ITERATIVE COURSE DESIGN IN MOOCS: EVALUATING A PROTOMOOC

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ABSTRACT

This paper describes an iterative approach to course design in an effort to improve the learner-centered conceptualization of Massive Open Online Courses (MOOCs). The research team built a (design research) MOOC prototype and used three measurement tools to gather user feedback. The authors categorized this feedback and translated it into 57 improvement tasks, which they implemented in the public version of the MOOC. They discuss the protoMOOC iteration approach, underline its applicability, and suggest it as a method for fellow MOOC designers.

Keywords: Design education, Life-long learning, Design learning, Design thinking, Massive Open Online Courses

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Cite this article: von Schmieden, K., Mayer, L., Taheri, M., Meinel, C. (2019) 'Iterative Course Design in MOOCs: Evaluating a ProtoMOOC', in *Proceedings of the 22nd International Conference on Engineering Design (ICED19),* Delft, The Netherlands, 5-8 August 2019. DOI:10.1017/dsi.2019.58

1 INTRODUCTION

Massive Open Online Courses (MOOCs) are a rapidly growing resource of digital educational material offered by universities and private companies. They present a valuable opportunity in the context of lifelong learning (Yuan, Powell & Cetis, 2013). With the expansion of MOOCs, we are also witnessing a growing demand for teaching a diverse range of subjects online, including design thinking. Design thinking is a popular human-centered approach for tackling complex societal problems or innovating products, services or systems (Martin, 2009; Brown, 2009). Teaching design thinking skills in an online course enables non-domain learners to apply user-centered approaches in their own work life, and offers domain-specific designers a way to explore other industry applications of design skills. As a MOOC, the course is open to all participants free of costs and thus enhances lifelong learning opportunities.

The research team faced distinctive challenges in conceptualizing and constructing a design thinking MOOC, though: As online courses have gained momentum, a debate about their effectiveness and user-friendliness has commenced. Courses often exhibit high dropout rates, and the format has been criticized for frontal teaching styles (e.g., Liyanagunawardena, Parslow & Williams, 2014).

In this paper, we describe an iterative approach to improve a design research MOOC with the goal of enhancing the user-centeredness of its design. In this way, we try to address some of these challenges. As a result, we hope to offer more effective online design thinking education for the public. The research team built and tested a MOOC prototype (protoMOOC) with a closed test group and deployed a threefold mixed-methods approach to evaluate and gather user feedback. Afterwards, the collected feedback was categorized and translated into actionable tasks. Based on these tasks, the researchers improved the MOOC and ran it publicly from August to October 2017. The motivation of this paper is to describe the protoMOOC approach, underline its applicability, and suggest it as a method for fellow MOOC designers.

2 AN ITERATIVE APPROACH TO COURSE DESIGN: SETTING UP A MOOC PROTOTYPE

Our motivation to run the protoMOOC was to test its content in a closed environment in order to iterate and improve the format, course design, and applicability of the course. We were interested in the process of a feedback-based advancement of an online course. We designed and ran the protoMOOC on the German MOOC platform openHPI. It was free of charge, offered certificates without tuition fees and was conducted in English.

The context of teaching and learning design thinking has been researched and improved (Beckman & Barry, 2007). Next to a growing supply of university courses and business coaching, first design thinking trainings are offered in online courses. We assessed existing design thinking MOOCs and derived best practice recommendations from them (Taheri & Meinel, 2015). Subsequently, we built a prototype version of the design research MOOC based on three pillars: the best practice assessment, an evaluation of the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson, 1987) in MOOCs (Siemens & Tittenberger, 2009), and findings from testing learning material with a student group (Taheri, Unterholzer & Meinel, 2016a).

A crucial course design decision for the protoMOOC was the choice of providing a skill-based and individual learner course (adapted from the classification of learning outcomes by Kraiger, Ford & Salas, 1993 (Taheri *et al*., 2016b). In this way, learners individually acquire skills that are crucial for the design thinking process. We thus reduce the participants' expenditure of time by avoiding teaming up and project work procedures and allow more room for self-paced learning. Thereby, we intend to establish an easily approachable, user-friendly entry-level course to design research. The protoMOOC introduced learners to design research skills, which are crucial in design thinking. While the term "design thinking" in managerial discourse is quite ambiguous (Johansson-Sköldberg, Woodilla & Çetinkaya, 2013) and several professional design practices are taught under the label of "design thinking" (Dorst, 2010), Carlgren, Rauth and Elmquist (2016) found the five recurring themes of user focus, problem framing, visualization, experimentation and diversity in industry application and research. These themes further inspired our focus on crucial design research skills.

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In another didactic decision, we split the design thinking process into three skill-based MOOCs. While there are different visualizations of a design thinking process, e.g. by IDEO, the d.school at Stanford University (2010), the School of Design Thinking at the Hasso Plattner Institute in Potsdam, or the Rotman School of Management (Fraser, 2012), all these process models describe the three stages of data gathering, idea generation, and testing, in varying degrees (Carlgren, Rauth & Elmquist, 2016). The protoMOOC corresponded with the first phase of data gathering or "finding inspiration". We focused on two basic and crucial skills in this phase: Observation (being attentive to one's surrounding) and Qualitative Interviewing (planning and conducting an interview as well as finding surprising aspects and starting to interpret them).

We chose a mix of learning modes for the protoMOOC, e.g., videos, exercises, or peer assessment. A mix of learning modes functions as a prerequisite for active learning (Bonwell & Eison, 1991). Active learning means that students "engage, think critically, discuss, and problem solve as a natural and expected part of the learning experience" (Staley, 2003, p. 5). The protoMOOC consisted of four weeks: a welcoming or "warm up" week (1), two weeks of design research content (2 & 3, containing the units of Observation and Qualitative Interviewing), and a wrap up week (4). We defined the learning objectives based on the weekly content and knowledge goals for learners. Taking Bloom's taxonomy (1994) into consideration, we rephrased the course objectives as four learner objectives to be displayed on the course's landing page.

We recruited learners through university networks and thus addressed an international audience with both experienced and inexperienced design thinking learners. Only invited participants could enter the course, the protoMOOC was not visible to other website visitors.

The focus of this paper is to examine whether a mixed-methods, iterative protoMOOC approach is helpful to improve a MOOC in a learner-centered way.

2.1 Methods

Our iterative approach to course design consisted of a mixed methodology aiming at gathering and evaluating user feedback on the protoMOOC. We embedded a course evaluation survey (CES) before and after the course; integrated skill confidence ratings (SCR), and conducted 16 qualitative follow-up interviews. All three measurement tools used in the protoMOOC and their purposes are listed in Table 1.

Table 1. Overview of all measurement tools used to evaluate the MOOC prototype. QN = quantitative, QL = qualitative

Measurement Tool	Type of Measure	Measurement Purpose	Purpose for Iteration
Course Evaluation Survey (CES)	QN, QL	compare learners' course expectation and satisfaction prior to course start & after course completion; basic demographics	Which learning expectations were not fulfilled? When do we need to provide more support?
Skill Confidence Rating (SCR)	Pre: QN Post: QN, QL	examine learners' perceived skill development; receive feedback on unfulfilled needs per learning module (in post SCR	When did participants lack support? When could we provide more material or support?
Qualitative Interviews (QI)	QN	extract insights for MOOC iteration	When did participants struggle? Which problems did they run into?

2.1.1 Course evaluation survey (CES)

The purpose of the CES is to compare learners' course expectation and satisfaction prior to course start and after the course completion, as well as gathering data on basic demographics. The pre CES was integrated in the welcoming week, before any design research learning content was published. It consisted of eleven question items. The post CES was positioned at the end of the wrap up week and thus past the learning content. It consisted of 16 question items. The two surveys thereby bracketed the course. For course iteration, this survey provides information on how many participants felt that their

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learning expectation were met, allowing us to interpret which learning goals needed to be communicated more clearly.

2.1.2 Skill confidence rating (SCR)

We developed and tested the SCR with the purpose of examining learners' perception of their own skill development. It was positioned in the units of Observation (week 2) and Qualitative Interviewing (week 3). The survey requested learners to estimate their confidence with skills central to the methods before (e.g., How confident do you feel about preparing for a qualitative interview, e.g., writing an interview scheme) and after taking the module (e.g., How confident do you feel about preparing for a qualitative interview after taking this week's learning unit on Qualitative Interviewing) on a numerical Likert scale. The response scale for every question ranged from 1 ("not at all confident") to 10 ("absolutely confident"). In total, five items were checked for pre- and post estimation. Additionally, learners could give comments about what they missed in the preceding module via a text box. This open answer format allowed for prompt feedback on the modules, enabling the course instructors to relate the change in skill confidence to didactic design and to detect unmet learner needs quickly.
We thus used the SCR as a measurement tool for learner development, because it allowed course instructors to a) understand the initial level of participants' perception of their skills and b) understand the development of participants' skill perception.
The SCR helps course instructors to understand learner skill perception in a MOOC without multiple choice tests or other independent quantitative learner score assessments. For iteration, the SCR provides information about difficult phases for learners, and missing material or content for learners.

2.1.3 Qualitative interviews (QI)

We conducted qualitative interviews to learn more about learner experiences in the course. We asked participants to enter their email addresses if they were interested in being interviewed about their learning experiences and conducted 16 qualitative interviews with after the course end. Interviewees were categorized into design thinking novices, design thinking experts, and international learners. We commenced the interviews with a semi-structured set of questions, with 26 questions in the basic question set, and 12 and 5 additional questions for design thinking experts and international learners respectively. All interviewees were asked about their personal experience with the course content, the weekly learning material, the peer rating system, the discussion forum, the learning platform, learning modality and device use, as well as participant activity (regarding persistence and dropout). The set for design thinking experts included additional questions about design thinking methodology, didactic design and further recommendations, while international learners received additional questions about diversity consideration and support of different learning styles. For iteration, the interview notes helped us to identify when and why learners struggled, and which problems they faced during their learning experience.

3 PROTOMOOC EVALUATION RESULTS

In total, 125 learners enrolled in the protoMOOC. 43 learners took part in the warm-up activity, 30 submitted an Observation assignment, and 20 submitted a Qualitative Interview assignment. Below, we describe the evaluation of CES, SCR and interview results.

3.1 Course evaluation survey (CES)

Of 125 enrolled learners, n = 70 took part in the pre CES. Most of them belonged to the age group of 25-34 year olds (n = 33), followed by 18-24 year olds (n = 13) and 45-54 year olds (n = 12). More women than men participated (female: n = 40, male: n = 29). Most learners assessed themselves as "beginners" to design thinking (n = 33) and were new to taking a MOOC (n = 30 picked "none" as their experience level with online courses). An analysis of questions and comments revealed that participants needed more information on the certification, individual learner structure, estimated workload and required time, as well as the possibility of applying course contents prior to the course.
Participants were asked to phrase their learning expectations in the pre CES. An analysis revealed a wide range of expectations and needs that sometimes differed from the available course content. While some participants wished to explore or refresh their knowledge of the method of design thinking,

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others were hoping to learn about design thinking phases or aspects not covered in the protoMOOC. Several participants focused their expectations on the possibility of applying design thinking in their jobs and lives. Others described the wish of receiving a certificate for the course (having certified proof for their Curriculum Vitae) or exploring an online learning platform for the first time. The deviation of learner expectations and the learning objectives displayed on the course's landing pages indicated that the objectives needed to be phrased more clearly and should be positioned more visibly.
20 learners took part in the post CES. Overall, these learners were satisfied with the MOOC: On a scale from 1 (not satisfied at all) to 10 (absolutely satisfied), 6 learners rated their satisfaction with the overall MOOC with 9, followed by satisfaction ratings of 8 and 6 by 4 learners each. Nonetheless, needs for improvement were voiced in the questions and comments: Participants asked for a conclusive summary document, clearer explanations prior to exercises and assignments, clearer communication of deadlines, a revision of video subtitles and more design thinking application case stories.
Using the CES in the protoMOOC helped us as course instructors to understand participant demographics, learner expectations and learner satisfaction with the course, content and platform.

3.2 Skill confidence rating (SCR)

To analyse the quantitative data of the SCR, we calculated means. For the first module on Observation, n = 49 participated in the pre SCR, while n = 24 filled in the post SCR. For the second module on Qualitative Interviewing, n = 40 filled in the pre SCR and n = 24 the post SCR. After cleaning, the sample consisted of n = 13 participants. We exemplarily report on the findings from the Observation module: For Question 1, in a small cleaned sample (n = 13), means increased from M = 6,38 (SD = 1,71) to M = 7,69 (1,11). This change was significant, paired t(12) = -2,5 ; p = 0,03. For Question 2 (n = 13), means increased from M = 7,08 (SD = 1,04) to M = 8,15 (SD = 1,21). This change was significant, paired t(12) = -4,07 ; p = 0,001. Means for the question items are displayed in Table 2. The results indicate that the course content helps learners to develop more confidence with the taught skills.

Table 2. Mean comparison of SCR pre and post rating for all question items per learning module (n = 13)

Module		**Pre**	**Post**
Observation			
Q1	To what extent would you consider yourself being attentive to your daily environment (before and after taking this week's learning unit on Observation)	M = 6.38	M = 7.69
Q2	How easy is it for you to interpret what lies behind a problem (before and after taking this week's learning unit on Observation)	M = 7.08	M = 8.15

Participants made avid use of the free answer option in the post SCR for both modules. We sorted learner comments in a feedback grid, the categories being 1) positive comments, 2) negative comments, 3) open questions and 4) new ideas for improvement by participants. While learners stated that they enjoyed the topical sessions in general, they named two major needs concerning the didactic design of the protoMOOC. Firstly, they required more information on subtopics of the conveyed skills, for example by learning about the concepts of hidden needs, motivation, and non-vocal interviewee reactions. Secondly, they desired more in-depth feedback for their performance.
Using the SCR in the protoMOOC helped us to better understand learner development in the course, and to understand which information or concepts are missing or unclear for learners.

3.3 Qualitative interviews (QI)

We conducted 16 qualitative interviews with a semi-structured set of questions. All interviews were recorded and transcribed. To structure the interview notes, we once more applied the feedback grid tool. Interviewees shared detailed remarks about the different learning modules, their expenditure of time for different tasks and how they experienced the peer assessment.
We gathered a broad range of feedback through the qualitative interviews, which helped us to discover potential for improvement in several areas.

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4 MOOC ITERATION APPROACH

Our course iteration approach was threefold: 1) gathering data through CES, SCR and qualitative interviews, 2) sorting data in feedback grids and extracting a list of topics, and 3) translate structured feedback into actionable tasks.

We structured the feedback and learning gathered through the CES, SCR and the qualitative interviews in feedback grids. In the feedback grids, we identified 14 topics of improvement. Next, we merged the feedback grids of CES, SCR and qualitative interviews into one topical feedback list and sorted quotes or findings below the 14 topics. We translated the feedback for each topic into actionable tasks by using the "Keep/Change/Introduce" model, a feedback management model modification.

In total, we defined 82 tasks and chose 57 of these actions for implementation in the first course iteration. Most important changes regarding the 14 topic categories are listed in table 3:

Table 3. The most important iteration tasks for the 14 feedback topics derived from participant feedback

Feedback topic	Most important iteration task
Videos	creation of seven new course videos to condense and complement content and iteration of existing videos
Templates	iteration and creation of assignment and exercise templates
Additional resources	expansion of additional resources, including case studies from different industries
Structure, time commitment & deadlines	creation of clear time structure visualizations for the landing page
Course title and course objectives	change of course title for clarity
Course Design	creation of four expert videos to enhance the course content
Research Methods (survey design etc.)	introduction of "knowledge transfer" discussion forum posts as means of gathering information and encouraging skill application
Learning module "warm-up"	keep introduction week
Learning module "Observation"	creation of additional material for contextualizing the "job story" method
Learning module "Qualitative Interviewing"	restructuring and enhancement of unit to two weeks length
Peer Review Assignment	iteration of assignment rubrics, creation of example assignments and example feedback
Discussion Forum	introduction of "Bug List" post to report about possible technical errors
Addressing cultural diversity	adaption of assignment texts to emphasize cultural sensitivity
Other	creation of two module summaries in textbook format

4.1 Iteration task example

In the following, we describe the route from feedback to task within the topic "Learning module QI". We found a pattern through analysing CES results and interviewee quotes: participants struggled with planning, conducting and interpreting a qualitative interview within the seven days scheduled for the unit. We translated this feedback into the actionable iteration task of changing the "Qualitative Interview" unit length from one to two weeks by splitting up the tasks of conducting an interview and taking first steps towards interpreting it. This led to the creation of new lecture videos, templates and an updated assignment task. In the iterated MOOC version, participants went through one week of preparing and conducting an interview, and another week of interpreting surprising aspects in their interviews. The underlying motive was to keep the workload manageable for participants and to provide enough time and space for introducing the concept of interpreting interviews.

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4.2 MOOC iteration results

We ran the iterated MOOC on design research from August to October 2017. This time, the course landing page was publicly visible, and we advertised the course through social media, e-mail newsletters, and press releases. Like the protoMOOC, the course ran free of charge on openHPI and was conducted in English[1]. 5164 learners were enrolled at the middle of the course. 64% of enrolled learners visited the course, accounting for 3043 active participants at the middle of the course and 3491 active participants at the end of the course. According to platform data, enrolled learners came from 98 different countries, with the majority (2328 learners) being based in Germany, followed by the United States (232 learners) and India (134 learners). 932 participants uploaded the first assignment for Observation, 619 uploaded the second assignment for Qualitative Interviewing. 786 learners received a Record of Achievement for gaining more than 50% of total points (awarded through exercises and assignments) at the end of course. Thereby, 25,83% of active participants completed the course. Communication in the discussion forum was active: Course participants started 191 discussion threads and wrote 1912 posts.

Learner satisfaction and development in the iterated MOOC was once more assessed through a CES bracketing the whole course and SCR surveys bracketing the topical sessions.

Results from the iterated MOOC CES show that learners were satisfied with the overall course. On a scale from 1 (not satisfied at all) to 10 (absolutely satisfied), 84,75% of participants who answered the question item (n = 400) chose a value between 7 and 10 (see Figure 1). 136 participants rated their satisfaction with 8, followed by satisfaction ratings of 10 (by 70 participants) and 7 (by 67 participants).

For the question item of "How satisfied are you with the quality of the content presented in the course?", we see a similar pattern (n = 390): 89,49% of participants who answered the question item chose a value between 7 and 10. 130 participants rated their satisfaction with 8 (see Figure 2).

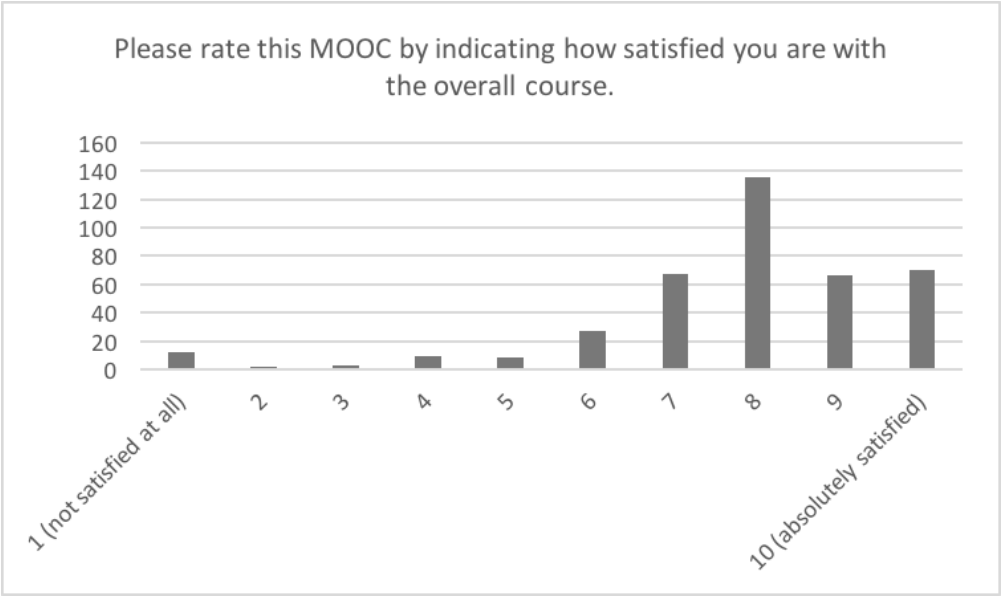

Figure 1. Post CES results for participants' rating of satisfaction with the overall course (n=400)

Regarding the exemplary feedback topic and iteration task of expanding the Qualitative Interview learning module, we discuss the question items focused on the learning module: 79,55% of participants who answered the question item "Please indicate to what extent the course met its objective of helping you to prepare and conduct good qualitative interviews?" chose a value of 7 or higher on a scale of 1 (not at all) to 10 (absolutely), with 116 participants giving the rating 8 (see Figure 3).

[1] The course is still accessible in archive mode: https://open.hpi.de/courses/insights-2017/

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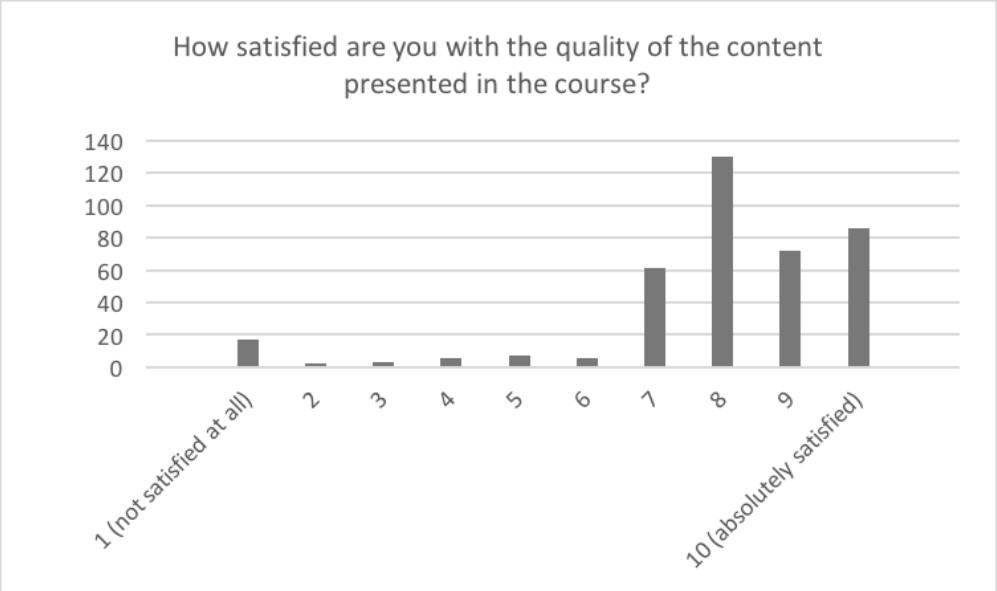

Figure 2. Post CES results for participants' rating of satisfaction with the quality of the course content (n=390)

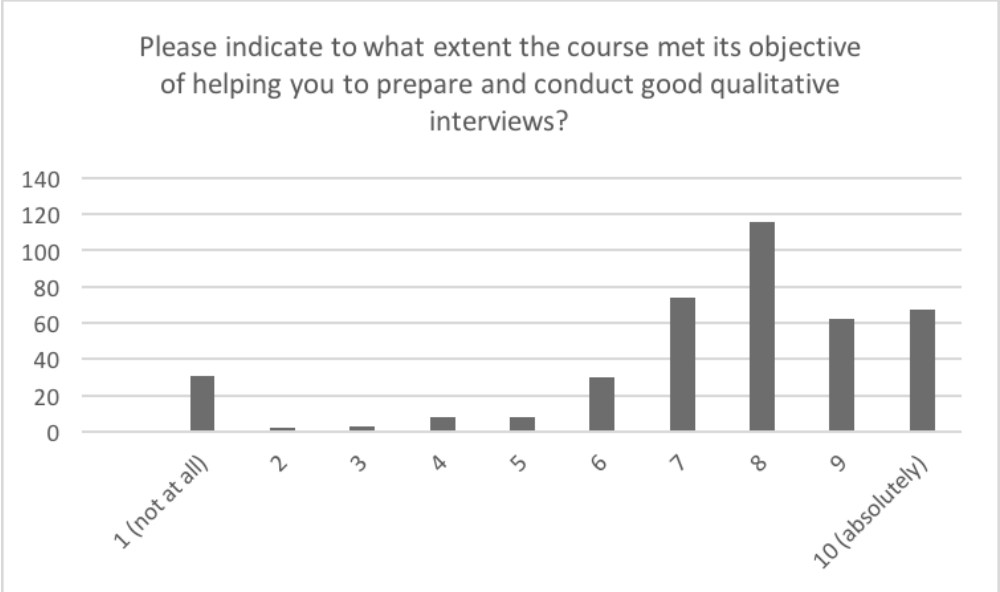

Figure 3. Post CES results for participants' rating of learning objective realisation (for preparing and conduction interviews) (n=401)

For the question item targeting the next week, "Please indicate to what extent the course met its objective of helping you to analyse interview notes and interpret interesting findings", 79,63% chose a value of 7 or higher (see Figure 4). In the survey's comment field, several participants voiced difficulties with managing their time for the weeks of conducting and interpreting qualitative interviews in the survey and stated that they "got stressed out" during week 3 and 4. Nonetheless, a majority of 84,89% rated the weekly workload of the course as "just right" - 266 participants out of n = 313.

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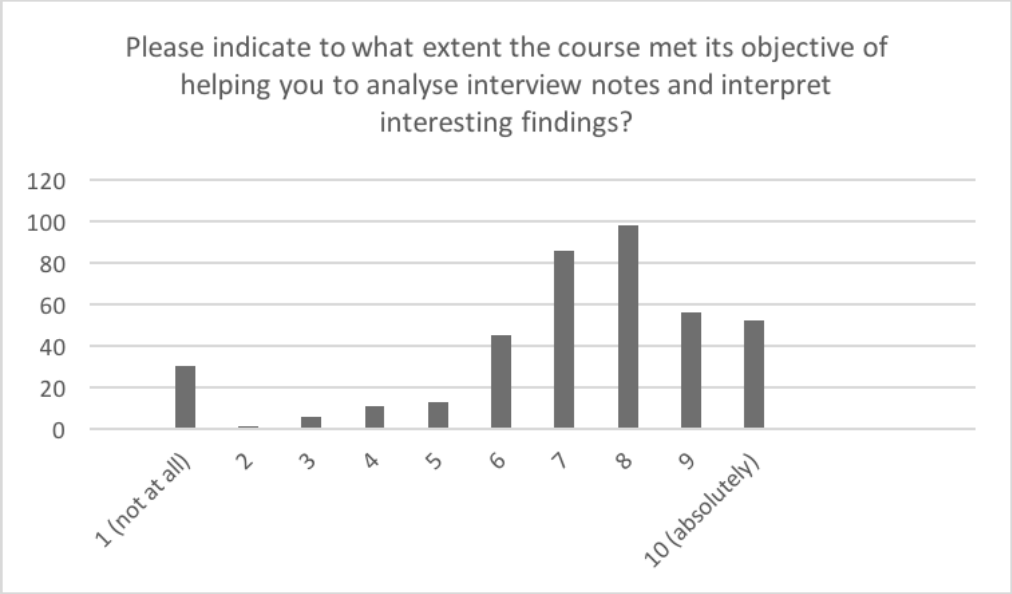

Figure 4. Post CES results for participants' rating of learning objective realisation (for analysing interviews notes and interpreting findings) (n=398)

5 DISCUSSION

The research team experienced the approach of building and improving a MOOC prototype as effective for online course design. Testing the course enabled us to eradicate technical errors ahead of time. The user feedback enabled us to implement 57 course content improvements. Overall, course evaluation survey results indicate that learners were satisfied with the iterated course. While we cannot conclude which of these content improvements impacted learner satisfaction, and in which way, we interpret the overall course satisfaction as a sign for successful course design. From the course instructor perspective, the course design was enhanced by the protoMOOC iteration.

During the iterated MOOC, active participant numbers were steady, with a decrease in the number of submissions from first (n = 932) to second assignment (n = 619). In comparison to the total number of learners who logged on to the course at least once (n = 3043), nearly one third completed the first assignment and around 20% finished the second assignment. These assignment submission numbers are high in relation to common online learner dropout numbers. Literature reports average dropout rates in MOOCs of up to 90% (Jordan, 2014). Although our completion numbers exceed average numbers reported by other course providers, there is still a large number of participants who quit. We thus cannot compare these numbers. Independent from the comparison we make here, we aim to find out how to support motivated learners to complete their online learning experience in future research and MOOC design.

A limitation of the protoMOOC approach is its small sample size for the quantitative measures (the skill confidence rating and course evaluation survey). While survey results informed us about general feedback and statistics, the 16 qualitative interviews proved to be especially fruitful for gathering feedback about user experience. We therefore recommend semi-structured qualitative interviews as a feedback touchpoint in the beginning phases of online course creation and to test protoMOOCs. Findings from protoMOOCs can help formulate hypotheses which can consequently be tested through quantitative measures in large size public MOOCs. The large sample sizes in quantitative surveys of public MOOCs consequently allow for validating or disproving hypotheses established during a protoMOOC.

5.1 Implications

User-centered course design and user-driven iteration of online courses can have a positive impact on both stakeholders, course instructors and participants. Learner and instructor reactions can be particularly enhanced when applying this approach during the course period. Making small changes to the course content or shooting short videos in reaction to learner feedback are easy ways to improve the in-situ learning experience. These on-the-go activities acknowledge learner feedback and treat

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online courses as adaptive matter. We hope to advance our course adaptability in future iteration even more through new tools and course elements.

Taking our own experiences in the course and the research findings of this paper into account, we conclude that the iterative protoMOOC approach is a fruitful and helpful tool in course design. Gathering the data through a mixed-methods research design, sorting the data in feedback grids and extracting a list of topics, and translating the structured feedback into actionable tasks in the protected realm of a prototype course can help course instructors to create an improved, more learner-centered MOOC. We recommend it to both novice course designers and experienced course designers taking on a new course topic.

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