on their personal learning needs and to set their own goals/learning objectives. Guidance would be provided to ensure learners chose goals that are compatible with the course objectives.

CONSIDER: This approach to goal-setting is challenging for learners who do not want to expend effort in setting their own learning goals. However, by providing a set of outline learning objectives, inexperienced learners towards could be scaffolded in developing their own learning goals.

This pattern links with [REFLECT ON BOTH THEORY AND PRACTICE]

2. REFLECT ON BOTH THEORY AND PRACTICE

You want the learning to be valuable to the learner’s ongoing professional practice, but you find a misalignment between the course content and the learner’s work. So you encourage the learners to align the theory learned in the course with their professional practice.

For professional learners, the value of learning is increased when the link between content and practice is clear. Providing opportunities for professional learners to explicitly integrate the theory learned on the course with their work practice and context not only enhances learning and engagement, but links theoretical expertise with practical expertise.

Integrating the conceptual or theoretical knowledge learned through a formal course with practical or experiential knowledge learned in informal, practice-based settings is important for professional learning (Tynjälä & Gijbels, 2012). Tynjälä’s framework for integrative pedagogy (Tynjälä & Kallio, 2009) provides insight into how different types of expertise can be integrated across the formal learning-informal workplace boundary. Self-regulated learning research in formal contexts (e.g. Kauffman, 2004) demonstrates that learners who were encouraged to reflect on their learning, gained more knowledge. This activity enhances learning effectiveness and increases motivation.
Course design should include tasks that explicitly require learners to link what they are learning in theory (in formal education) to their current practice (while learning on-the-job). Additional tasks could require learners to articulate and share action plans for embedding theoretical knowledge into their work practice. Examples generated by learners could form a growing resource, illustrating diverse ways in which theory and practice might be linked. This resource could also be used to refine and enhance course content.

CONSIDER: Linking theory with practice requires concepts to be taken across boundaries from one context (the course) to another (the workplace). This boundary crossing presents a challenge to experienced professional learners. Some learners will need to be supported in doing this through, for example, the inclusion of real world case studies that encourage reflection as an integral component of the course.

4. BREAK DOWN THE BARRIERS

You want to take advantage of the wealth of learning opportunities that your learners have access to within their professional networks. But the learners tend to stick to the course pathway (i.e. pre-determined activities and knowledge within the course), so you encourage learners to discuss their learning with a wide range of people across their professional networks, as well as within the course.

In contrast to undergraduate learners, professional learners bring ready-made professional networks that can provide valuable expertise to complement course materials. By focusing on course content, or internal discussion forums, MOOC designs miss an opportunity to access this powerful resource.

Most MOOCs focus on the resources (eg text, video and other media) that form the core course content. Learners may be encouraged to utilise course discussion forums to discuss course content with peers. These discussion forums can be unsatisfactory, as they may be focused on technical issues, or dominated by a few individuals who intimidate other participants. But professional learners often have their own mature professional networks developed over years and focused on their own situation. Discussion with one’s own colleagues is high value as it is localised and directly relevant to practice. An individual’s existing network is a trusted resource and can be
activated easily through platforms such as Facebook, Yammer or Twitter.

Instead of attempting to create new, high quality communities inside courses from scratch for every cohort, designers can encourage learners to use their pre-existing networks to discuss course ideas and the questions they have. Interaction with an external network encourages breakdown of barriers between learning and work and can have lasting value in fostering personal learning networks. To complement this (and to support learners who do not have professional networks or who seek to broaden their network), course designers should also encourage focused communities to develop. Communities could emerge around language (MOOC participants can lack confidence to engage when they are not confident about expressing themselves in a second language), or role (e.g. school teachers and university academics in parallel communities) or motivation (based on different expectations).

CONSIDER: You have to achieve a careful balance to encourage learners to share new knowledge they have gained back into the course environment, perhaps through specially designed tasks. Some learners may not have an appropriate external network to draw upon, in which case learners should still be able to use the course discussion forums to find other learners.


5. PRODUCTIVE MOOCS

You want to leave your learners with more than a certificate at the end of the course. But you find the learners focus on achieving the course certificate. So you encourage learners to engage in authentic tasks to help them gain lasting knowledge.

Instead of a certificate, course designs can be tailored to support learners in creating an output (e.g. a knowledge artefact) of lasting value to evidence their learning.

MOOCs typically last several weeks, requiring around 10 hours effort each week. Upon successful completion of the MOOC, the learner may be awarded a certificate of completion. However, certificates may have limited value for some professionals. For some professionals (particularly those who are already well-qualified) it may be more valuable to use the time learning on the MOOC to create new knowledge that demonstrates their learning directly.

Set authentic tasks which have a clear useful output that learners can include in their portfolio as a record of achievement. For example:

- learners could be asked to specify an output based on a current challenge, and work to complete it through the course.
- learners with similar backgrounds could work together to critique policy or conduct a foresighting exercise.
- learners with complementary expertise could be brought together to define and resolve real-world problems as ad hoc transient communities (Berlanga, Sloep, Kester, Brouns, Rosmalen, & Koper, 2008). See [CAPITALISE ON DIVERSITY]

CONSIDER: You have to cede some control to your learners – you don’t know what they will come up with, or have any way of ensuring its quality. Designs which encourage peer-evaluation could be adapted to mitigate this.

This pattern links with [CAPITALISE ON DIVERSITY]

4.2 MOOC Design Team Questionnaire

The MOOC Design Team Questionnaire collects information on MOOC design. The instrument is structured as a set of 54 questions, each focused on the phases and sub-processes of self-regulated learning (Zimmerman, 2000). Each question probes whether the course design would encourage particular self-regulated learning behaviours.

The audit tool is designed to be used by an independent researcher or self-administered by the course designers. Questions are directed at different members of the course team, dependent on their focus: questions about the overall course philosophy are directed to the strategic lead; technical questions are directed to the platform developer, questions about the specific learning design of the course are directed to the course design team, and finally, questions about how the course works in practice are directed to course teaching assistants. A copy of the instrument is available from figshare at: [http://dx.doi.org/10.6084/m9.figshare.907150](http://dx.doi.org/10.6084/m9.figshare.907150) and was trialled with a team of instructional designers who designed
Fundamentals of Clinical Trials MOOC (https://www.edX.org/course/harvard-university/hsp-hms214x/fundamentals-clinical-trials/941). This audit highlighted the inward focus of the course as well as the inflexibility of the platform. These observations were confirmed in our study interviews as participants articulated how they engaged with the course and their professional networks.

Data collected by the instrument provides a record of the learning design of the MOOC, focusing on the mechanisms by which it supports, or fails to support learners in self-regulating their learning. The instrument highlights how design can be influenced by strategic or technical factors, in addition to pedagogical decisions. It also collects information from teaching assistants regarding how the course is perceived by learners and how those learners engage with the course. The data collected can be used to identify gaps, and opportunities for subsequent design revision.

5. Conclusions

MOOC environments can be designed in ways to encourage self-regulated learning. This paper has outlined two toolsets that can be used to guide MOOC design to encourage self-regulation.

The MOOC SRL-patterns present a mechanism for sharing design experience of value both to researchers and practitioners. The patterns described here emphasise the importance of accommodating the particular needs of professional learners and capitalising on the networks and expertise they bring with them as they learn. For researchers, the patterns provide a common language for describing MOOC designs to support further study. For practitioners, these design patterns demonstrate ways in which courses can take advantage of the knowledge and expertise that professional learners bring to their formal learning experience, and highlight the importance of course design that engages professional learners and meets their individual needs.

The MOOC-DTQ tool guides instructional designers in pedagogic design decisions made at platform (macro) level as well as at course (micro) level. This tool enables instructional designers to audit their design decisions and provides examples of possible interventions that may improve their design. Many of these activities are applicable within Massive Open Online Courses, though the context, discipline and level of study have to be taken into consideration.
References


Pedagogies based on active and collaborative learning approaches have been recognised as both effective and engaging in online course settings. However, implementing such pedagogies poses challenges for instructors in terms of educational design, orchestration and assessment. These challenges are multiplied with increasing scale, and could become catastrophic in massive learning situations. This paper presents findings from the MOOC design patterns project that articulate design solutions for such circumstances. We used the Participatory Pattern Workshop methodology to examine practitioner experiences from designing and delivering such MOOCs, encode these experiences as design narratives and extract design patterns from these. The resulting patterns could be easily implemented in any MOOC that aspires to implement similar pedagogical approaches. Finally, being aware of these challenges at the design stage is invaluable in helping all MOOC developers choose viable solution paths.

**Editorial note:**
This paper presents outputs from the MOOC Design Patterns project (http://www.moocdesign.cde.london.ac.uk/). The design narratives and design patterns in this paper are available in expanded form, under a creative commons license, from http://www.moocdesign.cde.london.ac.uk/outputs

1. Introduction

The MOOC design patterns project (http://www.moocdesign.cde.london.ac.uk/), funded under the University of London Centre for Distance Education’s Teaching and Research Awards scheme, aimed to explore, define and articulate the emerging design principles and patterns that underpin the development and delivery of massive open online courses, and to demonstrate them by the application to the design of new MOOCS. This project used the Participatory Pattern Workshop (PPW) methodology (Mor, Warburton & Winters, 2012) to review practitioners’ experiences from designing and facilitating MOOCs and extract transferable design knowledge from these experiences in the form of design patterns.

This paper presents a strand of inquiry from the MOOC design pattern project, which focused on the challenges of active and collaborative MOOCs – in particular, design-based teacher-training MOOCs. We reflect on experiences from three MOOCs: the Open Learning Design Studio (OLDS) MOOC, led by the Open University UK and the HandsonICT pilots II and III, led by the Universitat Oberta de Catalunya. These MOOCs overlapped in their topics and pedagogical approach and shared several other characteristics, yet each one was unique in many aspects. We examine some of the practices common to the three MOOCs and derive educational design patterns from these.
Active, collaborative learning is an approach to learning and teaching which seeks to actively involve students to enhance the effectiveness of instruction and students’ learning (Bonwell & Eison 1991, Meyers & Jones 1993). It is considered to be more effective than alternatives, for example, a meta-analysis by Anderson et al (2001) found a significant advantage for active learning in STEM subjects. In the realm of teachers professional development, a review by Cordingley et al (2005) highlights the potential of engaging teachers in collaborative learning design. However, the common knowledge of active, collaborative, design-based education refers to small group scenarios, which are predominantly classroom (or studio) based. Scaling such pedagogies to massive online learning scenarios poses significant challenges.

2. The MOOCs

The Open Learning Design Studio (OLDS) MOOC (http://www.olds.ac.uk/, Bentley et al, 2014; Cross, 2013) ran for nine weeks starting January 2013. It was designed and facilitated by a consortium of seven academic institutions, and partially funded by JISC. It aimed to provide practitioners and researchers an overview of the field of learning design, highlighting the main issues and debates, and offering an opportunity to experience multiple approaches, methodologies and tools and assess their value for the participants’ daily work. This MOOC was modelled on the studio metaphor, which is a common pedagogical format in many design disciplines. In this format, learners work in groups on a project of their own definition, with the guidance and support of the course tutors. We structured each week as a series of activities which were designed to provoke particular questions, and to highlight certain idea, tools or techniques.

The Hands-On ICT project (http://handsonict.eu/) is an EU funded project promoting the integration of ICT tools in teaching and learning. The ‘Learning Design Studio for ICT-based learning activities’ MOOC was designed to provide a solution to some of tasks by engaging teachers in an active, project-based experience of learning design. The course was designed as a set of activities to walk educators in the design process of an ICT-based learning activity ready to be used in their classrooms. This MOOC was first run in spring 2014 (pilot II) and then revised and re-run in Autumn 2014 (pilot III).

All three MOOCs shared the core topic of Learning Design, and the pedagogical structure of the Learning Design Studio (Mor and Mogilevsky, 2013). All three where produced on a relatively low budget, and self-hosted (i.e., not supported by a MOOC platform). The MOOCs had 1,000-3,000 registered participants, out of which several hundred were active.

However, the OLDS MOOC was oriented primarily at higher education practitioners and educational researchers, while the Hands-on MOOCs addressed school teachers. OLDS MOOC was nine weeks long, whereas the Hands-on MOOCs ran for five weeks. Consequently, while OLDS MOOC was designed to expose participants to a wide range of perspectives, debates, tools and techniques, Handson took a much more focuses and minimalist approach.

3. The Participatory Pattern Methodology

The Participatory Pattern Workshop methodology (PPW) also called the “Participatory Methodology for Practical Design Patterns”, is a process by which communities of practitioners can collaboratively reflect on the challenges they face and the methods for addressing them. This methodology has been initially developed in a blended context, through series of face-to-face workshops interleaved with on-line collaboration (e.g. Mor, Mellar, Pachler, & Daly, 2010). However, it has also been used in purely online configurations (e.g. Warburton, 2009).

The PPW methodology is based on the SNaP! framework (Mor, 2013). SNaP! stands for (design) scenarios, narratives and patterns. A Design Narrative (Mor, 2011; Bell, Hoadley & Linn, 2004) is a semi-structured story that illuminates a particular attempt to address a real-world challenge, recounting an incident where the designer attempted to bring about a change in the user’s world. It details the context of this incident, the objectives of the design and the user, the actions they took and their result, the obstacles they encountered and how they dealt with them. Design narratives provide the richness of detail that is essential for understanding the complexity of design work, but they are too specific to support the application of this understanding to novel challenges.

Design Patterns (Goodyear & Retalis, 2010; Goodyear, 2005) generalise these understandings to formulate claims identifying a typical challenge which arises in a given class of situations, and suggest a tested method for resolving it. Design patterns originated from Christopher Alexander’s work in the theory
of architecture. In his words, a pattern “describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice” (Alexander et al., 1977). A Design Scenario takes the form of a Design Narrative and projects it into the future, to formulate a testable design proposition. It proposes a story of the predicted effects of a proposed innovation. A story that can be verified or falsified by implementing that innovation.

The PPW methodology (Figure 1) guides interdisciplinary groups of practitioners and researchers through a process of sharing their experience through design narratives, extracting design patterns from these, and using those to develop design scenarios.

Figure 1: Overview of the participatory pattern workshop methodology with auxiliary support toolkit (from Mor, Warburton, and Winters 2012).

A strength of the PPW methodology is the flexibility in the style and format of the workshops. In this design patterns project, the following workshops were used:

- **Workshop 1**: Sharing of design narratives and creation of proto-design patterns, building on the ‘Rule of Three’ where possible.
- **Workshop 2**: Review and iteration of design patterns; aggregation of patterns into design domains; rapid validation exercise based on future design scenarios or challenges.

- **Workshop 3**: Selected design patterns were shepherded into publishable outputs using a writer’s workshop approach. The aim was to finalise these chosen design patterns for public release, and to adapt elements to a set of learning design principles for future open online course development.

The workshops themselves were supported by a suite of online tools that included:

- **Google Sites** ([http://www.moocdesign.cde.london.ac.uk/](http://www.moocdesign.cde.london.ac.uk/)) provided a flexible web presence to organise and engage participants in their journey through the PPW process.
- **The Learning Fesign Grid** ([http://www.ld-grid.org/](http://www.ld-grid.org/)) provided a resource of tools and instructions to the approaches being used.
- **Integrated Learning Design Environment** ([http://ilde.upf.edu/moocs/](http://ilde.upf.edu/moocs/)) was used as an online tool to support the recording, sharing and editing of the design narratives, patterns and scenarios.

The next section introduces a challenge in the domain of active and collaborative MOOCs. The following section offers a narrative which recounts an attempt to address this challenge. Finally, several design patterns are derived by identifying design elements common to this narrative and others.

### 4. Emerging Challenges

A project-based MOOC is situated somewhere between an xMOOC and a cMOOC. Similar to an xMOOC, participants are guided through a sequence of curated resources, activities which refer to these resources, and discussions which offer a space for collective reflection on these experiences. Yet, akin to a cMOOC, the social dynamics are central to the learning experience, and are to a large extent emergent. An xMOOC is designed to provide participants fairly uniform experiences, and consequently the ensuing activities and discussions are predictable to an extent. A project, or design, based MOOC relies on participants’ interpretation of creative tasks and the content they produce in response. Furthermore, while the tasks in the MOOC may be presented in a linear sequence, the actual design process participants undertake is far from linear. In a traditional
studio (or project based) classroom this would be addressed by plenary sessions, where students review their progress and the issues they encountered, and discuss these with their peers and their tutors.

5. Addressing the challenges: OLDS MOOC Convergence sessions

To address the challenge above, OLDS MOOC introduced convergence sessions: weekly live video chats where several facilitators and several participants discussed the last week’s activities. These were structured as one hour Google Hangout sessions, with an adjacent Twitter chat (using an agreed hashtag) where other participants could interact with those in the video chat. Facilitators often shared their doubts and reflected on the past week’s activities in an open and earnest discussion.

The objectives of these sessions where to:

- Give participants feedback and clarifications regarding the last weeks’ activities.
- Allow participants to provide feedback regarding the last weeks’ activities to the course designers and facilitators.
- Offer a first glimpse of next weeks’ activities.
- Offer participants a sense of direct interaction with facilitators, through the proxy of selected representatives.

For each session, the MOOC team would:

1. Set up a “holding page” with all the details and a note saying “the live video will be available here”.
2. Schedule the session well in advance, usually on the same time and day each week, and announce them on the MOOC mailing list. The team would explain that the session is synchronous, but there would be a recording which would be available for asynchronous viewing.
3. Send an open invitation for participants to join the session, and also personally invite participants who had been active in the MOOC’s social media.
4. 2-3 days before the session, create a “circle” in Google+ with all the facilitators and participants who are expected to join the live video chat.
5. On the day, open the Google Hangouts session 30 minutes before the start time, invite all the facilitators and participants who were allocated to the live video chat and run sound checks.
6. Remind all other participants of the hashtag for the session.

Once live, the team would:

1. Have one facilitator chairing the session, one monitoring the technical aspects, and one monitoring the interactions on the Twitter hashtag and other social media.
2. Begin with a recount of the last week’s activities, followed by impressions and reflections of participants and facilitators. That would take about 15-20 minutes, and flow into an open discussion of 30-40 minutes. We would conclude with a brief introduction of the next week’s activities.
3. Occasionally, guests would present a tool or method relevant to the coming week.

These convergence sessions started almost as an afterthought, and turned out to be one of the central features of the MOOC. Facilitators enjoyed the conversations with co-facilitators and participants, and in terms of the MOOC experience these sessions became almost the participation baseline: if you couldn’t complete any other activity this week, you knew that at least you can get the “vibe” by viewing the convergence session.

The combination of a small number of participants in a live video chat and a larger circle interacting through the Twitter hashtag offered both facilitators and participants the one element which is most desperately missing in MOOCs: the direct teacher-learner interaction, which provides facilitators an indicator of where the learners are and the learners a sense of where the facilitators want them to go. Although only a small number of participants experienced this interaction in person, the live broadcast of the event allowed others to feel that they are interacting with the facilitators by proxy.

Following the success of the convergence sessions in OLDS MOOC, a similar structure of activity was adopted by the HandsonICT MOOCs, although it was implemented with slightly different technology.
6. Design Patterns

This section suggests three design patterns: two derived from the above design narrative, by juxtaposing it with other narratives and identifying the recurring problems and methods of solution; the other pattern being derived from recurring solutions in narratives that described how to engage learners in active learning processes. Pattern collections or “languages” adopt a common template which allows readers to review, evaluate and apply the patterns more easily. The template used here is based on the built-in template of the Integrated Learning Design Environment (ILDE, Hernández-Leo et al, 2014) used by the MOOC design patterns project.

The first pattern, FishBowl, is a direct generalisation of the convergence session construct used in the OLDS MOOC and the HandsonICT MOOCs. The second pattern, Check-Points, takes a broader look, acknowledging that the FishBowl is, in one sense, an instance of a larger class of phenomena. The third pattern, See-Do-Share, relates explicitly to activity design and the value in pushing participants to produce, play with, share and then reflect on the artefacts that they produce through the study they are pursuing.

These three patterns have been reviewed by peers, and are now close to a fully mature form. The SNaP! framework identifies several phases in the development of a pattern. To qualify as constructive and rigorous “building blocks” for design, they will need to be further validated by reference to additional examples and supported by relevant theories.

1. FishBowl
(Source: http://ilde.upf.edu/moocs/v/b1w)

Simulate intimate interaction between teacher and students in a large-scale online course by broadcasting sessions where selected students act as proxies for the cohort.

Problem

In a traditional classroom setting, learners and teachers will occasionally pause the flow of educational activities and discuss their experiences, expectations, concerns - and any issues that have emerged. Such discussions, whether planned or ad-hoc, offer teacher and learners invaluable opportunities to calibrate their view of the state of the course and make any necessary adjustments in their practice.

This allows learners to understand if the issues they are struggling with are personal or common to others, to alert the teachers to specific obstacles, and to receive confirmation for their chosen path and learning practices.

At the same time, these discussions offer teachers invaluable opportunities to validate their teaching strategy and practices, and receive feedback from the learners.

MOOCs do not have the capacity to entertain such interactions: learners are dispersed geographically, the numbers are too big for synchronous sessions, and the teacher to student ratio is such that personal interaction is all but impossible.

Context

This is applicable to online courses where face-to-face sessions are not incorporated. It works best when the course size (in terms of student numbers) passes the tipping point at which providing individual responses to queries/issues is unmanageable. The course tutor should be involved.

Solution

In a FishBowl session, a small number of MOOC facilitators and participants engage in an intimate conversation, yet this interaction is webcast live and recorded so that all MOOC participants can watch and react to it. Set up a synchronous online conferencing tool to host the FishBowl session. An example would be the use of Google Hangouts to provide the bowl. Invite the fish and advertise the event to the intended audience. Composition of the group can vary but the recommendation would be one or two tutors and a few invited participants. Conduct the session as a tutorial, where participants reflect on their experiences from the last week’s activities, and tutors comment on those reflections and respond to participant’s questions.

Examples

• OLDS-MOOC convergence sessions
• HandOn ICT convergence sessions
• University of Surrey MSc Systems Biology taster course

Related patterns

• Checkpoints
Notes

See literature on the role of “teacher presence” in contributing to the success of online courses (Garrison 2007).

2. Checkpoints

(Source: http://ilde.upf.edu/moocs/v/bvvy)

Use clear breathing spaces to help synchronise the course flow and allow others to catch up and join in.

Problem

In a social, non-linear MOOC (such as a cMOOC or a project-based MOOC) interaction between participants is essential to the success of the MOOC. However, participants approach activities in a different pace, and sometimes even a different order, making it hard to synchronize their experiences. Some participants diverge into independent explorations branching out of the MOOC activities. Sharing these could enhance the social learning experience, but at the same time it makes synchronization even harder.

Context

cMOOCs or other MOOCs which have a strong social element and flexibility in the activity flow.

Solution

Create regular “checkpoints”, which offer participants opportunities to synchronise with the course flow and pace, catch up on the social vibe and notice the recent highlights. Such checkpoints could be synchronous events, recorded for those who cannot attend at the time - such as FishBowl sessions or webcasts. They can also be asynchronous events, such as forum posts or mails.

Checkpoints are:

- Scheduled at regular times throughout the MOOC
- Produced in real time by the MOOC facilitators, reviewing and commenting on recent activity
- A summary of recent MOOC activity and a preview of upcoming activity
- A showcase of student contributions
- A candid account of issues, difficulties and unexpected developments in the MOOC

Examples

The OLDS MOOC used several such checkpoints:

- A facilitators’ blog
- Daily and weekly summary emails
- Live convergence sessions using google hangouts and twitter.

Related patterns

- Showcase Learning (Robertson, 2014)
- FishBowl

3. See Do Share

(Source: http://ilde.upf.edu/moocs/pg/lds/view/2068/)

Create activities that encourage learners to explore, engage with, and then share new concepts and practices to help make them meaningful in a short time frame.

Problem

Many courses cover a wide variety of topics that need to be introduced and then explored with the aim of engendering both deep insights and practical use. This is difficult when learners are distributed across the world and direct contact between facilitators and learners will be sporadic. This problem is amplified when some learners will follow a predefined path, others will chart their own path, and others will only visit selected activities. Therefore how do you introduce new concepts, tools or practices, in a way that would be accessible and meaningful, assess learners understanding, and facilitate the emergence of social constructs, with limited resources and large number of students?

Context

This pattern is applicable for MOOCs that are following a collaborative project-based pedagogy with large numbers of registered participants, and when it is impossible to predict how many will actually show up. Here we expect variety in participant approaches where a significant portion of participants may follow through the MOOC, dedicating 3-10 hours a week, while others may only participate casually, dipping in and out and choosing the activities they want to complete.
Solution

Lead participants through a cycle of active engagement with the learning materials by promoting the following activities:

- **Study** - read a short text / view a video presenting the rationale and the core ideas.
- **Review** - examine and critique a worked example.
- **Play** - experiment with the tool / method.
- **Do** - perform a structured task, using the tool / method, and produce outputs.
- **Share** - publish these outputs to the web, and link to them from a shared space.
- **Assess** - review your peer’s productions.
- **Reflect** - post an entry to your learning journal
- **Discuss** - participate in an online discussion.

Potential variations to this cycle include:

- **Research** (in more depth) before or in parallel to the Do.
- **Discuss** before Reflect, or Reflect - Discuss - Reflect.
- **Demonstrate** (after discuss): bring together whatever you think demonstrates what you got out of the activity, display it and apply for a badge.

**Examples:**

- This pattern was the core structure of most activities in the OLDS MOOC. It was later reused by the Handson MOOCs.
- This approach was used as core activity structure in the MUVEnation project (Warburton, 2009) and the CarerPlus project (Warburton 2014).

**Related patterns**

- Showcase Learning (Robertson, 2014)
- Objects to Talk With (Mor, 2010)

7. Discussion

Active and collaborative pedagogies, such as project-based learning, problem-based learning, inquiry learning, have been recognised as effective and engaging in many areas. At the same time, implementing such pedagogies poses challenges for educators in terms of educational design, orchestration and assessment. These challenges are multiplied with scale, and thus could become catastrophic in massive learning situations. It would be a mistake to conclude that such approaches are not sustainable in large cohorts, and revert to a limited pedagogical repertoire. At the same time, it would be unreasonable to assume that the same techniques and practices that work in a small-scale, co-located setting would be transferable to a massive, online one.

As more educators venture into this field, and cautiously experiment with the opportunities it affords, effective practices will emerge. Some of these will be adaptations of age-old practices which are tweaked to comply with the constraints and dynamics of massive online education. Others will be original practices which leverage the unique advantages of this new environment. In both cases, we need mechanisms for rapid, precise and yet critical sharing of the design knowledge that is encapsulated in these new practices.

The convergence session narrative presented in this paper, and the three related patterns, are examples of such elements of design knowledge. These patterns could be easily implemented in any MOOC which strives to implement similar pedagogical approaches. No less important, the challenges which these patterns illuminate are likely to be confronted by any such MOOC – and being aware of these at design time is valuable, regardless of the path of solution taken.

A range of patterns have been identified during the MOOC design patterns project which connect with those illustrated here, and form a proto-language of patterns for MOOC design that includes active and collaborative learning (Table 1). Such a language forms a common asset that will help promote design solutions for quality education at a massive scale and we invite other developers, practitioners and researchers to contribute to both refining and then using them.
Domain | Patterns
--- | ---
Structure | ADJACENT PLATFORMS; MOOC LEGACY; BRING THEM ALONG; SCAFFOLDED MOOC; CHECKPOINTS
Orientation | INDUCTION; BEND DON’T BREAK; KNOW YOUR AUDIENCES
Participation | FISHBOWL; PROVOCATIVE QUESTION; CHATFLOW; SPARKING FORUM PARTICIPATION; SHARING WALL
Learning | KNOWING THE STORY; SIX MINUTE VIDEO; SEE DO SHARE
Community | CROWD BONDING; DRUMBEAT;
Management | ENGENDERING TEAMWORK

Table 1: Full list of MOOC design patterns organised by design domain

References


Patterns for Using Top-level MOOCs in a Regular University

In this paper we describe pedagogical patterns for using MOOCs in a flipped classroom setting. These patterns are grounded on good practices in flipped classrooms.

In the course Mobile Application Development in our Bachelor computing programmes, students follow a MOOC of Stanford University. In this course, our students master key concepts and theories directed at building mobile apps, and follow the course in a flipped classroom setting. In our context, students watch videos of the MOOCs at home, make and submit exercises before classroom discussions, attend classes at school and present their mobile programming skills in a serious project.

In addition to passing the course goals, students find that they can successfully follow advanced top-class education. This supports them in developing lifelong learning skills. Furthermore, successfully completing an advanced Stanford course boosts their self-esteem.

The resulting patterns describe good practices for the design and use of MOOCs in a flipped classroom context.

1. Introduction

Massive Open Online Courses (MOOCs) have received much public, media and board attention since the first Stanford Artificial Intelligence course in 2011. The promise to deliver top-quality education has raised massive public interest. Many pupils, students and professionals have taken courses and quite a lot of them do exercises and assignments.

Most attention in the literature (Bayne & Ross, 2014; Knox, 2014) has focused on describing MOOCs, and most universities are interested in developing their own MOOCs. We are more interested in using MOOCs in our study programme, especially when these MOOCs originate from Stanford, MIT or other highly-respected universities. In this way, our students not only receive good education, but they can include in their résumés that they have successfully attended a Stanford advanced course in programming, for example, even though they studied at a regular university.

However, MOOCs are not designed for use in a classroom setting, but for students learning individually. Furthermore, it is not clear that the students from our university satisfy prior knowledge demands related to particular MOOCs of other institutes. Finally, we expect that most of our students will successfully complete courses. As the completion rate of MOOCs is rather low, this requires special attention.
Since 2010, we have used the flipped classroom in our Bachelor computing programmes (Diepen van, et al., 2015). We started with flipping the fourth year course “scripting for designers” and extended this pedagogical form to freshmen courses on programming (with an annual enrolment of 300 students). The flipped classroom addresses an ancient teachers’ dream: prepared students in class. Our variant of flipped classrooms consists of:

- Videos explaining key concepts and how to use them. Students watch videos before a lecture.
- Exercises and assignments for the students related to the videos. Students submit their homework before a lecture. By submitting the homework, a student shows that she has given serious attention to the exercises. We do not require completeness nor correctness.
- Interactive lectures based on submitted homework. Feedback, connecting homework to key concepts, elaboration and preparing the class for the next videos.

By linking MOOCs to flipped classrooms, we managed to solve the MOOC classroom issues. The high workload involved could be reduced if MOOC designers would support classroom use by adding hooks to the videos that clearly describe prior knowledge requirements.

In this paper we propose three patterns: MOOC-BASED COURSE DESIGN, MOOC-HOOK and ACTIVE MOOC STUDENT. Table 1 gives an overview of these patterns including their target audiences. Within these high-level patterns, we might refer to other patterns using SMALL CAPS. These patterns are summarised in the Appendix. However, some of these referred patterns may not have been described yet - this is part of future work.

### Pedagogical patterns

Patterns for the latter domain, education, were first initiated and collected by the Pedagogical Patterns Project\(^1\), but many other authors also contributed to the body of pattern literature in this field (see e.g. Köppe, 2013; Mor, Mellar, Warburton, & Winters, 2014; Schmolitzky & Schümmer, 2009). These patterns – and pattern languages – covered various aspects of education and are mainly based on constructivism. The aspects range from general pedagogical principles (e.g. ACTIVE STUDENT or LINKING OLD TO NEW), to patterns for specific instructional methods (e.g. for lectures (Köppe & Schalken-Pinkster, 2013) or team projects (Hayes et al., 2006) to content-specific patterns, teaching software design patterns and the usage of technologies in education. But the emergence of new methods of instruction continue to form new sub-domains for educational patterns.

### 3. MOOCs

<table>
<thead>
<tr>
<th>Pattern Name</th>
<th>Summary</th>
<th>Target Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOOC-BASED COURSE DESIGN</td>
<td>Use a high-level MOOC as base for a course in order to save time and to guarantee high quality.</td>
<td>Lecturers at regular universities</td>
</tr>
<tr>
<td>MOOC-HOOK</td>
<td>Provide Hooks in your MOOC so that other educators can use these to link their own material.</td>
<td>MOOC designers</td>
</tr>
<tr>
<td>ACTIVE MOOC STUDENT</td>
<td>Ensure that participants of the MOOC are actively learning and not passively consuming.</td>
<td>University lecturers, MOOC designers</td>
</tr>
</tbody>
</table>

Table 1: proposed patterns

The huge interest in MOOCs started in late 2011 with the online Stanford introductory course in Artificial Intelligence. The understanding of MOOCs is rapidly growing. Two frequently cited contributions are Pappano (2012), a newspaper article, and a case study on an early MIT MOOC (Breslow, Pritchard, DeBoer, Stump, Ho & Seaton, 2013, vol 8). In Bayne & Ross (2014), an overview is given of UK MOOCs and their pedagogical base. Since 2013, various conferences like eMOOCs (Cress & Kloos, 2014) have been organised. In 2015, MOOCs have become part of the mainstream education.

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\(^1\) www.pedagogicalpatterns.org
of major educational conferences like EADTU. But as far as we know, not much attention has been given to using a MOOC as part of an ordinary course.

Similar to MOOCs, flipped classrooms are the result of experiments by teachers. Instead of sharing lectures with students all over the world, the flipped classroom is directed at improving the learning processes of students in a class. The core idea is to shift lecturing to a students’ class preparation, and to use class time itself for interaction with students. Lecturing can be recorded on video; the context in our work is to use excellent MOOCs (of the best experts) for lecturing and to support our students to understand and use these MOOCs in our own educational setting.

Educational Context at our University

The goals for using the flipped classroom in our computing courses are to increase student understanding and skills in programming. Based on Chickering’s principles for good Bachelor education (Chickering & Gamson, 1987), Garrison’s best practices for blended learning (Garrison & Vaughan, 2008), and Lean principles for waste reduction in processes (Balzer, 2010), we have designed each lesson in the courses by three elements: studying a knowledge clip (in our case a video explaining theory, concepts and its application), making exercises and submitting results, and classroom discussion between staff and students (Diepen van, et al., 2015). The role of MOOCs in this setting is to use the high quality educational material of others in the knowledge clips instead of producing the material ourselves.

Using a MOOC in a regular university course is quite a challenge. Appropriate MOOCs have to be found, studied and assessed on their usability (and copyright statements) for teaching in our preferred pedagogical set-up of a flipped classroom. In our case, this has led to the selection of a Stanford online course on Mobile Programming for IOS devices (published as an Open Education Resource under a Creative Commons License). This video should have been augmented (only permitted under some CC licenses) with exercises to stimulate active student learning. Not all of the challenges are addressed in the proposed patterns and remain part of future work.

Methodology

Our proposed patterns address several issues based on our experience in using a MOOC in our course. This way of finding patterns is different from the established way of analysing at least three known occurrences of working solutions in order to mine the essential pattern from them, which is pattern mining by pure induction (Kohls, 2013). Our patterns are partly mined by analysing the missing aspects of existing solutions (in our case, existing MOOCs), followed by an abductive inference of a working solution. This also means that we can’t claim that these are really mature patterns, as they do not satisfy the often used Rule of Three (Biggerstaff & Richter, 1987): if the solution worked in three or more cases, then it’s likely not a coincidence anymore but a pattern. Instead, we propose them as proto-patterns or abducted pattern candidates, which still need proper validation through successful applications.

4. The Patterns

Pattern: MOOC-BASED COURSE DESIGN

Context: In the design phase of a new course, you have identified the content and are now looking for ways of how to present the content. You not only want to present the content, but also want students to feel that they are able to handle high-level material.

Problem: Preparing high-level material is very time-intensive, and even if you manage to prepare such material, the students might not experience it as such.

Forces: The “not invented here”-syndrome can lead to re-doing existing work. This may also happen when schools insist on creating institutional learning materials themselves. On the other hand, courses that are developed by the institutions themselves, but - because of lack of time or experience - are not completely developed when the course starts or are of low quality, can lead to unsatisfying experiences for both students and teachers.

Solution: Use a MOOC provided by a prestigious institute or professor as the basis for your course and design all other instructional parts around it.

Using such a MOOC in your course will have some positive effects: the students know (if they are familiar with the institute or professor) that the material is likely to be of high quality and cover the state of the art in the topic. If the MOOC covers all aspects relevant for the course, then integrating this MOOC will also save time for the design of the course (this is similar to using a textbook and other educational material for your

2 http://c2.com/cgi/wiki/ProtoPattern
However, if the MOOC does not address all aspects of the course content sufficiently (or covers too much), then the course preparation has to take this into account. If important topics are missing, then the course designer should be able to link additional relevant material to the MOOC using the provided MOOC-HOOKs. Such material could be either another MOOC, or readers, other short videos etc.

Applying this solution requires a sequence of steps: find a MOOC (or combination of MOOCs) that fits the learning objectives of your course; adjust course planning and MOOC structure; optionally create additional material on topics not covered by the MOOC; and add supplementary material such as exercises or quizzes, or use MOOC-HOOKs to connect with other information sources.

Related patterns: MOOC-BASED COURSE DESIGN is an alternative for TEXT BOOK COURSE DESIGN and can help with implementing a FLIPPED CLASSROOM

Example: A large part of the course Mobile Application Development at HAN University was developed around the Stanford Online Course “Developing iOS 7 Apps for iPhone and iPad”\(^3\). This material covers about two-thirds of the available course time. The rest was developed using a selection from the (Coursera) MOOC “Programming Mobile Applications for Android Handheld Systems”\(^4\) by the University of Maryland.

Supplementary material was developed covering:

1. “viewing questions” that students could answer while watching the video (and submit using an online form). The viewing questions that came with the Coursera MOOC were (partly) replaced.

2. exercises that students could do to experience the subjects discussed in the MOOCs.

3. extra material (videos, online articles and exercises) to address gaps between the required knowledge and the actual knowledge of our students (for example, about the programming language C).

For testing in the iOS part of the course, the assignments from the Stanford material were used. These were graded using the Stanford requirements and some additional criteria. For testing in the Android part of the course, an assignment from a (now defunct) Harvard course on mobile programming was used with some extra subject matter.

Pattern: MOOC-HOOK

Context: You are designing a MOOC which also should be usable as a basis for courses in your own university or other institutions.

Problem: If students are not able to follow the MOOC anymore because they have problems connecting their prior knowledge to the presented concepts, they will be likely to drop-out and therefore do not reach the desired learning objectives of the course.

Forces: There is often a diverse student population and it is sometimes not known who exactly will take the class and what their prior experience is. It is also hard to take into account all potential topics that need or should be covered in the MOOC if the broader curriculum is unknown. As a MOOC designer, you can’t know what has already been covered in the curriculum of the university that is using the MOOC for their courses.

Solution: Identify parts in the MOOC where certain prior knowledge is essential for understanding and provide a HOOK for linking additional material at the moment when it is needed by the students.

Ideally, the users of the MOOC (the university lecturers who apply MOOC-BASED COURSE DESIGN) will easily be able to connect the other material to the MOOC-HOOKs through hyperlinking or a similar mechanism. In that case, these links will show up at relevant moments and the MOOC-participants can activate them for acquiring or refreshing the additional essential knowledge. However, not all video-learning environments that are used for MOOCs offer such functionality. In such a case, a more simple solution would be to provide a list with moments where certain prior knowledge is assumed so that the lecturer can add the links to the additional material to this list. In both cases, the HOOKs should be optional so that students can also choose to skip them if they don’t need them.

Offering MOOC-HOOKs makes it possible to handle a diverse student population with mixed prior experiences, but identifying the appropriate parts in the MOOC and the related essential prior knowledge costs extra time.

Related Patterns: LINKING OLD TO NEW, DIGESTIBLE PACKETS, REPEAT YOURSELF (indirect application, what you can do as teacher (repeating important topics) can also be integrated in
MOOCs by HOOKs, so even though we are quite sure that the students have the required knowledge, it still might be a good idea to offer a HOOK to older/other material again), STUDENT DRIVEN LECTURE (a basic aspect of MOOCs: being able to choose for yourself what and when to learn next; HOOKs add that the students do not only choose between the content presented in the MOOC, but also of related content).

Examples: In our course Mobile Application Development we studied the Stanford MOOC on iOS programming to identify gaps between actual and required prior knowledge and added hooks to the original material ourselves. In many textbooks, it is common to describe prior knowledge requirements either in an overview or in an introduction of a book chapter. Transferring this text book practice to a MOOC results in the hooks.

In a MOOC on design patterns the UML notation is usually assumed as prior knowledge. However, if specific parts of the UML are applied for showing the structure of certain patterns, e.g. the interface notation and implements relation, then a MOOC-HOOK could be provided that links to a website where these parts of UML are described in detail.

Pattern: ACTIVE MOOC STUDENT

This pattern is a refinement of ACTIVE STUDENT (Bergin, 2012).

Context: You’re using a MOOC for your course.

Problem: Just presenting the topic in the MOOC might not be sufficient to assist the students in understanding it. You simply don’t know if students have learned anything during the MOOC/course and discovering this only at the end of the MOOC/course is most likely irreparable.

Forces: Listening, watching and reading can be passive activities that do not automatically lead to learning. But you have no direct influence on the MOOC itself to trigger students’ more active engagement with the material.

Solution: Add regular exercises and assignments to the video and use the students’ solutions to get a grip on their progress.

Exercises and assignments promote active learning, and the students have to apply the newly acquired knowledge and hereby demonstrate their level of competence. Using the students’ solutions amplifies the benefits of this pattern: making the submission of results obligatory (as pre-requisite for using them) likely encourages the students to not skip them and, by examining the solutions, you as teacher can identify misconceptions and also well-understood concepts and adjust the in-class meeting according to this information. However, the examination of the students’ solutions certainly costs extra time and it might be hard to impossible to always examine all of them, depending on the class size. In that case, random samples might help to at least get an indication of the students’ performance.

Make sure that the exercises/assignments are in sync with the presentations and other material. Also use the results of these exercises/assignments for providing feedback to the students on their own learning progress.

Related Patterns: USE STUDENT SOLUTIONS as basis for providing FEEDBACK.

Example: The exercises in the “Scripting for Designers” course.

5. Discussion

Our work on using MOOCs in a course is based on our experience on stimulating student learning in Flipped classroom design. As a regular university we would like to use MOOCs in our courses as a more activating component than the textbooks that we currently use and as a part of preparing students for lifelong learning. For MOOC designers this implies that they include MOOC-HOOKs in their videos identifying prior knowledge, or even better, offering quick lessons to fill the gap. Use of MOOCs in education at regular universities is still rather new and it will take a while before support as offered in textbooks is given.

Our research is focused on developing and understanding flipped classrooms in higher education. We hope that working with pedagogical patterns as a way to describe good practices in education helps with identifying and sharing our knowledge and that of others in a comprehensible and reusable way. One of the next steps in this research is the work on a pattern language for flipping the classroom in computer science education.
## Appendix

### SUMMARY OF REFERENCED PATTERNS

<table>
<thead>
<tr>
<th>Pattern Name &amp; Reference</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIGESTABLE PACKETS (Bergin, 2012)</td>
<td>Applying this can lead to smaller elements which are small because they don’t cover certain aspects of the topic, which are assumed to be known a priori.</td>
</tr>
<tr>
<td>FEEDBACK (Bergin, 2012)</td>
<td>Give the students differentiated and objective feedback on their performance.</td>
</tr>
<tr>
<td>FLIPPED CLASSROOM (e-teaching.org, 2015)</td>
<td>Students are preparing themselves at home in advance of a lesson.</td>
</tr>
<tr>
<td>LINKING OLD TO NEW (Bergin, 2012)</td>
<td>Help the learner to make associations between new information and existing knowledge by using an old wrapper to introduce this new information.</td>
</tr>
<tr>
<td>REPEAT YOURSELF (Bergin, 2012)</td>
<td>Repeat important topics so that they are easier to remember and link to each other.</td>
</tr>
<tr>
<td>STUDENT DRIVEN LECTURE (Bergin, 2012)</td>
<td>Let students select topics that are covered in the lecture.</td>
</tr>
<tr>
<td>TEXT BOOK COURSE DESIGN (unpublished)</td>
<td>Selecting a text book as backbone in designing a course.</td>
</tr>
<tr>
<td>USE STUDENT SOLUTIONS (Köppe et al., 2015)</td>
<td>Use the work that students have handed in as examples in class.</td>
</tr>
</tbody>
</table>
References


Websites

Design patterns for promoting peer interaction in discussion forums in MOOCs

Design patterns are a way of sharing evidence-based solutions to educational design problems. The design patterns presented in this paper were produced through a series of workshops, which aimed to identify Massive Open Online Course (MOOC) design principles from workshop participants’ experiences of designing, teaching and learning on these courses. MOOCs present a challenge for the existing pedagogy of online learning, particularly as it relates to promoting peer interaction and discussion. MOOC cohort sizes, participation patterns and diversity of learners mean that discussions can remain superficial, become difficult to navigate, or never develop beyond isolated posts. In addition, MOOC platforms may not provide sufficient tools to support moderation. This paper draws on four case studies of designing and teaching on a range of MOOCs presenting seven design narratives relating to the experience in these MOOCs. Evidence presented in the narratives is abstracted in the form of three design patterns created through a collaborative process using techniques similar to those used in collective autoethnography. The patterns: “Special Interest Discussions”, “Celebrity Touch” and “Look and Engage”, draw together shared lessons and present possible solutions to the problem of creating, managing and facilitating meaningful discussion in MOOCs through the careful use of staged learning activities and facilitation strategies.

Editorial note:
This paper presents outputs from the MOOC Design Patterns project (http://www.moocdesign.cde.london.ac.uk/). The design narratives and design patterns in this paper are available in expanded form, under a creative commons license, from http://www.moocdesign.cde.london.ac.uk/outputs

1. Introduction

The emergence of MOOCs, or Massively Open Online Courses, has drawn media and academic attention to the future of online learning. The popularity of MOOCs, with cohorts running into tens of thousands of enrolled learners (Belanger & Thornton, 2013), have caused a stir in the very traditional world of higher education. As a result, they have been variously hailed as the future of learning (Bogost, Schroeder, Davidson & Filrei, 2013) or criticised for missing the point of learning altogether (Boyers, 2013). MOOCs have not only created new models for universities to provide higher education, but also present new ways for learners to engage with it. By removing entry barriers of payment and physical attendance, MOOCs have been successful in attracting ‘massive’ cohorts. While some are experienced in higher educational settings and self-directed learning, others are less so. Yet the open door policy attracts learners from a wide variety of backgrounds, who may have diverse

Authors
Tharindu R Liyanagunawardena
t.r.liyanagunawardena@reading.ac.uk
Teaching Fellow, University of Reading
Reading, UK
Eileen Kennedy
e.kennedy@ioe.ac.uk
Research Officer, UCL Institute of Education
London, UK
Paige Cuffe
p.a.cuffe@open.ac.uk
Associate Lecturer & Consultant, Open University
Milton Keynes, UK

Tags
Design Patterns; Design Narratives; Massive Open Online Courses (MOOCs); Forums; Interaction
educational needs (Liyanagunawardena, Parslow & Williams, 2014). The sheer scale and limited resources mean that MOOCs present significant challenges to traditional higher education pedagogies to provide an effective learning experience. Thus requiring a re-examination of pedagogical strategy for this new form of online learning. The technological capacities of the MOOC platforms have tended to eclipse issues of pedagogy in the development of early MOOCs, which largely consisted of videos of face-to-face lectures made available online. MOOC pedagogy has developed since then to compensate for the lack of teacher presence through peer communication and assessment strategies (Kizilcec, Piech & Schneider, 2013) but, to offer quality education at scale it is necessary to share good practices of effective learning design in MOOCs.

This paper is the result of the authors’ participation in a series of workshops for experienced MOOC designers, tutors and students, aiming to pool the collective knowledge of ‘what works well on a MOOC’ in order to elicit a set of design principles that could guide those involved in creating and teaching on MOOCs. We attended three workshops, during which we shared design narratives from the MOOCs we had worked on. These MOOCs represented a range of MOOCs: a Connectivist MOOC, where learners spontaneously opened up their own online spaces; a small scale Continuous Professional Development (CPD) open course targeted at university lecturers; and two MOOCs that were offered on Coursera and FutureLearn platforms.

Yet, despite the diverse character of our experience with MOOCs, commonalities were identified. In particular, we all shared experiences of challenges in creating opportunities for meaningful discussion on MOOCs. We mined these overlapping features to construct design patterns collaboratively, which abstracted our MOOC design problems and the pedagogical solutions we created in response. Together, the design patterns share our experiences of forum facilitation strategies and learner-generated artefacts to create a focus for discussions. These are not the only solutions to the challenges of creating meaningful discussions in MOOCs, but these patterns have proven to be successful in our varied experience of MOOCs.

In this paper, we situate issues of MOOC learning design within the research on the pedagogical challenges of discussion in a MOOC, which forms the problem statement that our design patterns intend to address. We provide details of four MOOC case studies as the empirical evidence for our designs. The methodology section then presents our approach to developing the design narratives and patterns. We include six MOOC design narratives, and these together provide evidence to support our three design patterns. We conclude the paper with a discussion of the extent to which we are able to control all forces that impact MOOC pedagogy.

2. Problem Statement: the Challenges of Discussion in MOOCs

MOOCs typically employ a combination of video lectures, quizzes, articles and discussions to deliver the course content and to keep the learners engaged. However, empirical evidence suggests only a small proportion of the active enrolled participants complete the courses (Ho et al, 2015; Koller, Ng, Do, & Chen, 2013). It is possible that MOOC participants behave differently from other learners because of the very different nature of the contract in MOOCs (Liyanagunawardena, Parslow & Williams, 2014, Bentley et al, 2014). Yet, if we want MOOCs to create an environment where committed learners can succeed, we need to pay close attention to pedagogy when designing a MOOC.

Laurillard (2012) argued that in order for learning to take place, it is necessary to engage in cycles of communication between teachers and learners, and learners with each other, as well as to provide environments that model skills and allow learners to practice their learning. In a MOOC, the massive numbers test the capacity of the teacher to engage in personalised communication with individual participants. However, it is possible to put a greater emphasis on peer-to-peer communication to support the learning. This kind of learning needs to be carefully designed to develop the swift trust needed for initial group formation and team-work in the virtual environment (Jarvenpaa & Leidner, 1999), and include “ways of judging which people are offering helpful and reliable advice” (Ferguson & Sharples, 2014). The “Network Effect” may postulate that there is a cascading increase in the value/utility of the network the bigger it gets (Ferguson & Sharples, 2014), but the sheer size may become overwhelming to a learner if they are not supported to deal with it effectively. Simple measures such as mentors and educators acknowledging answers by other participants may provide positive reinforcement, reassuring the learners of the ‘validity’ of the response.

The use of discussion in online learning is not new or unusual. The importance of the online community has long been recognised (Rovai, 2000) as has been the role of the facilitator in achieving
forum participation (Shea, 2006). Asynchronous discussion forums have been subject to critique for lacking the social presence of synchronous communication, where "immediate feedback is available" (Spencer, 2001). However, there are learning benefits to having space to reflect before responding to others’ ideas and “intellecutially engaging with and extending or critiquing them” (Coffin et al, 2005). Nevertheless, Smith & Smith (2014) argue that watching active learners discuss is informative and supports learning in ‘passive’ learners.

Differences between online distance learning and MOOCs are created inter alia by scale, and the learners’ freedom to use or not use any element of the ‘course’. These make it difficult to create activities to act as a “spark” (Salmon, 2002) to discussion in forums, particularly since learners work less as communities and more as crowds (Haythornthwaite, 2009). Indeed Margaryan, Bianco & Littlejohn (2015) note a lack of evidence of collaborative learning between peers in most MOOC designs they examined.

There are, however, contrasting views on the value of forums for MOOCs. Gillani & Enyon, (2014) concluded that “largely, forum use was inconsistent and non-cohesive”. Yet, Seaton et al’s (2014) examination of how frequently learners accessed various components of the MOOC, and how long they spent on each, suggested forums were central to students’ support. Similarly, Ashton et al (2014) demonstrate a strong association between forum activity and achievement in MOOCs. Scale and learner engagement patterns do create specific demands on MOOC design of discussion activities, but the immediacy of response available within the more populous forums in MOOCs could be harnessed to achieve a greater sense of social presence. Careful design could help meaningful academic interaction develop within the crowd.

Facilitating a discussion in a MOOC can be an overwhelming experience as the volume of posts keep growing throughout the day and night as participants are contributing from different time zones covering the globe. Chandrasekaran, et al (2015), noted that limited available time means that “decisions may be subjective” about “which threads in a course’s discussion forum merit instructor intervention”. Importantly, evidence suggests the amount of discussion increased when the lecturer or facilitator “was involved” but not controlling or leading discussions (Fear & Erikson-Brown, 2014).

Yet, despite the major MOOC platforms’ capacity to cope with massive classes, they often lack effective tools for individual facilitators to manage discussions, similar to the ones that are present within Learning Management Systems (LMS) such as Moodle. For example, the ability to move posts from one discussion to another or merging discussion threads are some of the basic tools available to facilitators using Moodle. While some MOOC platforms are beginning to add design features to manage peer interaction, in others, discussion facilitation tools such as these are currently not available. Coursera has a feature that presents users with a list of existing threads with similar subject headings when a participant tries to create a new discussion thread. This strategy reduces the number of parallel threads for the same subject and eases the navigation of discussions. Furthermore, some MOOC platforms have ‘design guidelines’ and ‘helpful suggestions’ that are offered to educators of courses, which sometimes, as we show in our paper, can be unfavourable for the course.

Our aim in this paper, therefore, is to share our experience of learning designs and facilitation strategies on MOOCs that create the conditions for meaningful discussion and the co-construction of knowledge to take place. We begin by providing details of four MOOC case studies that form the evidence that we will use to support the design narratives and patterns we have collaboratively produced.

3. Case Studies

Case 1: Begin Programming: Build your first mobile game

“Begin Programming: Build your first mobile game” is a seven week course offered on the FutureLearn platform by the University of Reading. The course introduces basic programming concepts to beginners using a mobile game as a vehicle. The course uses Java programming language and the mobile game is developed for Android platform. This MOOC differs from traditional programming courses as it provides a game framework, which the learners install in their machines, to get started. Then the participants build a mobile game on top of this framework from the programming constructs they learn each week rather than starting from a ‘Hello World!’ application, a simple greeting printed on the screen, which most programming courses use as the first exercise. The course was first run on the FutureLearn Beta platform in October 2013 with 10,000 registrants (capped); since then has completed three more iterations, February 2014, October 2014 and February 2015.
with some 38,000, 32,000, and 23,000 registrants. The next run of the course is planned for June 2015. The course was targeted at complete beginners but it attracted a considerable proportion of experienced programmers as well (Liyanagunawardena, Lundqvist & Williams, 2015). Completing the majority of steps in the course along with the final week tests qualify a participant to earn a statement of participation.

Case 2: H817 Open

The “H817 Open” was a seven week MOOC/Open boundary course offered by the Open University in 2013; the designer of the course was Prof. Martin Weller. It was aimed at postgraduate learners. It was run on the existing OpenLearn Moodle, the Open University’s open access platform, with students also making use of other spaces - such as Google Groups - as they desired. In the single presentation of this MOOC, participants were both informal open learners and the students formally registered for the “H817 Openness and Innovation” module of the Master in Online and Distance Education at the Open University. Because of its open nature, the number of participants is difficult to define, but the first week’s materials were visited by over 1,900 unique visitors (Weller, 2013). In this course, badges were available for milestone activities, and peer discussion - interaction rather than collaborative activity. Blogging was the most commonly suggested response to the week’s activities and a blog aggregator was used. Whilst, upon completion, registered students submitted a formally assessed proposal for implementing open education in their institution, both informal learners and formal learners were able to earn badges from selected activities. At the time the MOOC was run, the platform was undergoing updates, which limited forum functionality and made even basic forum management tools such as search and moving of posts into threads unavailable to facilitators for approximately ten days. Thereafter limited tools were available.

Case 3: BLOOC

The “BLOOC” (a name derived from a conflation of “Bloomsbury” and “MOOC”) was a small scale MOOC run by the Bloomsbury Learning Environment, a collaboration sharing technical and pedagogical resources in learning technology between the five Bloomsbury Colleges of the University of London: Birkbeck, the Institute of Education (now University College London (UCL) Institute of Education), the London School of Hygiene & Tropical Medicine, the Royal Veterinary College and the School of Oriental & African Studies. The aim was to provide an opportunity for busy professionals to gain first hand experience of how Moodle can be used to support online learning. The four week course ran in June 2014 on an open access Moodle platform. The course was targeted at teaching staff across the Bloomsbury Colleges, a group considered particularly difficult to reach with conventional training because of their already overfull schedules. There were 211 registrations, far more than attended by comparable face to face professional development events. There were no formal assessments. The BLOOC was the inspiration behind other professional development online courses (such as UCL Arena Digital) and is currently being developed as an “on-demand course”.

Case 4: What Future for Education?

The “What Future for Education?” MOOC was a six week course offered by the University of London in collaboration with the UCL Institute of Education on the Coursera MOOC platform. The course ran between in September 2014 and aimed to encourage participants to challenge commonly held ideas and preconceptions about education, reflect on their own experiences and critically examine their preferences for the future of education. The course was aimed at anyone with an interest in education, such as teachers, educators or parents, and attracted 13,460 registrations. It is currently being developed as an “on-demand course” with Coursera.

4. Methodology

The design narratives and patterns presented in this paper were developed through the authors’ participation in a series of MOOC Design workshops (Warburton & Mor, 2014). This project adopted the SNaP! methodology (Mor, 2013) and the Participatory Pattern Workshop format (Mor, Warburton, & Winters, 2012) to produce a set of design principles developed from participants’ experience of MOOCs. This process involved several stages to elicit participants’ knowledge of designing, teaching and learning on MOOCs, initially in the form of design narratives, and subsequently as design patterns, which could then be combined to form a design language to support practitioners in designing or teaching on MOOCs. The concept of a design pattern is derived from the field of architecture, principally from the work of Alexander, Ishikawa, & Silverstein (1977). Alexander et al. (1977) developed a collection of evidence-based architectural design problems and their
solutions to support the design of homes, offices, public buildings, or the planning of towns. These ideas were abstracted in the form of patterns, which were combined to create a pattern language of architecture. The approach has since been applied to the context of education by means of a pedagogical pattern language (Derntl & Botturi, 2006).

During the three workshops we attended, we were encouraged to articulate our experience of teaching and designing MOOCs as design narratives. Design narratives can be understood as a means to “represent design knowledge extracted from empirical evidence, capturing and interpreting the designers’ experience” (Mor, Warburton, & Winters, 2012, p.165). The STARR template (Situation, Task, Action, Results and Reflection) was used to document the teaching and learning problems we experienced in MOOCs. These were then abstracted to create a set of patterns as a way of describing design problems in MOOCs along with proposed solutions. Pedagogical patterns of this type take the general form: ‘for problem P, under circumstances C, solution S has been known to work’ (Mor, Warburton, & Winters, 2012, p.165).

Our experience of designing, teaching or facilitating on MOOCs had derived from separate contexts, but the patterns we produced were the result of collaboration, combining our individual and collective activities. As we exchanged and refined our narratives over the course of the workshops, we began to adopt techniques that were similar to those used in collective autoethnography (Moore et al. 2013; Geist-Martin et al. 2010). In this sense, having produced our individual narratives, we reflected on the evidence they provided together and identified “clear patterns across our accounts” (Moore et al. 2013, p. 6) to produce the second stage abstraction in the form of the design patterns. The next section, therefore, presents our design narratives, and following this, we present the design patterns that we have collectively abstracted from them.

5. Design narratives

The design narratives produced are presented below using the STARR presentation template.

<table>
<thead>
<tr>
<th>1. Experts Corner (<a href="http://ilde.upf.edu/moocs/v/c5t">http://ilde.upf.edu/moocs/v/c5t</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Situation</strong></td>
</tr>
<tr>
<td><strong>Task</strong></td>
</tr>
<tr>
<td><strong>Action</strong></td>
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<tr>
<td><strong>Result</strong></td>
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</tbody>
</table>
**Reflection**

By introducing the “Experts’ Corner” activity educators were able to contain the advanced discussions happening in a beginners course to a specific area of the course so that both beginners and experienced programmers were happy to engage with the course as they pleased. Pre-created discussion areas according to themes arising from the course helps to facilitate interaction in MOOCs.

**2. Priming the forum** ([http://ilde.upf.edu/moocs/v/c5p](http://ilde.upf.edu/moocs/v/c5p))

**Situation**
The opening weeks of “H817 Open”, a relatively small MOOC, produced a profusion of disordered posts which could not be searched, organised, tagged or otherwise managed by either the moderators or by the learners themselves. Within days it was unmanageable for all but the most dogged. Some learners made use of a Google+ community which arose; a limited amount of interaction was also achieved between some bloggers. A significant minority of the formal students returned to their smaller closed forums after the first ten days. Whilst some of the discussion in the official forum was of an especially high academic quality, the dispersed discussions struggled to achieve the same. Many learners expressed deep satisfaction with the interaction achieved on Google+ and through blog comments, but these were largely experienced users of social media for learning.

**Task**
To elicit and support sharing of views expressed in forum posts in response to each week’s readings or webinar recordings, and to deepen discussion around these posts. Learners struggled to self-organise posts and threads, resulting in many individual threads with a lone post. As responses could not be organised after they were posted, the volume of threads became unmanageable for learners and staff to sift through and many posts elicited no response.

**Action**
Following initial suggestions by some students, forums for each of the following weeks were pre-populated with threads defined by their different work contexts.

**Result**
The pre-populated threads in the discussion areas allowed participants to more readily identify groups to join, based on common interests. Grouping in this way also appeared to increase the number of individual posts, which received responses.

**Reflection**
By pre-populating discussion forums with threads according to the types of discussions anticipated in the course, educators were able to create more meaningful interaction between learners where the MOOC participants did not just post comments but also received replies and maintained a meaningful dialogue or conversation.

**3. Academic magnet** ([http://ilde.upf.edu/moocs/v/c5l](http://ilde.upf.edu/moocs/v/c5l))

**Situation**
Despite the large number of forum posts as contributions to discussions in the “H817 Open” course in the first week, it was difficult to see many ongoing discussions. Many contributions were standalone posts by individuals, with threads containing fewer than ten posts with little linking or referring to one another’s posts abounding.

**Task**
The task for the course facilitators was to create dialogue within forums so that interaction developed, as the first part of creating an environment of trust and connection to facilitate the growth of discussion.

**Action**
The course creator and lead educator Prof. Martin Weller offered informal comment on several forum posts, notably also in the learner led social networking spaces such as the Google+ forum.
Result
As soon as Prof. Weller’s brief comments - even when social in nature - appeared on a discussion thread it created an enormous influx of posts to that conversation. These threads then became discussions or dialogues rather than monologues as were observed before.

Reflection
Learners like to receive feedback and to be noticed by the educator. In a MOOC learners and educators do not know each other personally, unlike in a face-to-face setting. In the online setting, an educator posting on a thread that a learner has posted seems to provide the impression that the educator is recognising or noticing the contributors/contributions of that thread. Learners may also see the discussions where educator has posted as useful, interesting, or worthy to follow. This could be a strategy used by learners to filter-out the information overload they face.

4. Endorsing helpful MOOC participants

Situation
In the “Begin Programming: Build your first mobile game” MOOC we wanted to encourage participants to help each other in solving problems. This was essential in this MOOC as the course was on beginner programming and there could be a lot of people new to programming struggling with little things like syntax errors because they did not know how to solve it or search for a solution on the web. Many first time programmers find it difficult to understand programming logic and because they do not know how to critically evaluate someone’s offered help they tend to wait for an educator or mentor to answer their questions, which in a MOOC is impossible to achieve.

Task
For each week in the course we created a discussion step ‘Let’s Help Each Other’ where we asked people who needed help to post their questions. Educators and mentors encouraged the other course participants to answer these questions and support each other. However, we discovered that participants were reluctant to accept solutions offered by their peers.

Action
The team of educators and mentors started to encourage and endorse particularly helpful answers by posting a small comment encouraging the replied participant thanking him and possibly adding something more.

Result
This action by the course team encouraged participants to answer more questions. It also was viewed by other participants as an ‘endorsement’ for the answering student so that he/she could be identified as a trustworthy person providing answers. This was especially useful in this course as the platform did not support ‘Community TA’ type roles provided by other MOOC platforms.

Reflection
If one is struggling to understand a concept (for example like a maths concept where there is one correct answer) unless you know that the person trying to help has some credibility you may be reluctant to take others seriously. Similarly in technical subjects participants coming from different disciplines and for the first time studying computing find it scary, especially if they are suggesting deleting a file, changing a configuration of your computer, which you have never done before. Not knowing how these changes would impact other programmes on your computer, it is reasonable that participants wait for reassurance. In this situation, they rely on a known party (teacher, teaching assistant, official mentors) in the course. When educators and mentors started appreciating participants who were helping each other, the learner cohort started accepting them as experts.
This narrative is somewhat complementary to ‘Wear your skills on your shirt’ (http://web.lkldev.ioe.ac.uk/patternlanguage/xwiki/bin/view/Patterns/WearYourSkills.html) design pattern.

### 5. Easy co-construction (http://ilde.upf.edu/moocs/v/c58)

**Situation**
As university teachers, BLOOC participants were particularly time-poor, but fast learners. We wanted to make the most of their visits to the course, no matter how brief. As a result, the course aimed to model effective Moodle learning designs that the teachers could use in their own courses. Rather than formally teach the pedagogy of online learning, we wanted participants to experience it themselves, particularly collaborative learning. However, it was unlikely that participants would take part in group activities that required co-ordination and regular contact.

**Task**
We wanted to add simple but engaging collaborative activities that were not dependent on simultaneous contributions from other course members (i.e. activities that involved individual tasks) but which would result in a collection of resources to create “social presence” (Kehrwald, 2010) by making the other participants visible, and effectively share teaching knowledge among the academic community at the Bloomsbury Colleges.

**Action**
We introduced one or more activities each week (these included a Moodle Glossary, a Padlet - padlet.com - “Wall of Media” and a Moodle database) that required participants to add an individual contribution that quickly grew into a rich set of interactive resources constructed by the participants themselves. The goal of the activity was to enable participants to experience a sense of community, build knowledge of teaching online together, and to experience learning through tools they could use in their own teaching.

**Result**
Tutors modelled each activity by adding an entry to the glossary or database, along with an image, or a virtual post-it note to the Padlet linking to an image or video and participants were invited to do the same.

**Reflection**
Motivation to participate was stimulated by the interactive dimensions of the activities – for example, the glossary terms could be auto-linked to words in the Moodle course, and the Padlet was simple, visually appealing and dynamic (e.g. a link to a YouTube video would immediately embed and play). The tasks themselves were successful in part because they were low-risk (requiring little technical skill) but high reward (the result was impressive). Participants were also able to create discussions around the tools about their plans to use the activities in their own teaching. The activities therefore created a light-touch social presence and prompted participants’ reflection on their own teaching and learning, which was one of the aims of the course.

### 6. Scaffolding interaction (http://ilde.upf.edu/moocs/v/c5c)

**Situation**
The Coursera MOOC “What Future for Education?” (University of London) was designed as a taster course for the Master of Arts (MA) in Education offered by UCL Institute of Education. One of the objectives was to create a similar learning experience to the MA which also involves online study. The MA is designed to encourage online students to actively engage in meaningful dialogue with their peers and tutors – something challenging to achieve on a MOOC because of the cohort size.

**Task**
We wanted to add simple but engaging collaborative activities that were not dependent on simultaneous contributions from other course members (i.e. activities that involved individual tasks) but which would result in a collection of resources to create “social presence” (Kehrwald, 2010) by making the other participants visible, and effectively share teaching knowledge among the academic community at the Bloomsbury Colleges.

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**Result**
The activities were effective in engaging participants. The glossary activity was the fourth most frequently viewed activity in the course including the introduction forum. The Padlet activity attracted many positive comments from participants, including expressions of intention to use it in their own teaching.

**Reflection**
Motivation to participate was stimulated by the interactive dimensions of the activities – for example, the glossary terms could be auto-linked to words in the Moodle course, and the Padlet was simple, visually appealing and dynamic (e.g. a link to a YouTube video would immediately embed and play). The tasks themselves were successful in part because they were low-risk (requiring little technical skill) but high reward (the result was impressive). Participants were also able to create discussions around the tools about their plans to use the activities in their own teaching. The activities therefore created a light-touch social presence and prompted participants’ reflection on their own teaching and learning, which was one of the aims of the course.
We were, therefore, concerned that the MOOC discussion boards could result in a list of comments without structure, and that constructive dialogue would not take place.

### Task
We wanted a means to scaffold exchanges between MOOC participants that would result in genuine dialogue to produce the kind of reflective learning that the MOOC was designed to achieve. In particular we wanted to create a supportive environment where participants would develop each other’s learning in a constructive way.

### Action
Each week we created a collaborative activity using Padlet as a “discussion starter”. Participants were asked to “Start the discussion” by posting an image on the Padlet to discuss in the forum in relation to the topic of the week, and respond to another participant’s discussion in a structured way. For example, in week 3, participants were invited to post an image, link or description on the Padlet of famously ‘good’ teachers from fiction (novels, TV, films), then to explain their choice in the forum. Participants were then asked to respond to two other posts by providing further arguments in support and then to develop the conversation by responding to prompts such as “What are the features of a “good teacher” or “good teaching”? Are some of these features universal, or are they context specific? Should teachers be paid according to their results?”

### Result
The ‘discussion starter’ role of the Padlet worked very well and quickly became a popular feature of the MOOC. Originally the Padlet was free-form, so students could post anywhere. However, as the posts appeared, it became necessary to switch to a more formal, grid format in order to make it easier for people to see all the posts (i.e. so participants were not posting on top of others’ posts).

Not all the discussion followed the structured format - some participants launched their own reflection of the issues, but there was a great deal of supportive exchange between participants nevertheless.

### Reflection
The Padlet wall became a rich learning resource in its own right that was constructed by participants, so even if students did not engage in the discussion at all, they would be immediately aware of the various ways the concepts could be applied to the world around them, and the different perspectives that could be supported. This created ‘social presence’ for students even if they did not actively engage in the discussion/co-construction.

### 7. Sharing views
Most learners in the “H817 Open” MOOC were education professionals who needed a clear learning focus to discussions in the forum. The mixture of formal and informal learners in a MOOC environment in early 2013 - a time when most educators had not yet experienced a MOOC - may have created the feeling of awkwardness of many learners in initiating interaction with their peers, a necessary first step to developing discussion. Whilst an introductory thread opened by a facilitator quickly grew to 90 posts, which referenced one another, most other threads tended to have fewer than five posts and many posts did not reference those of any other learner.

### Task
The MOOC design intended for learners to interact via comments on one another’s blogs, and to use the forum for discussion on some tasks - but not all. The forum was to provide peer interaction and support both from fellow learners and facilitators. In addition, this MOOC on open education and open educational resources (OER) sought to encourage open practice and the sharing of resources created.
In Week 1 learners were encouraged in the third MOOC activity to “create a visual representation that defines openness in education” in response to readings provided about these concepts. These representations were to be included in learners’ blogs.

A learner opened a thread in the official forum to share a link to a blog and other learners spontaneously responded within the thread, both sharing links to their own visual representations and commenting on one another’s. Their posts within this thread referenced other posts and interaction between learners was clear and included both supportive and approving comment on the content, the form of representations, and the sharing of techniques and tools to create them. This thread was the third most populous in the first week, with between ten and thirty times more activity than almost all other threads.

Learners appeared to have enjoyed the task, and were very willing to share their results, which might suggest that this felt less threatening for some than text-based responses. It was easier for learners to quickly engage with, appreciate the work of others and to comment positively. The visual form appeared to make it easier to grasp many other learners thoughts and views of the concepts without a large time investment. They began to interact more freely, not only in the formal MOOC forum, but also in other social networking spaces where these visual forms were more readily embedded into posts.

6. Design Patterns

<table>
<thead>
<tr>
<th>Pattern Name</th>
<th>Summary</th>
<th>Narrative evidence</th>
<th>Target audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Interest Discussions</td>
<td>Pre-group discussions around themes or interests to help facilitate/manage discussions for facilitators and learners.</td>
<td>Experts Corner; Priming the Forum.</td>
<td>MOOC designers; MOOC forum moderators</td>
</tr>
<tr>
<td>Celebrity Touch</td>
<td>Consciously use the effect of tutor posts in attracting learner attention to lend status to helpful or insightful posts from learners, and enhance peer learning.</td>
<td>Endorsing helpful MOOC participants; Academic Magnet.</td>
<td>MOOC forum moderators</td>
</tr>
<tr>
<td>Look and Engage</td>
<td>Create an individual collaborative task around a digital artefact to stimulate meaningful dialogues among large, diverse groups.</td>
<td>Scaffolding Interaction; Easy co-construction; Sharing Views.</td>
<td>MOOC designers</td>
</tr>
</tbody>
</table>

Table 1: Summary of design patterns identified
7. Pattern: Special Interest Discussions

(http://ilde.upf.edu/moocs/v/c5x)

Context: Discussions are a good way to engage learners. In MOOCs too, discussions are used as a pedagogical tool to provide the opportunity for the learners to co-construct knowledge by “talking to” other learners.

Problem: Finding a group of participants with similar interests to one’s own can be difficult in a MOOC discussion. This creates a large number of posts to the discussion but without there being a dialogue. That is, the participants post their views but hardly anyone notices them as there are too many posts to read in order to get to a post that is of interest to you.

Forces: MOOC platforms may or may not support introduction of divisions by the educator team.

Solution: In a MOOC where participants are expected to post in a discussion where the course team identify/anticipate different areas of interest or levels of learners, providing structure to the discussion by grouping discussion areas for special interests groups helps facilitation and learner experience.

Examples: Both in the “H817Open” course and “Begin Programming” course (“Priming the forum” and “Experts’ Corner” narratives) we have observed a marked improvement by introducing structured discussion areas.


“Celebrity Touch” http://ilde.upf.edu/moocs/pg/lds/view/2398/

8. Pattern: Celebrity Touch (http://ilde.upf.edu/moocs/v/c4x)

Context: In MOOCs thousands participate and it is difficult to be noticed among the crowd. Similarly there are large numbers of discussion posts by participants in the wide-ranging discussion forums. Some posts can provide insight and challenging ideas, but because they do not support the popular discourse they may not garner attention. Other posts can appear to be of less consequence to other participants, garnering more/less attention. On the other hand posts will gather where the ‘celebrity’ posts - in this instance celebrity being the lead academic/ tutors/ facilitators.

Problem: Massive cohort size requires discussions to be largely peer-led, but learners are not always in a position to differentiate posts from their peers that helpfully extend or clarify the discussion.

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CC-3 Ornate Red carpet backgrounds vector material 04

http://freedesignfile.com/25682-ornate-red-carpet-backgrounds-vector-material-04/
Forces: Posts with responses from course tutors can attract attention from learners in a way that posts from peers do not. However, the discussion can easily be misdirected if the tutor responds to posts that present misconceptions or those that take inflammatory positions simply to seek attention. Sometimes discussions around a tutor post have contributions that may not adhere to appropriate academic conventions, but nevertheless become prominent within the course. Tutor responses may draw attention and overshadow other good posts from participants without such a response.

Solution: Highlight posts that are helpful in supporting deeper understanding or broadening discussion by responding to them. Note that the presence of the lead academic needs to be judiciously deployed in light of the effect it has.

Examples: In “Begin programming” (“Endorsing helpful MOOC participants” narrative) and in “H817Open” (“Academic magnet” narrative) the effect on crowd attention to posts receiving facilitator or lead academic attention was observed.

Related pattern: “Chatflow (v2)” http://ilde.upf.edu/moocs/pg/lds/view/2134/
“Drumbeat” http://ilde.upf.edu/moocs/pg/lds/view/2166/
“Special Interest Discussions” http://ilde.upf.edu/moocs/pg/lds/view/2391/

Examples: An initial version of this activity was used in the BLOOC - narrative “Easy Co-construction”. This solution (including the two staged collaboration task followed by discussion) was implemented in the “What Future for Education?” MOOC (narrative “Scaffolding Interaction”). “H817 Open” similarly used visual artefacts as a response to readings (narrative “Sharing Views”).

Related pattern: “See Do Share” http://ilde.upf.edu/moocs/v/bvr

10. Towards a Pattern Language for MOOCs

Among the differences between supporting learning through interaction in forums in online learning and MOOCs, a major one is the much greater number of participants within a MOOC. For both facilitators and learners there is a need to organise contributions within the forum such that a meaningful selection of narratives and topics emerges from which the learner can choose to engage. Failure to do this results in too great a participation cost, in terms of time and effort required (Butler et al, 2014), which can lead to diminishing interaction. Complicating the effect of scale is the lack of fixed start dates and the number of learners, who may move in and out of in a complex pattern of participation (Kizilcec, Peich & Schneider, 2013; Ferguson & Clow, 2015). This makes conventional approaches to community development in online programmes less easy to map onto the MOOC environment.

The MOOCs we examined varied in style, size, target audience, subject area, and platforms used - the latter also reflects a differing associated pedagogical style (Ferguson & Clow, 2015). As such, an attempt to fully understand aspects of participation on these MOOCs through comparison of mere quantitative data would have been meaningless. Explanations for the phenomena we describe require an examination beyond massed data or an insider view. To this end, by initially describing in design narratives elements of our experience of MOOC discussion forums and co-construction activities, a basis was created around which we could begin to discuss and compare, and draw out the principles of practice and design which transcend a single MOOC or style of MOOC. This collaborative reflection developed into an iterative process of remembering and re-visiting our individual experience and prompted further narratives to be recorded. Commonalities in our experiences of challenges and successes in achieving meaningful discussion in these spaces for the maximum number of learners were then captured in the patterns presented here.

However, the design patterns we have presented here are partial solutions to the challenges of discussion, interaction and co-construction on a MOOC. The rapidly accumulating experience of designing and teaching or facilitating MOOCs within the teaching community has the potential to provide many more alternative solutions. We hope that our approach to representing and sharing our experience with MOOCs might act as a stimulus to others to elicit their own MOOC design narratives and patterns, and begin to share them more widely.

The role of patterns in “building on the success of others in a cumulative manner” (Mor et al, 2014) is to allow for solutions that are more widely applicable to be formulated. We hope these patterns can form a contribution towards the development of a pattern language for MOOC forum design. The idea of a pattern language is to combine design patterns into a practical guide to designing MOOCs. A MOOC pattern language will be a design solution of linked parts that are easily drawn on and applied to other designs in this sphere. To paraphrase Alexander et al. (1977), the pattern language could be used to help teach or facilitate a MOOC, or to design an individual MOOC activity; or to work with other people to design a full scale MOOC.

11. Concluding thoughts

With the arrival of MOOCs, the changing nature of online learning spaces has created challenges for design and facilitation. The need for conscious design to achieve interaction in learning in general (Laurillard, 2012) and interaction in forums in particular (Salmon, 2002) has long been recognised. Among the things to consider and capture in the future are: the effects on discussion of the different teaching attitudes expressed in platform design; the non-linear paths of participation within MOOCs; and the effects on interaction of participation that fluxes and might not persist. The constraints of platform providers on expressing a chosen pedagogy require awareness of the importance of developing tools that align with rather than dictate pedagogy.

The design narratives and patterns we have presented here are the result of our attempts to create new learning designs and implement new discussion moderation/facilitation approaches. These narratives represent our individual experiences, but were combined into design patterns that were supported by evidence from multiple MOOCs. This process has enabled
us to reflect collaboratively on our experience and produce evidence based pedagogy for MOOCs. We call for additional pattern development so that we can work towards formulating a comprehensive and cohesive pattern language for MOOCs.
References


Making it Personal: Understanding the Online Learning Experience to Enable Design of an Inclusive, Integrated e-Learning Solution for Students

Despite the availability of online learning applications and management systems used to deliver, house and organize e-learning content, students learning online continue to struggle with barriers that create an unnecessary disconnect between themselves and their peers, professors, the learning material and their parents (where applicable). Barriers personally experienced through participation in a synchronous online university-level graduate class, and documented barriers experienced by other students in similar distance learning environments, served as the primary narrative and driving incentive for this study. In addition to an extensive literature review, an in-depth study of a distance learning environment was conducted using an adaptation of Smart Design’s 6 Real People approach which included 5 persona’s, based on 5 real participants; a high school special needs class, a Masters of Inclusive Design Class, the Director of Education for Special Needs, A University Professor of Distance Learning, and a Visually Impaired User (Blind Participant). The users’ experiences were documented through means of ethnographic observations, direct observations, and detailed interviews. Findings from these revealed many barriers and disruptions, including psychological, emotional, social, gender-related, environmental and cultural issues that were detrimental to class involvement and student success. These findings were then synthesized and applied to create a prototype, called inClass, developed to address these barriers and provide a model for a more cohesive, unified and accessible e-learning solution. Although this paper does not refer directly to design patterns, and does not claim to follow a pattern-based methodology it demonstrates some effective user-centred design techniques which pattern scouts and authors should consider as powerful tools for mining, elaborating and validating patterns.

1. Introduction and Related Works

Participation in online learning across a variety of distance learning environments is growing rapidly due to increased affordability of enabling technologies and access to high-quality content. Yet in the midst of this growth many online learners cite feelings of isolation and poor communication (Dzakiria, 2008; Economides, 2008).

It seemed almost counterintuitive to continue reviewing literature about technical subject matter related to e-learning when our proposed design solution (and the motivation behind it) is user-centered; conceived from our own experiences and observations as distance learners in the Master of Design in Inclusive Design program at OCAD University. This meant moving away from reviewing literature that was technical in nature toward literature that is more focused on understanding what the distance learning experience is all about through the lens of students and instructors.
The first paper reviewed in this context was by Roussou (2004) entitled “Learning by doing and learning through play.” This paper highlighted interactivity as essential to learning citing Seymour Papert’s constructivist learning approach and the idea that the learner (or instructor for that matter) learns best when they are given the opportunity to set their own direction of learning. From a distance learning application interface viewpoint this could translate into providing the user with the ability to tailor their distance learning interface to their individual needs and preferences. In a 1987 paper by Malone and Lepper, challenge, curiosity, control, fantasy, competition, cooperation and recognition are also cited as essential to learning but more so as intrinsic motivations. These motivations could also be leveraged to improve upon current designs of distance learning web applications.

In much of the literature reviewed it was not just intrinsic motivations that were found to play a key role in determining the quality of a distance learning experience. One study by Dzakiria (2008) studied the voices of distance learners in Malaysia seeking to explore and offer a qualitative understanding of distance learner’s perceptions of their educational experiences in distance learning. The findings broke down into two major areas – student-instructor interaction and technology used. As concerns student-instructor interaction the greatest problem experienced by students was a feeling of isolation. Many students expressed not knowing how to communicate or ask for help from their instructors, feedback from instructors was not timely and when feedback was provided learners were unsure of the instructors meaning. In the case of technology used most learners wished it was simpler to use stating in one instance, that “technology used in this course looks complicated.” Overall, the findings from this study determined that for a quality distance learning experience essential elements include: a) an environment that is safe, flexible and facilitates learner support, b) a more personalized experience and c) being made aware of what it means to be a distance learner vs. in-class learner.

A second paper entitled “Serving Non-Traditional Students in E-Learning Environments” by Miller and Liu (2003) also does well at uncovering perceptions of students’ and instructors’ e-learning experiences. As in the Dzakiria paper, they too find that faculty mentoring, speedy responses to student inquiries and personalized responses to students rank as the most important aspects of enhancing non-traditional student learning. Unlike the Dzakiria study however this study also profiled aspects most important to instructor distance learning experiences. They found that most instructors tended to use group projects and open discussion as methods of choice.

Another study by Tham and Werner (2002) wraps the student, instructor and technological aspects of e-learning into one concluding that online learning success is found at the intersection of all three. As concerns the instructors they highlight that online educators wear many hats (technological, pedagogical and social) as noted by Bonk (2000). Of these, the social hat is even more important in distance learning because, as was observed by Dzakiria (2008), students typically feel isolated as if they are in the dark. Technological communication tools should be used to alleviate this by helping to establish a friendly, cohesive and inviting learning environment. In terms of the student this is the first paper that makes mention of learning styles and the importance of understanding the learning styles of students to avoid things such as mismatch of a diverse cohort in group work which can result in poor performance and hinder learning. This study does not go into detail about how the learning styles may be evaluated.

The previously cited Gunasekaran study (2002) does touch on how learning styles may be evaluated. It makes mention of Knowledge Pool, an e-learning and training company that introduced a preferred learning style evaluator. Called the Insights Discovery System Evaluator and Report it assesses personality, decision-making and communication styles. Paul Butler, CEO of Knowledge Pool is quoted as saying, “By suiting students personalities and providing the motivation inherent to their learning styles, we believe that students are more likely to utilize, retain and seek additional learning when these tools and methods are applied.” Integrating a learning style evaluator tool into a web application for distance learning to create a learner profile that provides transparency to learner preferences before a course is started could significantly aid in improving the overall distance learning experience.

Adding another dimension to the topic of learning styles and profiles and the importance of evaluating and understanding learning styles in the e-learning environment is a paper by Economides (2008). Economides paper entitled “Culture-aware Collaborative Learning” cites that cultural differences of individual learners affects their collaboration and thus their learning and suggests that the collaborative e-learning environment be adapted to the learner’s cultural profile. “Learners with diverse cultural background may have divergent modes of communicating, interacting, and working. They may...
have different views of the world, different values, behaviors, and attitudes. They may also develop different feelings and thoughts during the collaborative learning activities. Therefore, the system should take into consideration cultural aspects of the learners in order to support every individual learner as well their efficient interaction and goal accomplishment.”

Taken together, this review of related research about what makes a quality distance learning experience, and the value of directly studying the types of experiences distance learners have had in the past, provides valuable design patterns that can be leveraged to design a solution that can truly provide an improved distance learning experience.

The goal of our research is two-fold: 1) to identify opportunities for personalization of the digital learning experience through in vivo study of a distance learning environment and; 2) to understand how digital media might be leveraged in the design of a new e-learning solution that successfully preserves the individual needs of online learning participants.

2. Research Methods

2.1. Justification

Qualitative ethnographic research methods consisting of observations and interviews were chosen as most appropriate research methods for achieving our research goals. Observations provided for a general understanding of the learning dynamics associated with several different learning environments including corporate training, distance education and special education classrooms. Observations involved both “insider” and “outsider” observers to provide for inclusive perspectives; the “insider” experiencing shared user frustrations, and the “outsider” possessing necessary usability expertise. The knowledge gained from the observations then allowed us to dive deeper into researching the problem by way of a targeted interview to validate and confirm our findings.

Our ethnographic observation-interview methodology was modeled after similar methodologies used successfully in the design world. IDEO, a world-renowned design consultancy, subscribes to the human-centered design process and developed the Human Centered Design Toolkit or HCD for short. It breaks down the research process through the lenses of Desirability, Feasibility and Viability. The HCD process itself is to:

- HEAR (collect peoples stories and inspirations)
- CREATE (take what you hear and put into frameworks and prototypes)
- DELIVER (realize your solutions through implementation)

Much of the ethnographic study and observations are completed during the “HEAR” stage.

Smart Design, a consulting and innovation firm established in 1980 with the idea that design should be about people, not things, also utilize an ethnographic approach to their research. Dan Formosa, founder, states that,

“Design should also consider the needs of a wide range of people, not a homogenized “average”. People are diverse. Just as important, any one person can find his or her self in a diverse number of situations. In past projects our rejection of an average person or stereotype as a target, replaced with an understanding of diverse needs of many people, has led to a variety of innovations in product design. It has therefore been our point of view, for a long time, to reject the notion of “average” or “ideal” and consider the real world (Formosa, 2009).”

This view led to Smart Design’s creation of their “six real people” approach, a method that focuses design efforts on a range of real people, typically outside the average user base and more at the extremes. The idea is simple. Identify six real people, each of whom the design team wishes to accommodate (or impress) with a new product – then design that product so that it does, in fact, impress all six (Formosa, 2009).

The very nature, and successful use, of ethnographic observations and interviews to gain insights into several aspects of the person-product interface including - psychological and emotional, social, gender-related, environmental and cultural issues - informed our decision to deploy them as our primary research methods.

2.2. Participants

The research process began by identifying and creating 5 personas. Although a fictitious description, these personas were developed based on observations of actual users of distance learning. They ranged from diverse students to instructors to corporate personnel. However, further in our process these
 personas served as a basis for our decision to use the six real people approach described earlier with the exception that we focused on five representative real people instead of six to drive the development of our idea as depicted in Figure 1 below.

Our first real participant was the entire Master of Inclusive Design class comprised of twenty-one graduate students (eight males and thirteen females). The students were ethnically diverse ranging from Asian, White, and African American to Aboriginal. The students meet twice a week (Thursday and Friday), four hours each week, for sixteen weeks. It was common to have nine students attend class virtually and twelve students attend either virtually or physically. The participants attending virtually consisted of students within Canada, the US, and the UAE.

The high school special needs class consisted of two teachers and fifteen special needs students ranging in age from 14-21 years of age. This class is housed within a regular high school building and is contained within its own classroom environment. Students range in ability from non-verbal to verbal, wheelchair bound to fully-abled, non-readers to 2nd/3rd grade level and includes students with Down’s syndrome, Autism and Intellectual Disability (formerly Mental Retardation). Both classroom teachers were interviewed. Both are females. One teacher is in her late 30's while the other is in her early 60’s.

The director of education for the special needs at the learning development center is involved in shaping the early years foundational curriculum and structure of educational formats. The center looks after kids that may not be able to attend schools for average students. The students at the center consists of down syndrome, aspergers, autism, motor skills and other physical and intellectual disabilities. The center also conducts educational psychology assessments, therapy assessments and multi-disciplinary assessments for children age 0 - 18 years. The interviewee provided insights as to how digital inclusion and digital design could assist in education for special needs children and some of the areas where it could fill a gap in the industry.

The blind participant in this study is an accessibility expert in the financial industry. His day-to-day work includes providing stakeholders project advice on accessibility-related issues and certifying projects that meet compliance to the Company’s accessibility guidelines, and among other tasks. The blind participant is also a part-time researcher of accessible information and communications technologies in postsecondary education. Given his credentials, it was important that we kept the interview casual and open-ended so his responses do not influence our research objective, or create design fixation.

The university professor participating in this study teaches at a reputable college in Toronto, Ontario, in the field of health care. Her classes include diverse groups of students; multi culturally and geographically. Classes are conducted through online learning tools as well as the option to be present in a classroom setting. Students are given schedules with links to online class meetings prior to the beginning of the semester. Tools used in each class include basic features; such as video conferencing, text chat, audio conversations, and screen sharing.

2.3. Procedure

Research of our five real people was conducted either in the form of ethnographic observations, interviews or a combination of both depending on the situation. The research team, consisting of four members with diverse skills and backgrounds, conducted the interviews and observations over a total of twelve weeks.

When conducting observations the team observed learners in their normal classroom environment from the start to the end of class. For observation of the Master’s class, two different classes were studied on two different days and times. In the first class remote conferencing equipment was set up including the required videoconferencing software. The software we tested included Adobe Connect, Skype, Google Hangout and GoToMeeting (Figure 2). In the second class we...
had an administrator organize the virtual meeting logistics. Common to both classes was the use of a laptop, speaker, microphone and recording device. Both classes also used the learning management system, ATutor. Student and teacher comments and feedback were captured using pen and paper and feedback was documented in Google Docs. The participants were unaware that we were observing and documenting their behavior and comments. For observation of the high school special needs class one class was observed in one sitting from start to end of class. During this time learners were observed participating during one lesson. Observations of learners were written down and then later documented for further study in a Microsoft Word document.

Interviews were structured to be informal and/or casual conversations with interviewees. Four series of interviews were conducted; one each with the director of education, the university professor, the blind participant and the teachers of the high school special needs class. Three of the four interviews were conducted face-to-face allowing both verbal and non-verbal responses to be captured. Responses were captured using a pen and paper and compiled as results after the interview using Google Docs. Our fourth interview, with the blind participant, was conducted through instant messaging. To see and hear the questions our blind participant used the JAWS screen reader and a standard mouse and keyboard. The interviewer captured notes using a word processing software as well as reviewing the chat log, and summarized the responses in Google Docs after the interview. All interviews lasted one hour or less.

The twelve weeks during which research was conducted were divided into three time periods herein referred to as Phase 1, Phase 2 and Phase 3. Phase 1 consisted of studying the Master’s class. This part of the research was conducted over six synchronous online class sessions spanning eight of the twelve weeks. Three researchers collected data remotely via Skype chat transcripts which were later analyzed while one researcher collected data via traditional in-class, face-to-face classroom observation of student interaction. There were no set criteria for data collection. Both positive and negative feedback was collected including comments from students and instructors, verbally or virtually (through chat), during the two hour lecture. At completion of each class session data was compiled using a collaborative software, Google Docs, and analyzed for similarities, differences, gaps and opportunities.

Phase 2 involved direct observation of the high school special needs class in their class learning environment. This took place over a one week period. The class was observed for a period of sixty minutes. Only the teachers were made aware of our intent to observe the class ahead of time. There was no interaction between observer and students during the class session. The students were observed as they participated in their class session and notes of observations were made accordingly.

Phase 3 involved conducting interviews with each of our real people directly over a period of two weeks with the exception of the Master’s class. Each interview subject was briefed about our intent, asked if they would be willing to participate and then signed a consent form. Two open-ended interview questions were also prepared ahead of time to serve as seed questions for eliciting additional interview feedback about each subject’s distance learning experiences. Each person was asked the same two seed questions. Question 1 asked “Do you see a gap in the day to day learning and/or training that happens here where you believe that technology can help close that gap?” Question 2 asked, “If you had access to a digital application that allowed you to connect better with your learners (and their stakeholders)
what are your thoughts on that?” Responses to these questions were captured as well as additional discussion points.

3. Results

3.1. Observations and Interviews

The sections that follow summarize both observation and interview outcomes from each of the five real people.

3.1.1 Master of Inclusive Design Class

The insights yielded from data collected from Skype log transcripts and direct participant observation of this class (Figure 3) pointed to five major gaps in the learner experience. The first gap was that of set-up struggles and inefficiencies. Specifically, it was noted that valuable class time was being lost on the front-end of class on account of two major issues: i) trying to sort out audio and video requirements and; ii) trying to figure out who was present, either physically or online, at the start of each class session. These issues, in turn, pushed an actual class start time to fifteen minutes later than originally scheduled causing the class to either be cut short or run fifteen minutes over on the back end.

Figure 3: Students of the Masters of Inclusive Design program, participating in a distance learning environment.

Messy work flow related to content logistics during class time was noted as another significant gap. Recurring issues included poor transparency to links, usernames and passwords which caused frustration and inefficient use of class time required of peers to share these with one another. Furthermore, in order to send emails or communicate with peers during the class learners would have to step outside of the native meeting app to send emails or use back channel chat. When using chat, it was also noted that many students had difficulty following conversation streams as there were several different topics of conversation running at the same time.

The third gap identified was participant barrier. Both virtual and physical learners expressed on several occasions feeling as if an invisible barrier existed between participants making for an impersonal learning experience. Much of these feelings were associated with participant inability to see body language and affective expressions.

Fourth was lack of responsiveness from the actual collaborative classroom meeting software application being used. For example, microphones left unmuted by users captured unwanted and distracting sounds such as someone typing on a keyboard, a dog barking in the background or the sound of a PA system at the train station. The inability of the software to respond to such unwanted distractions creates interruptions for all learners and in some cases completely breaks the flow of the lesson.

The final major gap was found to be an overwhelming need for optional non-verbal methods of communication. Not surprisingly, since non-verbal communication makes up two-thirds of all communication (Gobron, S), participants expressed the need for options such as video and captioning.

3.1.2 High School Special Needs Class

Observations of this class occurred during a physical education lesson that involved students interacting with Microsoft XBox Kinect with Motion sensor and a game called Motion Explosion. The first ten to fifteen minutes were taken to set up the game for play. A considerable amount of effort went into achieving buy-in from students on what game to play, figuring out how to physically choose what game to play and how to setup customization options illustrating the importance of making interface options and choices for participation more obvious, easier to use and easier to understand.

Once the game was chosen (a dodgeball style game) and set up accordingly the students began to play. At the outset it was clear that many participating students had a difficult time understanding what to do with many requiring help in the form of verbal and physical cues from the teacher. The game itself did nothing, nor were there any options for providing cues and examples to the players on why they needed to do again illustrating the importance of a simple, easy to use interface.

During game play it was also noted that many of the participants were looking for reaffirmation of a job well done. The game did not provide any since most of the participants, many of whom have severe physical and intellectual disabilities, were performing at a level lower than the system deemed acceptable. This was a significant takeaway in that it points to the need for applications that allow users, or their teachers, to set user
performance goals in line with the physical and intellectual capabilities of the user so that appropriate feedback and reaffirmation can be given (rather than not at all).

During game play it was also noted that, particularly for wheelchair-bound users with significantly reduced mobility, sensors were not able to recognize their movements and kept timing out. In fact, one of the teachers commented that “Microsoft said it had problems recognizing people in a wheelchair.” This brought to light the need for applications to do a better job sensing inputs from users and to provide the option for users to adapt the interface to accommodate for decreased motor skills.

Finally, it was also noted that participants could not tell who they were when their scores for “Player 1” or “Player 2” came up or whether they did well or not. There was no easily recognizable visual of themselves. In a related instance black students were using white avatars. There was no way to customize the avatars to allow for personalization to suit personal player preferences. Clearly digital applications, especially those used for learning, need to do a better job at representing user likeness not only to improve learner self-recognition but also to increase learner engagement and cultural relevance.

3.1.3 Director of Education for Special Needs

To understand from the perspective of education administration we had interviewed the education director at a centre that looks after diagnosis, therapy and education. The participant referred to personalization in the interface as a means to control colours. This is due to children with special needs often being sensitive to certain colours such as bright tones. She also highlighted that it should not be the instructor’s or parent’s task to identify the color scheme. As a user, the application should be expected to know what is right for a specific user. This could mean a set of color themes available for selection but the selection must be carefully selected.

The participant also brought to our attention that working parents are less fluid in communicating with the instructors, trainers and therapists. It would be great if digital inclusion could solve this problem and make parents more proactive in sharing and communicating with their children’s instructors. A forum or tracker based communication approach could add a lot of value. Another feedback was to make parents be able to digitally participate in assisting children complete their tasks and assignments. Instructors always wished they could have instant feedback from the parents on their children’s development and behavioural patterns at home. It is vital for the child’s development that parents are able to track progress of their child’s exercise and be able to communicate directly with their teachers, which is especially important.

The participant also brought to our attention that most learning applications are dull and boring. These systems are engineered and lack the spark of creativity in the user interface or fail to promote creativity in children. In most cases, the difference between using traditional methods and digital applications are only in the use of technology or hardware. There seems to be little thought and value placed on children’s emotional or interest points in the digital environment. Although some iPad apps are emerging most are designed for individual use rather than a classroom environment. The digital inclusion should be blended with good inclusive design or inclusive creative graphics to encourage and motivate students to get involved.

3.1.4 Visually Impaired User (Blind Participant)

Our blind participant provided several responses about the current state of eLearning systems. He felt that current learning management systems were not completely accessible, particularly for visually impaired users, and provided three reasons. The first is that most learning management systems comes from many third-party sources, making it difficult to customize. The second is that shrink-wrapped learning management systems are often white-labeled, and as a result does not provide a one-size-fits-one solution. And third is that most learning management systems are designed for sighted users. For example, interactive learning exercises, such as dragging-and-dropping of elements on screen become irrelevant without an alternative learning method. Another example he provided was multimedia, such as video, which is difficult to use if course designers do not provide video captions or descriptions.

When asked in what ways do you think designers can improve eLearning systems for personalization, the participant responded that systems should have a familiar interface in which people already know of. For example, many people already know how to use Facebook. Having a learning system with similar features such as Facebook can decrease the learning curve and may increase the adoption rate. Another suggestion was to include the Universal Design of Learning principles as an integral part of the learning management system.
3.1.5 University Professor of Distance Learning

The University Professor participant commented on virtual communication, inclusion, and overall user experience, with regards to distance learning. The participant provided didactic feedback on experiences and communication within the class. She described a brief history of previous systems used for distance learning, and is content with the current software being used. Features that were found efficient include in-application recording, the option for video chat, and text chat. The participant continued to reveal that something is missing; the remote students do not participate as much in conversation, they miss out on non-verbal communication, and often not everyone is comfortable using webcam and audio. There are also accessibility issues with this system. For example, one class taught was located in the Bahamas. They did not have competent internet access, which made teaching classes strenuous. Some students do not have access to quality microphones and video which disrupts communication. Ideas to better overall learning include more efficient personalization options, language translation, technological support, and mandatory in-class sessions.

Collectively, the results of the above interviews and observations resulted in the identification of seven key design patterns, henceforth referred to as the seven core stages, that will improve the current e-learning experience: class awareness, attendance, class activity, peer interactions, assignments and tests, progress, and student-teacher interactions. In the next section we shall discuss how these findings led to the creation of our design artifact, the inClass concept.

3.2. Design Artifact

3.2.1 User Journey

Results about who we are designing for were compiled to aid in developing a user archetype of our five real users to help guide decisions throughout the development process. Creating this summary helped to understand the nature of the industry, understand user behaviors and to define objectives. Next, user-journeys were created (Figure 4) to illustrate how real people might interact with the potential platform. These journeys were communicated visually, with supporting text, sketches and photographs in the style of a flow-chart. The outcome allowed us to identify possible routes, and usable features that added value to the final design.

![Figure 4: A user journey designed to aid in understanding of user experience, and behaviours.](image)

3.2.2 User Experience Architecture

Based on the discoveries from the previous task we began sketching ideas that aligned with the user journeys to facilitate concept exploration, structure details and interface solutions (Figure 5).

![Figure 5: Common themes discovered through user journeys. Orange words are technical features, while blue words are emotional features.](image)

Subsequently, we then executed information architecture. We started by creating a low-fidelity site-map to address the pages that need prototyping and designing (Figure 6). Next, we defined a more detailed user-flow which acted as an evolving artifact through the various project stages.

![Figure 6: One of the low-fidelity site-map design concepts, focusing on dated to-do lists.](image)
We then created wireframes to design the portal experience and specify the interactions (Figure 7). Wireframing allowed us to test the design concepts through prototyping and helped us define the technology and functional behaviors of the project.

3.2.3 Touchpoint Map

Given the resource constraints encountered during this project creation of a touchpoint map as the culmination of our design artifact was decided upon as a reasonable compromise between development time and illustration of key functional features. A touchpoint map is a user experience design artifact that showcases potential system features, capabilities and functionalities, as well as user interaction. Subsequent design phases, such as creating wireframes, will allow designers to use the touchpoint map as a guide to design the interface and to refine system requirements. It also becomes the reference point for the designers to see whether they are hitting the benchmark in solving the real problems.

The sections below and respective figures therein describe each module of the touchpoint map. Figure 8 illustrates the touchpoint map in its entirety.

3.2.3a Class Awareness

The Class Awareness module provides students an easy way to conduct course administration throughout the school experience. This module removes the complexity of managing courses allowing students to concentrate on what matters most: learning. The Class Awareness module has three main features namely, course notification, course registration (Figure 9), and course recommendation.

The course notification feature reminds students of when the registration of the courses have begun. The system displays this reminder in the notification toolbar. The student can also set up email and text message alert reminders of registration dates.

The course registration feature lists applicable courses that students can take based on their student profile. This is done by showcasing the courses that the student is eligible to register for. The idea is to guide the user of what classes they need to join rather than making them search using class codes. Students
can then register for courses simply by selecting a course from the list and clicking the “Register” button next to the course description.

The course recommendation feature recommends courses (e.g., electives) students can take based on the student’s interests, feedback and academic progress. This feature works together with the course registration and notification modules, as described below.

### 3.2.3b Attendance

The Attendance Module is a single sign-on feature that allows students to use their inClass username and password to access external software systems and all other university-related logins (Figure 10). The idea is to streamline the whole process into one single dashboard which becomes the gateway to all things about their education and admin related.

This feature removes the need to remember multiple usernames, passwords, and system locations. Once the educator or system administrator adds the external system (e.g., GoToMeeting, Google Drive, ATutor etc.) to inClass through the Control Panel, students can then access the resource on their dashboard. As soon as the student selects the resource, the system will automatically redirect and sign in the user. Users also have the ability to easily switch between external applications by selecting another application on the application list, while maintaining a seamless transition between the two applications.

The Attendance Module also works with the Peer Interactions module, as described below. Briefly, the Peer Interactions Classmates Status Bar will display indicators (e.g., online, offline, etc.) informing the user who is available for a conversation or to collaborate.

### 3.2.3c Class Activity

The Class Activity module displays all course material, class and peer discussions, class announcements, and other school-related activities, on a timeline (Figure 11). This timeline works with the built in tagging engine. Once the educator or student submits content, the inClass System will automatically tag content by date, time and location. With tagged content, users can easily search and retrieve data through the timeline or using the search feature.

This feature integrates with mainstream document management systems, such as Google Drive, to allow students to use external systems and tools they are most familiar with and are comfortable using. This integration occurs once the educator or system administrator adds the document management system to inClass. After integration, students can then access inClass course materials, such as lectures, tests and assignments, from the document management system.
3.2.3d Peer Interactions

The Peer Interactions module provides students a simple way to take part in discussions and to collaborate. Students and teachers can start conversations in the inClass environment by first reviewing the Classmates Status Bar. This Status Bar shows user availability (e.g., online or offline) as well as the time difference of distance learners in other countries to ensure meetings are appropriate for both parties.

Students can interact with one another in three ways. The first method of interaction is through the forum (Figure 12). The forum provides a simple method to capture all discussions in a central and accessible location. The system automatically tags all forum content the student or teacher submits for easy search and retrieval. Also, when a teacher posts an assignment, this will go into the class activity feed whereby students can start interacting directly from the landing page.

![Figure 12: Wireframe sketches outlining features of the forum.](image)

The second method of interaction is by integrating a social network site with inClass, such as Facebook. Once integrated, students can then access and participate in forum posts and discussions through the social network site.

3.2.3e Assignments and Tests

The Assignments and Tests module provides students an easy and convenient way to see when tests and assignments are due (Figure 13). This scheduling tool works with the built-in to-do list. To illustrate, once the educator adds an assignment to inClass, the system will automatically populate the student’s to-do list with the associated task and due date. Along with a dedicated box for the student to submit their assignment. Only after the student has submitted the assignment through the system’s submission module will the system remove the task off of the student’s to-do list. To complement this module, students can also set up email and text message alert reminders of upcoming due dates.

![Figure 13: Wireframe design showing the Assignments & Test results on a mobile device.](image)

Apart from automated tasks, students can add their own tasks to the list, sync it with Google Calendar or other calendars via APIs.

3.2.3f Progress

The Progress Module is a feedback tool that shows students’ their progress for each class, such as marks and grades. The system displays this feedback with both text and graphics (i.e., charts) for easy comparison of feedback between courses and as an accessible alternative format (Figure 14). The main benefit of this module is to display all feedback in a central location, while also allowing access to this feedback through various entry points, such as the timeline. Another benefit is that educators can personalize this feedback (i.e., grading criteria) at both the class level and individual student level.
Our research has identified the following main benefits of this module. The first is that it provides an alternative form of communications for both the student and teacher during and after school hours. Providing an alternative form of communications can also benefit students that feel uncomfortable speaking in front of the class or need to speak to the teacher privately. Another benefit is that frequent communications allow the teacher to capture student feedback. Teachers can then use this feedback to build an understanding of what students currently like or dislike about the class to further customize the course material to better suit their needs and interests.

4. Conclusion

We have presented a design concept for a distance learning web application that, based on comprehensive user-centered research, delivers meaningful functionality that is inclusive of user needs and preferences. The barrier-based design narrative together with the multi-user, multi-environment research approach used to understand the current state of the distance learning experience from a diverse range of online learners and instructors provided a holistic and organic foundation for our identification of seven core e-learning stages: class awareness, attendance, class activity, peer interactions, assignments and tests, progress, and student-teacher interactions. Identification and subsequent transparency to these seven core stages provides for a rich use-case medium from which a truly personal and inclusive design concept prototype could be developed. Although presented as a touchpoint map rather than a fully functional clickable prototype it is our belief that this is just a matter of semantics in terms of providing a sound basis from which to realize a fully viable solution to improve the distance learning experience. Additionally, the user-centered design techniques used to inform the design of the prototype may provide pattern scouts and authors with powerful tools for mining, elaborating and validating design patterns. It is our opinion that given the research and proposed solution presented we have provided a substantial case for development of a solution containing the proposed feature set and for leveraging a learner/instructor-centric research methodology to develop similar distance learning solutions.
References


