Ask the Instructors: Motivations and Challenges of Teaching Massive Open Online Courses

[1]Saijing Zheng, [2]Pamela Wisniewski, [1]Mary Beth Rosson, [1]John M. Carroll
[1]College of Information Sciences and Technology
The Pennsylvania State University
{suz128, mrosson, jcarroll}@ist.psu.edu
[2]College of Engineering and Computer Science
The University of Central Florida
pamwis@ucf.edu

ABSTRACT
Massive Open Online Courses (MOOCs) have experienced rapid growth and attracted significant attention within academia. However, despite widespread acceptance of MOOCs as a unique opportunity to transform educational practices, many questions remain regarding their sustainability, given the high dropout rates and challenges related to collaborative learning support [12]. Recent research has attempted to address these concerns by analyzing students' MOOC experiences and how MOOCs may fall short in meeting students' learning needs [41]. However, very little research has approached the problem from an *instructor* perspective. We report an interview study of 14 MOOC instructors in which we used grounded theory to uncover the complex processes, motivations, and challenges associated with teaching a MOOC. A key finding is that we should provide support through the *whole* instruction process. By enhancing support for instructors and their MOOC collaborators, we may improve outcomes for all MOOC stakeholders, including students.

Author Keywords
Massive Open Online Courses; MOOCs; online learning; MOOC instructors; collaboration; motivation; challenges

ACM Classification Keywords
H.5 [Information Interfaces and Presentation] (e.g. HCI); K.3.1 [Computer Uses in Education]: Distance Learning; J.4 [Social and Behavioral Sciences]

General Terms
Human Factors; Design

INTRODUCTION
Compared with traditional online courses, Massive Open Online Courses (MOOCs) are larger in scale, distributed worldwide, clear of financial barriers, and without geographic constraints. MOOCs provide an opportunity to teach interesting or critical content to new groups of learners who may not otherwise have the chance to receive high-quality education [21, 31]. As such, MOOCs have inspired rethinking and innovation in university education. Tens of thousands of enrolled students create a disruptive scale factor that raises both new possibilities and challenges, while inviting new visions and agendas.

Although MOOCs have been broadly recognized and are considered to be an innovation in online education, researchers and practitioners have little understanding of what the best practices are for students, instructors, or even MOOC carriers because of the newness of the MOOC paradigm [41, 42]. The novelty of MOOCs has inspired a growing body of research on education and technology; example topics include new tools [10], adaptations to teaching practices, information, and course management [30]; and the experiences, motivations, learning activities, and outcomes for MOOC students [19, 41, 20].

To date, however, the majority of MOOC research focuses on understanding *student* motivations and behavior patterns [8, 19, 41, 20], and on enhancing teaching practices to best serve students' needs [41]. Surprisingly, little attention has been given to MOOC instructors, who play a significant role in making MOOCs happen. Thus, it is essential to understand MOOC instructors' experiences, their motivations to teach within this novel learning format, their associated challenges, and how they deal with these challenges, so that we, as researchers and designers, can help them more effectively teach MOOCs. In this paper, we report the results of an in-depth interview study of 14 MOOC instructors. The study was guided by the following research questions:

1) *How does teaching a MOOC differ from non-MOOC online courses?*
2) *What motivates MOOC instructors to teach in this format?*
3) *What are the key challenges associated with teaching a MOOC?*
4) *How can we better support MOOC instructors in a way that enhances their experiences, as well as facilitating positive student outcomes?*

Using thematic analysis and grounded theory, we first describe the steps involved in administering a MOOC through a process model abstraction: MOOC instruction involves

CSCW '16, February 27-March 02, 2016, San Francisco, CA, USA
 ISBN 978-1-4503-3592-8/16/02…$15.00
DOI: http://dx.doi.org/10.1145/2818048.2820082

preparation, *implementation*, and *feedback*. We further describe the complex and iterative nature of this process. Second, we identify four main motivations that influence instructors to teach MOOCs: *worldwide impact on students*, *professional growth, research opportunities,* and *enhanced name recognition*. Third, we discuss five important challenges associated with administering a MOOC: *logistical complexities of collaborative work*, *crises of time management*, *scaling to meet expectations, extreme criticism and reputation risk*, and *insufficient support*.

Our findings give insight into how we can better support MOOC instructors. For instance, we find that the collaborative ecosystem between instructors and other MOOC actors (e.g., curriculum designers, video producers, teaching assistants, etc.) is often overlooked within the MOOC platform, as most course management systems tend to emphasize the student learning experience, leaving the larger collaboration efforts of administering a MOOC to be managed externally.

Overall, our study provides actionable guidance for supporting instructors as part of the MOOC community. We offer suggestions for enhancing collaboration support, as well as provide other recommendations for supporting instructors based on their stated motivations and challenges. Our work also advocates for a view of MOOCs as complex collaborative ecosystems, as a complement to existing research that examines MOOCs as a novel learning pedagogy. We discuss implications and future directions for our research, with the goal of helping improve the activities and outcomes for all MOOC stakeholders through enhanced instructor support.

BACKGROUND

MOOCs as a Novel Virtual Learning Environment

MOOCs are a part of the open education movement, which is an initiative to broaden access to learning by removing geographic and financial barriers often present in the traditional university system [18]. Open education platforms (e.g., Coursera, edX, Udacity, etc.) leverage advanced technologies such as interactive, streaming videos to connect subject-matter experts to learners, virtually worldwide [15]. Although MOOCs share some functional similarities with other Virtual Learning Environments (VLEs; e.g., regular online courses), the pedagogical and sociotechnical disparities in terms of the massiveness and openness of MOOCs are likely to lead to distinctive teaching experiences for MOOC instructors and considerations for the design of both curricula and systems [41]. Generally, MOOCs are distinct from other VLEs by their primary goal of making course content freely available to a massive number of students, while retaining the quality of the curricula.

Specifically, MOOCs differ from VLEs in several ways: scalability, students' flexibility and extent of control over the learning environment, student motivations and outcomes, and the relative roles of instructors [41]. Typically, the class size for a VLE is comparable to that of a traditional classroom, allowing instructors to play a hands-on role with personal feedback to their students [21]. MOOCs, in contrast, are designed to accommodate a very large number of students, and thus change the primary role of the instructor. A MOOC instructor performs more as a facilitator, cultivating a space for learning connections to occur [9, 27, 40].

MOOCs can be divided into two different types based on different pedagogies: Connectivist MOOCs (cMOOC) emphasize connected, collaborative learning [12, 36, 37]. In contrast, content-based, extended MOOCs (xMOOCs) apply a traditional learning approach through video lectures, short quizzes and peer assessment [12, 36, 37, 40]. xMOOCs (edX, Coursera, Udacity, etc.) and cMOOCs share the notion of free worldwide participation in a course without credit. However, xMOOCs differ in that they employ a well-defined course management platform. Our research focuses on xMOOCs, which have recently emerged quickly and at a tremendous scale, gaining rapid attention from students and institutions [12]. All subsequent mentions of 'MOOCs' in this paper refer to xMOOC variation. For a more in-depth overview of the differences between VLEs, cMOOCs, and xMOOCs, see [41].

The MOOC as a Collaborative System

As researchers and educators have developed a greater understanding of the MOOC phenomena, they have recognized that this novel form of a VLE is not simply an online system for the widespread broadcast of learning materials, but instead it involves a variety of interactions, collaborations, learning processes, and social activities among students and between students and instructors. Indeed, a number of researchers have suggested that MOOCs be considered as a collaborative learning environment [10, 23, 41, 42].

Once we consider a MOOC as a collaborative system, questions concerning the structure and dynamics of that system arise. Who are the stakeholders and what are their motivations for participation? What are their activities and collaborative dependencies? For years CSCW researchers have investigated such questions in a variety of domains, documenting the often invisible and nuanced activities and handoffs that enable real world collaborations to succeed, even in unexpected and complex activity structures [32, 38]. In the case of MOOCs, we can begin to list some of the main actors (e.g., students, teachers, instructional designers) but know little about their collaborative relationships, independent or shared responsibilities, and dependencies. We offer our qualitative study of instructors as one step toward understanding MOOCs as a collaborative system.

Although MOOCs are offered for "free" to students worldwide, the online course development and administration clearly requires many resources from people and host institutions. Thus, one way to understand the collaborative system that underlies MOOC operations is to consider the associated business processes [28], with an eye toward improving the smoothness or efficiency of the same. In gen-

eral a business process can be analyzed across three dimensions: workflows, roles, and acts. By considering MOOCs from the perspective of such factors, we may anticipate potential "breakdowns" or failures to reach satisfactory completion; alternately, we may discover opportunities to improve MOOC outcomes [28, 33].

The business process perspective suggests that we might use a process model to better understand instructors' experiences in the MOOC environment, focusing on instructors' workflow, as well as the roles and activities involved. By decomposing the workflow, we might understand how instructors coordinate with each other, what are the relationships among their different roles, and supporting systems. This understanding should help us to characterize the gap between MOOC instructors' needs and current support.

The Central Role of MOOC Instructors

Although MOOC students are expected to play a more active role in learning than those in traditional VLEs, we argue that MOOCs cannot be successful if the instructors are not supported. MOOC instructors play the crucial roles of both *teacher* and *facilitator*. In addition to developing curricula, MOOC instructors must orchestrate many secondary tasks (e.g., recording lectures, guiding discussions, uploading course content, etc.) to facilitate the primary task of student learning. But MOOCs platforms, websites, and collaboration tools focus primarily on providing contexts for *students* to perform their learning activities, not on supporting instructors. Teaching a MOOC can be extremely difficult when classes are massive, students are diverse in their learning backgrounds and motivations, and contributors are highly distributed in terms of geographic location. In order to design appropriate support for MOOC instructors, we must first understand their motivations for teaching and the challenges they face during the process.

Several studies have briefly addressed MOOC instructors' within their research agendas but have done this as a secondary consideration to a main focus on students' experiences and outcomes. For instance, one study surveyed instructors about their teaching motives prior to asking questions related to their students [17]. Other studies have outlined general reasons why instructors want to teach MOOCs, including intrigue [1, 26, 30], personal rewards [17], and altruism [22]. Other research has identified some challenges during teaching, including heavy workload [4, 16, 22], difficulty evaluating students' work, lack of response from students [2, 5, 24], and lack of student participation [12, 30]. These student-focused findings provide little explanation of the rationales behind instructors' motivations and challenges, and thus offer only limited insight about support for MOOC instructors. Our work is the first qualitative study that examines MOOC instructors' teaching experiences in a holistic fashion.

Moreover, prior literature has focused on the implementation period of MOOCs (i.e., teaching students) without looking at the whole process of MOOC instruction (See **Figure 1**). As a result, these studies have limited implications for helping MOOC instructors solve problems they face in the process of teaching MOOCs or for enhancing their teaching experiences, thus improving MOOC quality. By understanding the entire process of teaching a MOOC, from initial preparation to subsequent MOOC iterations, we are able to identify challenges and present solutions that support instructors throughout the entire process.

In this paper, we first describe our interview methods and data analysis approach. Then, we present a process model of MOOC teaching that emerged from our analysis. We continue our results by describing three categories of findings: 1) instructors' motivations to teach a MOOC; 2) challenges they encountered; and 3) practical implications and possible design solutions that support MOOC instructors and their collaborators.

RESEARCH METHOD

Recruitment and Data Collection

We recruited MOOC instructors through our home institution, a large public university in the Northeastern United States. We also reached out individually to publicly listed MOOC instructors via email and through professional connections at academic conferences. We had two inclusion criteria for participation: 1) instructors should have at least two sessions of MOOC teaching experience; 2) instructors should also have experience in more traditional teaching formats, such as regular online courses and in the classroom. We chose these criteria to ensure that the motivations, challenges, and coping strategies that emerged from our interviews were unique artifacts of teaching MOOCs, as opposed to general struggles associated with prepping new courses or more generally teaching college-level courses.

Our data were collected in the form of semi-structured, face-to-face interviews. At the beginning of each interview, we gathered demographic information about the participant (e.g., gender, age, general teaching duration). We then asked participants about their general MOOC experiences (e.g., how many MOOC sessions they have taught, the MOOC general information, the platforms used to teach the online courses, how long they have been using MOOCs, etc.). Our particular focus was on the tasks involved in teaching a MOOC, the motivations for teaching, and the associated challenges. We also asked participants to compare their prior teaching experiences within other contexts (i.e., classroom or VLE) to their experience teaching MOOCs. Interviews ranged from approximately 40 minutes to 2.5 hours. All interviews were audio-recorded, annotated and transcribed for further data analysis. The interviews produced a rich set of recollections and descriptions addressing many issues in the MOOC experience, which have been summarized as a number of emergent themes.

Data Analysis Approach

We employed thematic analysis and grounded theory, which emphasizes the concurrent processes of data collection and analysis [11]. After we conducted a small number of interviews, we conducted a preliminary data analysis session to identify core themes. For example, instructors' teaching load and processes, motivations, and challenges emerged as key concepts in the first stage of analysis. After these main themes were identified, we used axial coding to further delineate categories and sub-categories. Themes and categories were further refined by an iterative coding process that involved the first two authors. The initial results provided a coding guideline, which was applied to the next round of coding for each new set of interviews. When subsequent rounds of analyses were not able to uncover new themes or categories, this demonstrated saturation of theory [11]. This occurred after we conducted our 13th interview, and our 14th interview further confirmed that theoretical saturation had been reached. In presenting our main emergent themes, we use participant percentages or counts to convey prevalence of each theme among our participants.

Participant Profiles

Our 14 interviewees included 2 Full Professors, 6 Associate Professors, 5 Assistant Professors, and 1 Senior Researcher. Our participants spanned various disciplines, such as Geography, Innovation, Art, Human-Computer Interaction (HCI), Computer Sciences, and Information Sciences. All instructors had college-level teaching experience through resident teaching, online teaching, and MOOCs. Among our 14 participants, we interviewed five females and nine males. Their ages ranged from 30 to 70. Nine participants were from the United States, and five were from China. When referring to our participants in the following text, we use a consistent pseudonym to protect their identities.

RESULTS

The Process of Teaching a MOOC

From our interviews, we first abstracted the tasks and activities described by our participants into higher-level processes, creating a model that depicts the complex nature of their work (**Figure 1**). MOOC instructors need to complete three stages for each MOOC they teach: *preparation*, *implementation*, and *feedback*. In the following sub-sections, we discuss these stages and the associated tasks in more detail.

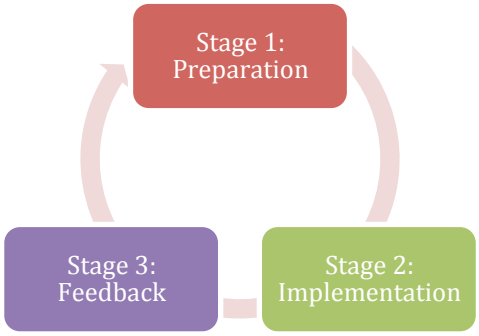

Figure 1: Process Model for Administering a MOOC

Stage 1: Preparation

A MOOC instructor's initial job is to establish and prepare the curriculum for the course. The instructor often must first submit a teaching proposal to the MOOC advisory office or committee within his or her university. For our sample of instructors, permission to teach a MOOC was granted because the proposal aligned with university requirements and strategic plans. After getting permission, the instructor designs the MOOC curricula by preparing teaching materials.

All of our MOOC instructors emphasized how challenging it is to organize appropriate content into 4-8 weeks of lectures that are clear and concise, especially when the anticipated audience varies so drastically. This stage usually takes a very long time to finish. Most of our participants believed they contributed at least 400 hours to preparation even before teaching a MOOC.

"I have gone through a long and tough period to prepare the course. Five minutes of lecture notes needs several times of modification. Lecture shooting consumes a huge amount of time 'cause I didn't have much experiences of working in front of the camera and I also hoped I could have a good image in the video." – Dr. Williams

Stage 2: Implementation

In the second stage, an instructor's primary duty is to launch the MOOC and ensure that it proceeds well. In doing so, instructors need to upload lectures, assignments, and announcements each week; solve problems (e.g., correct broken links of course materials, deal with students who are disruptive); answer questions raised by students; and update the social media account of the MOOC. One participant said he felt like a "firefighter" and was prepared at any time to solve problems as they arose.

"I always keep myself alerted because there were always something unpredictable happening. After making sure the lecture and other related materials are uploaded, I always keep an eye on the forum and even social media accounts. I need to discover the problems as early as possible to avoid a pile of complaints." – Dr. Hill

Although this stage does not demand as much time as the preparation stage, instructors experience mental pressure because they fear that their MOOC may fail if they do not deal with problems in a timely and appropriate manner.

Stage 3: Feedback

The instructor's job is not over when the MOOC ends. Our participants believed it was crucial to collect and organize the feedback and comments they received from students during the MOOC. They often tried to document comments from forum discussions, social media posts, and even student blogs. Then, the instructors incorporated this feedback into the redesign of the course for the next MOOC implementation, making this process iterative in nature.

"It is a tedious process to collect and select all the useful comments from tens of thousands of posts and discussions. But I have to do this because it's valuable for my future teaching." – Dr. Miller

Instructors spend much time manually filtering useful comments from the noise, but generally believe that this process is worthwhile for improving their future MOOCs.

Summary: Tasks and Collaborations

By analyzing instructors' descriptions of their activities and concerns into the three stages summarized in **Figure 1**, we were able to construct a broad picture of the lifecycle of a MOOC. **Table 1** summarizes the three stages of teaching a MOOC and lists various tasks associated with each.

Table 1: MOOC instructors' working procedures and tasks

Stages	Tasks
Stage 1: Preparation	✓ Submit proposal ✓ Design course ✓ Prepare teaching materials ✓ Shoot Lecture
Stage 2: Implementation	✓ Monitor course process ✓ Launch lecture and announcement each week ✓ Solve problems ✓ Answer questions ✓ Charge social media platforms
Stage3: Feedback	✓ Go through forum posts and Social media posts to collect feedback from students ✓ Redesign course based on comments ✓ Prepare for the next MOOC session

Importantly, we also found that instructors do not complete the tasks summarized above on their own. Collaboration across a larger team is an important and necessary part of a successful MOOC administration. According to our participants, the entire MOOC team ranged in size from 30 people to 200. For example, instructors need to collaborate with the MOOC committee of their institutions, curriculum design team, video production team, project manager, teaching assistants, technology coordinators, and the university MOOC strategy team. **Table 2** describes key activities and responsibilities performed by these collaborators.

Table 2: MOOC collaborators' responsibilities and activities

Collaborator Role	Responsibilities/Activities
Curriculum Design Team	✓ Assists in preparation of course materials
Video Production Team	✓ Facilitates digital recording of the teaching instruction
Project Manager	✓ Manages the project ✓ Makes sure the course is on time and on budget. ✓ Note: Only two participants said they have a project manager.
Teaching Assistants	✓ Helps answer students' questions ✓ Grades student assignments
Technology Coordinators	✓ Help solve technical problems on MOOC platforms
University MOOC Strategy Team	✓ Ensures that MOOCs offered by instructors align with university goals

Motivations to Teach a MOOC

While institutions often create teams to support MOOC instructors, the ultimate success or failure of a MOOC rests solely on the instructor. And, as shown in **Tables 1** and **2**, the complexity and hefty workload required to administer a MOOC is significant. Yet, all our participants *voluntarily* teach MOOCs even though their universities do not pay them additional money to take on this extra responsibility. One of our participants even covered part of the course expenses out of his own pocket. So what exactly is the appeal of teaching a MOOC?

We identified four broad types of motivations that influence instructors to teach MOOCs: *global impact on students*, *professional growth, research opportunities,* and *enhanced name recognition*. We present the motivations in descending order based how many instructors reflected the theme. Note that although the following discussion treats each of these themes separately, most instructors choose to be a MOOC instructor for multiple reasons.

Global Impact on Students

All of our MOOC instructors (14 out of 14) were motivated by the unprecedented opportunity to impact an enormous population of students. As college instructors, they usually teach classes with enrollments that range from 15 to 100 students. In a MOOC, they might teach over 45,000 students during one session! Moreover, these students are from different countries from all over the world. Instructors felt "thrilled" and "fruitful" because they could broadcast their knowledge globally to students who are learning on their own volition; they enjoy the opportunity to positively impact the lives of students who otherwise may not have such learning opportunities.

"You never have such a good opportunity to teach so many students! I still feel excited and incentivized to be a MOOC instructor, though I have taught three sessions. I still remember when I saw the enrolled student population had been so large that could fill a football stadium, I screamed! Every effort became so worthwhile that I never regret being a MOOC instructor." – Dr. Alberts

All of our participants are passionate about teaching and they believe that teaching more students during their career will add to their sense of achievement. They hope more people can benefit from their courses, and they see the

MOOC paradigm as aligning with their altruistic goals of giving back to society.

"*I spent a very long time to figure out how to effectively and efficiently search information we need. I have taught many people and want to teach more people how to search because these are really good techniques that everyone needs and can help them save lots of valuable time. I hope everyone knows. MOOC makes this become true. One of my session reached 8 million students that can never happen by teaching regular classes*." *– Dr. Rosenberg*

Professional Growth

All 14 instructors also shared that MOOCs provide them a testbed to improve the effectiveness of their teaching and help them to refine their teaching practices. For example, Dr. Philip has taught three times on Coursera. He collected, carefully analyzed, and categorized student comments (Stage 3 in **Figure 1**) at the end of his courses and adjusted and improved his teaching in the next round of his MOOC. Although he has taught regular college courses for several years, he has never been able to receive so many and such comprehensive comments from students.

"I love hearing feedback from them [students]. I want to see how they respond to my teaching material and course arrangement. This is the first time I have had so many students who can provide me valuable comments. It's definitely good for my teaching and my career." – Dr. Philip

Research Opportunities

Most (13 or 93%) of our instructors felt that the MOOC environment provides unique opportunities for conducting research. The MOOC student population is large and diverse enough to be an excellent (i.e., generalizable) research sample. Instructors have a subject pool in which they can launch experiments associated with their research projects during the course. Instructors who act as researchers can readily collect data on students' behaviors, perceptions, and attitudes. For example, a MOOC instructor in geography may use an interactive map to see whether and to what extent this technology could help enhance peer awareness and even build a sense of community.

"MOOC is a very attractive paradigm. It provides us a huge lab. Student behaviors are a large data set. I do enjoy exploring this magic world! I can find lots of interesting research topics from there." – Dr. Brit

Enhanced Name Recognition

Finally, 12 instructors (86%) said that they are motivated to teach a MOOC to enhance the name recognition of their institutions and themselves. From an institutional perspective, MOOCs are a good opportunity for a university or other institutions to advertise their programs globally. For example, some instructors were approached by their programs to organize and teach a MOOC to support student recruitment. Dr. Hill believes that MOOCs are a very effective means to introduce a program or an institution to students. He found that his many MOOC students later enrolled into other programs offered by his university.

"Our department head said 'you should teach a MOOC. It's the right time and good way to let more people know us.'" – Dr. Hill

Taking a career perspective, running a preeminent MOOC helps a university professor gain wide prestige, not only from students, but also from peers in the same field. Dr. Dong has taught a MOOC three times, and his MOOC ranked as one of the top ten popular courses on Coursera. As a result, he has been invited to many universities from different countries to give talks and has even been asked for his autograph by students:

"I was surprised people began to ask for my autograph. From that moment, I knew my MOOC had become well known." – Dr. Dong

At least in part due to his renowned MOOCs and enhanced name recognition in his field, Dr. Dong has been able to foster many new research collaborations with peers at other institutions around the globe.

Challenges of Teaching a MOOC

We identified five key challenges associated with administering a MOOC: *logistical complexities of collaborative work*, *crises of time management*, *scaling to meet expectations, extreme criticism and reputation risk*, and *insufficient support*. In the next section, we will describe each of these challenges in more detail; later in our discussion, we will summarize the relationships we observed between the different motivations and challenges.

Logistical Complexities of Collaborative Work

As shown in **Figure 1**, MOOC instructors have to go through three stages to complete teaching a MOOC, including preparation, implementation and feedback. Also, **Table 1** lists activities and tasks they have to complete in each stage. As such, all 14 instructors felt that they initially underestimated the amount and complexity of the work required to teach a MOOC.

"Teaching a MOOC is much more complicated than I imagined. When I planned to teach a MOOC, I thought I just needed to record my lectures and put them online, but when I really got involved in the process, I found I oversimplified the procedures in my mind." – Dr. Alison

Before teaching their first MOOCs, instructors had little sense of how many tasks and people they would need to manage, nor the best way how to accomplish this.

"*No one told me what I should do and the best strategies to make everything in order. I had to explore everything on my own. I really hope our university could draft a document or build a tutorial to show us the overall process and things we have to involve and the procedures we can follow, in doing so we can have a rough estimation of the teaching load." – Dr. Jason*

As shown in **Table 2**, MOOC instructors must collaborate with various professionals in order to teach a MOOC. In a typical classroom setting, instructors are more able to take on many of these roles on their own, essentially becoming a one person operation. But the scale of a MOOC *necessitates* that instructors manage different collaborators to make their MOOCs work. For most instructors, this was the first time they had to orchestrate a collaborative effort at this scale. Most instructors needed a trial period and experienced a steep learning curve for dealing with both new technologies and new people.

For instance, one instructor recorded a lecture for the first time in a professional recording studio. The video director had many suggestions for how to produce a good "show" and portray a professional image to the audience, including how to dress, apply proper make-up, and face the camera. To finish recording a five-minute lecture, the instructor was asked to repeat the lecture at least 10 times and was exposed to the spotlight for three hours. Because of the extended amount of time under very hot spotlights, the instructor had to change shirts three times and reapply make-up multiple times because she had become so sweaty.

"I had experience recording lectures during teaching online courses, but it was not as professional as this time. We didn't need to make it so serious, but we wanted the best effect. The first several shots were miserable because I didn't have experience, and I was nervous. I wanted to pass with one shot, but things went contrary to my wishes [laugh]. It's a tough but memorable collaboration with them." – Dr. Dong

Sometimes, our participants had conflicting opinions with collaborators, such as curriculum designers, which caused heated disagreements. Our participants were used to designing the curriculum on their own, but for MOOCs they are often required to collaborate with trained instructional designers, which required negotiation and caused delays.

"We have lots of back and forth discussions or even 'fights' to argue our curriculum plan. We have our own considerations and it was very hard to reach agreement. We did waste a lot of time…At last, we compromised to each other, and otherwise our work could not proceed. " – Dr. Cheng

For instructors who are used to being their own bosses in their normal classrooms, it was difficult to give up this level of control, especially when they worried that their personal reputations were at stake. Any unsuccessful collaboration could put the MOOC in danger. For instance, one of our participants hired a teaching assistant (TA) whose primary responsibilities were to report and solve technical problems and upload learning materials. Unfortunately, this TA suddenly quit the job after two days after launching the MOOC without giving any notice or explanation to the instructor. The instructor was very frustrated and lost two nights of sleep while handling this emergency situation.

"I never thought this would happen! He left without any pre notice. He was very important to keep the MOOC proceeding. I was shocked and extremely frustrated. I even cried to my husband, but I still needed to take over everything to avoid worse consequences." – Dr. Miller

Only two of the instructors had a project manager to help them organize the tasks, for instance, making budgets, hiring teaching assistants, tracking course design processes, making schedules with different groups of people, and ensuring the course was ready before the deadline. Most of our participants had to organize all these tasks by themselves. Moreover, without prior experiences and guidance, the process proved overwhelmingly difficult.

We found that some universities have their own MOOC committees to provide general guidelines for instructors, but these guidelines are often too vague to tangibly follow. Even within the same university, different instructors experienced very different procedures. For example, some instructors shoot and edit their videos themselves, but others have professional video producers. Some instructors manage MOOC platform data on their own, but some rely on IT support. Lack of consistent and unified constitution makes the complicated logistics more difficult to organize. Our participants felt overwhelmed to deal with these procedures.

"It would be great if university could develop a document or a tutorial to walk us through the whole process and provide us a consistent logistical procedure. Everyone involving in the MOOC group would have a rule to follow." – Dr. Jason

Crises of Time Management

Not surprisingly, all 14 of our participants believe that the time they invested into MOOCs had been far beyond their expectations. Recall that our participants reported they volunteered at least 400 hours to prepare a MOOC. Teaching MOOCs brought big challenges for our participants regarding both work-work and work-life balance. As one instructor joked, "the MOOC ate me!" *–Dr. Sandy*.

Work-Work-Balance

13 (93%) of our participants told us it was very difficult to strike a balance between teaching the MOOC and fulfilling other routine job responsibilities, especially during the first and second stages of administering a MOOC (See **Figure 1**). Because managing the MOOC was extra work on top of their primary work responsibilities (e.g., teaching regular college courses, having meetings, doing research, providing services for the affiliated institution, etc.), they felt conflicted about how to prioritize their time.

"I was struggling regarding how to divide my time. On one hand, for example, my students [in regular classes] paid a large amount of money to learn. So I must take care of them very well. On the other hand, I am a teacher, and I want to give the best to all my students [including MOOCs], though I wasn't paid by them or my university." – Dr. Cheng

Work-Life-Balance

11 (79%) of the instructors reported that MOOCs took up a large portion or even all of the spare time they normally spent with their families. Working on the MOOC was very time consuming with no stopping, particularly after the course was launched.

"I almost didn't have time to take care of my five year old son for almost six weeks. My husband took all my [parenting] responsibilities during that time. I felt very sorry for my family, but it's the only way I could finish my job." – Dr. Miller

Instructors often struggled to maintain a separation between negative experiences they had while teaching the MOOC and their personal lives. Instructors experienced a lot of pressure during teaching a MOOC, and they needed to find an outlet to vent their emotions. Their families became the most convenient channel:

"I didn't realize I had brought so much emotional [baggage] to my family until my husband persuaded [me] to stop teaching MOOCs to avoid torturing myself and him." – Dr. Alison

In an attempt to solve the work-work and work-life time crises, some participants chose to teach MOOCs only when they had reduced or no teaching loads at their universities. They also tried to avoid MOOC engagements around important conference submission deadlines and family events. Some participants found another colleague in the same field to teach the MOOC together to split pressure and workload.

Scaling to Meet Expectations

Due to the large-scale nature of MOOCs, all 14 of the instructors struggled when attempting to maintain realistic expectations of both their students and themselves when transitioning from regular-sized classrooms to teaching MOOCs. As a result, they often tried to apply traditional teaching norms to their MOOCs and ended up feeling an undue sense of failure. The most prominent ways instructors struggled to scale their expectations included focusing on student retention numbers, handling unexpected situations once the course was launched, and feeling pressure to attend to each individual student.

Focusing on Student Retention

All of our instructors believe that retention rate is a very important index of their students' satisfaction and overall course success. Unlike other teaching formats, retention is particularly problematic for MOOCs [8, 41]. On average only 10% of enrolled students finish a MOOC course once they register [12]. High drop-off rates become a concern for MOOC instructors who spend a large portion of their time trying to constantly engage students so that they remain enrolled. Although our instructors understand that MOOC students have different motivations to join MOOCs and may accomplish these goals even if they do not complete the course, instructors still hope to retain as many students as possible.

"As a teacher, I wish every student could finish the course and benefit from the course. In our regular courses, almost 90% of the students can finish the course. Even in online courses, our record is that we can keep 75% students to the end. When I saw 90% students leave my MOOC within two weeks, to be honest, I was not feeling good. I began to think about whether it was because of something I did wrong." – Dr. Gold

All of our participants believe it is very difficult to retain all students to the end, given that there is so much competing information on the Internet and that students are easily distracted. Thus, they tried various methods to make the course interesting and to continuously reminded students to return to the course to learn. For example, some instructors use social media (i.e. Facebook, Twitter) to attract students and often posted interesting content to maintain students' enthusiasm. They also held online office hours, for example using Google hangouts, to connect with students.

"I was always thinking how to keep them [students] in the class, but it's really not an easy job! MOOCs are optional to students, so I feel like my course needs to compete with other huge amounts of interesting information on the Internet. Thus, it's critical to make the content attractive and interesting…I found Facebook and Twitter are very good places to post something interesting and can also remind them go back to course in a timely way." – Dr. Carroll

Because retention was a concern for the instructors, they invested a lot of time and effort into making sure students did not drop their classes. If a large number of students did drop, then they experienced a sense of failure.

Dealing with the "Massive" Unknowns

Because MOOCs are extremely large in scale and impossible to test-run prior to implementing the course, instructors must be ready for a multitude of surprises, at a scale they have never had to deal with before. Due to unexpected issues that arose during MOOC implementation, 86% (12) of our participants reported being intensely stressed out on the days their MOOCs were launched. Recounting still-fresh memories of that launch day, many of them said they could not sleep on the first night after the course went live. They monitored the system (i.e. Coursera) closely to see how many students joined the course, how many began to talk or discuss the course content, and whether the course worked properly. For the first time in his life, Dr. Miller faced a very large audience, and he did not know what would happen. For example, would students like the course and be satisfied with the course schedule?

"The most scary thing is you cannot pilot run the MOOCs, so you don't know what will happen and how students will respond. There are so many students joining a MOOC. It means that hundreds of people are not happy with the

course, even if only 1% students are not satisfied with it. That is pretty serious to me! " – Dr. Carroll

The large scale of potential unpredictability makes instructors feel a loss of control:

"The huge population really gives me a lot of pressure. I have taught college courses online and offline for several years, but the number of audience [members] never exceeds one hundred. I have gotten used of having everything under control. But in MOOCs, the huge population makes me feel out of control." – Dr. Miller

Attending to Each Individual Student

Another reason scalability is such a big issue for instructors is that there is a misalignment between teaching norms that have emerged within regular-sized classes versus those appropriate for MOOCs. 79% (11) of the instructors we interviewed expressed their desire to give personalized attention to each of their students. In classes of normal size (whether offline or online) an instructor usually knows every student in the classroom. At this more manageable scale, instructors are able to help students when they have difficulties, easily demonstrating responsiveness to students' needs. Indeed, this sort of responsiveness to students' individualized needs is a standard teaching norm within the typical classroom. From an interaction perspective, this can be viewed as a type of "hub and spoke" network [3, 34], where the teacher enjoys direct contact with each student. In contrast a MOOC might be better conceived as a fully (or largely) connected graph, where many nodes are connected to many other nodes, and in particular, where no one node is connected to all. Other studies of complex coordination systems (e.g., emergency rooms) have demonstrated the importance of these more complex coordination networks [3, 34].

Yet, when MOOC instructors do try to apply the individualized attention norm (i.e., "hub and spoke" model) to thousands of students, they quickly find it is not feasible. When instructors cannot physically or mentally take care of students who need help, they feel frustrated and disappointed in their own performance as a teacher, even though they realize that at a rational level that this degree of responsiveness is simply unattainable:

"Although it's impossible to take care of every student in my course given the huge population, I still feel bad when I cannot finish going through all the discussion on the forum or answering all the questions they raised. I know I shouldn't feel guilty. But as a teacher, I feel like it's my responsibility to help everyone in my class." – Dr. Williams

All participants felt a little bit better after their first experience in teaching a MOOC. Experience gave them some psychological preparation to face a large scale audience, as well as physical and mental preparation to handle the unknown challenges and high demands of their time.

Extreme Criticism and Reputation Risk

MOOCs provide instructors more visibility to audiences but also force them to bear more accountability and suffer more criticism. All our participants (14) said they have received considerable criticism from their MOOC students. While some of criticism is about the course itself (e.g., errors in slides, course schedule, course contents, quality of the course, etc.), some students criticize the instructor directly (e.g., teaching skills, strategies, instructor's involvement, etc.). Our participants (14) even received comments that were rude or vulgar, with no specific bearing on the course or their instruction. Some instructors felt that this might be due to the large, semi-anonymous, and impersonal nature of MOOCs. Unfortunately, instructors need to process all of this "feedback," whether real or fictitious, constructive or destructive. Sometimes our instructors felt wronged and hurt because students made false accusations (based on misperceptions) about them being of derelict of their duties:

"I welcome good comments to help improve the course. But some comments are very rudely spoken without any respect. Some comments are very unfair, like they thought we earn a lot of money personally from MOOCs but we didn't, not even a penny! I become very emotional when I saw such kind of comments. They really should show us gratitude since we really put lots of effort in MOOCs, and we provide the course for free." – Dr. Gold

We found that instructors take comments – especially negative ones – very seriously. Even if positive feedback outweighs the negative, instructors tended to have a difficult time guarding their feelings from the negative comments. Instructors would overestimate the influence of the negative comments and believed these comments could lead to very bad consequences.

"When I think back of the comments, I actually did not see many of them. But there are so many discussions that I cannot go through all of them. So I might only find 1% of them. If those untrue comments were continually spread, my career would be ruined!" – Dr. Alison

According to 93% (13) of our instructors, extremely negative criticism from students also implied more serious consequences, such as potential career risks. As we mentioned earlier, name recognition is one of the important motivations for instructors to teach MOOCs. Like a double-edged sword, the risk of ruining their reputation and jeopardizing their careers is a major concern for instructors. Some participants discontinued teaching MOOCs or fear teaching another MOOC because of the potential risks to their personal reputations. According to one participant, some of his junior colleagues decided not to teach a MOOC in the first place to avoid possible damage to their tenure cases:

"My career might end if the MOOC failed. I did take a high risk when I decided to teach a MOOC. Some of my colleagues who have tenure pressure gave up the opportunity to teach a MOOC because they were afraid that the failure

of a MOOC might have very negative impact on their tenure process." – Dr. Philip

Insufficient Support

Overall, 93% (13) of our MOOC instructors stated that were not receiving enough support from their institutions (e.g., resources and policy support) or through the technology (i.e., MOOC platform) in order to perform their jobs effectively. One participant was very eager to tell us his stories about the difficulties he met when teaching MOOCs and helping us recruit other participants to do the same. His rationale was that MOOC instructors need help, and he hopes our research will attract much needed attention from academic institutions and MOOC carriers.

"Our MOOC instructors do need help, support, and people's understanding of our work. I know the MOOC system is not mature, but I hope it can improve quickly. I really expect the research focusing on instructors can let the education system understand difficulties and challenges we face." – Dr. Brit

Instructors' comments regarding lack of support fell into three broad categories: resources, policy support, and technological support.

Lack of Resources

86% (12) MOOC instructors experience difficulties due to general deficiencies in human resources and funding provided by their institutions. For example, many of our participants believe that they could not manage huge classes well by themselves, largely due to the challenges discussed in prior sections. Hiring a set of teaching assistants to help them would contribute to MOOC success, but they often do not have enough funding.

"Can you imagine how I teach a massive class but with no TA's help? But we usually have a TA even in a regular university class." – Dr. Cheng

"I only have one TA to help me manage so many students. I really need more, but I don't have funding to hire more." – Dr. Sandy

Indeed, only two instructors reported being able to hire several TAs to help them, which made teaching a MOOC much easier. But for our other participants, only one or even no TAs were provided.

Lack of Policy Support

79% (11) of our participants mentioned MOOC teaching is not officially counted toward their teaching loads; thus, instructors need to use their own time when teaching MOOCs, making it even harder to balance MOOC teaching, their work, and their personal lives (see the time management discussion above). Therefore, our participants strongly hope their universities can establish corresponding policies to give them appropriate teaching credit. For instance, teaching a MOOC should not only be counted as part of one's teaching load but also considered as a *double* load relative to other courses, given the heavy workload and number of students.

"It does not work in a long run. It's impossible and not fair for MOOC instructors to teach a massive class not even being accounted into teaching load. I think it is urgent to solve this problem." – Dr. Carroll

Our MOOC instructors, who have also taught in the classroom and online, consider teaching MOOCs to be especially difficult. They hope the education system will come to consider MOOC teaching as a special factor when considering tenure or promotion.

Lack of Technological Support

MOOC platforms (e.g. Coursera, edX) provide places to broadcast MOOC lectures and also offer some basic functionalities to enrich the content broadcasting, such as a discussion forums, self-tests, peer evaluations, pre- and post-surveys, and so on. Nonetheless, our participants believe that some important features are missing or should be replaced by improved services.

For example, all of the instructors were unhappy with the integrated MOOC discussion forums. Numerous discussion posts and comments are threaded together making it difficult for instructors to discover important or urgent questions and problems raised by students. As a result, instructors must spend an excessive amount of time sifting through the discussion forums to find and respond to pertinent information. To cope with this problem, instructors have appropriated a variety of familiar social media services (e.g. Facebook, Google+, Twitter) to complement the discussion within the MOOC forum. Some instructors even told students to report course related problems (e.g. a bad links) using a Facebook message instead of the forum.

Next, other instructors hoped that improved versions of a MOOC platform could have better services for collecting and analyzing student comments and questions. As we mentioned earlier, instructors consider students' feedback to be very valuable in refining their MOOCs; unfortunately, collecting and synthesizing this feedback is not an easy job. Also, some instructors noted that the current MOOC platform provides no guidance concerning the best practices for when instructors should post important content for students across multiple time zones.

"I hope when I post a message that it can be seen by students, as many as possible. In doing so, my message may have bigger impact and my students will feel I am with them." – Dr. Dong

Finally, some instructors expressed that they wanted the MOOC platform or another unified system provided by their universities to help them with their responsibilities that fell outside of teaching students but were necessary for orchestrating MOOC related activities.

"It would be a lot easier if our university had a unified system on which we could contact and make appointments with

video professionals, could post TA positions, could find IT support regarding technology problems we met, etc." – Dr. Jason

DISCUSSION

In this paper, we interviewed 14 MOOC instructors to gain deeper insights into what it takes to teach a MOOC, why instructors are motivated to take on this massive responsibility, and the challenges they must overcome to make a MOOC successful. First, we presented a high-level process model of teaching a MOOC (*preparation*, *implementation*, and *feedback.* See **Figure 1** and **Table 1**). Second, we identified four main sources of motivation for teaching MOOCs, which included *worldwide impact on students*, *professional growth, research opportunities*, and *enhanced name recognition*. Third, we outlined five challenges MOOC instructors face while teaching a MOOC (*logistical complexities of collaborative work*, *crises of time management*, *scaling to meet expectations, extreme criticism and reputation risk*, and *insufficient support*) as recounted in detail above. Our findings provide insight into the emerging practices and experiences of MOOC teaching, so that we can identify actionable ways to address potential issues. We turn now to a discussion of the key themes and their implications from both theoretical and practical perspectives.

Redefining "Teaching" in MOOCs

Ours is the first qualitative study to investigate MOOC instructors' experiences in a holistic fashion, from preparing a MOOC, to delivering it, and integrating student feedback to improve the next iteration. Based on the reflections from our instructors regarding their work procedures, we abstracted the individual tasks to develop high-level process model of MOOC administration. We also had a close look at different groups of collaborators associated with this process and their duties (**Table 1 & 2**).

These findings present an overall picture of the complex logistics of the tasks associated with MOOC instruction and, in general, uncover the heavy workload MOOC instructors take on. These reflections clearly demonstrate "teaching" a MOOC is *totally different* from teaching regular college classes. The massive scale causes instructors' huge emotional stress (due to extreme criticism, reputation risks, retention concerns, etc.) and heavy physical workload (due to time crises, complicated logistics, collaboration challenges, etc.). Also, current university policies and infrastructures do not provide them the support they need.

Moreover, the ultimate success of a MOOC depends on quality results at each stage in the cycle, and a breakdown in any part of this process could mean MOOC failure in the eyes of instructors. The preparation stage demands the longest time and heaviest workload and also involves the most collaboration. The implementation stage primarily requires extensive work to monitor, interpret and respond, and remind. It is difficult for instructors of normal courses to appreciate the huge burden of maintaining any sort of instructor-student connection in an enormous course such as this. The feedback stage is the most relaxed, but most valuable period, and is critical to the future MOOC sessions.

Thus, we need a new view of what "teaching" infers when considering MOOCs relative to teaching in other course formats. Teaching a MOOC is more like resourcing and implementing a large project, from drafting a proposal to receive funding, hiring assistants, looking for collaborators, to making sure every person in the project produces the right deliverable at the right time and with good quality . . . not to mention, creating course materials and providing quality instruction! MOOC instructors have a monumental amount of responsibilities that if not shared, have a limited chance of being done well. And, in the end, the collaborative work that results from a MOOC project may be evaluated by tens of thousands of people. In this sense, "managing" a MOOC might be a more accurate depicting of an instructors' job than "teaching." If we hope to support MOOC instructors, we must expand our scope to the whole process instead of focusing on the student-facing "course" as a bounded object. Of course, any teaching activities may be analyzed from a pedagogical perspective, but it is the massive size and complex coordination of work associated with "teaching" a MOOC that demands this more expansive view.

MOOC Sustainability

In order to ensure that MOOCs are sustainable, the motivations to teach a MOOC need to outweigh the challenges faced by instructors. However, our interviews suggest that the opposite may be true. Among 14 participants, two have decided not to teach MOOCs again; four were teaching a MOOC when we interviewed them and considering a break from MOOCs after finishing this current session; four have concerns about the excessive demands on their time but believe the situation will become better when the whole MOOC system become mature. Only four participants think they would regularly teach a MOOC regardless of its demands.

The main concern emerging from participants was that what they "pay out" is much more than they can afford. Teaching a MOOC costs them too much time, energy and emotion, and this has taken a toll on their normal life and work.

"One of my colleagues told me that I should make this decision [whether teaching a MOOC] very carefully because from his opinion, costs was much more than benefits, so he quit after teaching one session. Now I understand what his words meant. I actually have told my colleagues who are assistant professors that they should not teach MOOCs until they get tenured. I think teaching a MOOC would at least slow them down for half a year." –Dr. Rosenberg

"After teaching MOOC twice, I really feel exhausted. So I quit. Although I really enjoy interacting with so many students, I felt I put too much into my MOOC, my heart, my energy, my time, and even my emotions. I feel like I could

not afford it. I really feel exhausted. I might teach again when I can get enough support and help from my university and Coursera. Teaching may become easier. " –Dr. Alberts

Not surprisingly, the motivations to teach a MOOC often lead directly or indirectly to the challenges instructors encountered. For example, as part of seeking worldwide impact, instructors discovered challenges associated with time management, scaling of their expectations, and managing a complex coordination process with collaborators. Leveraging a MOOC to garner professional growth meant the possibility of extreme criticism from students, and gaining worldwide name recognition came at a great risk to ones reputation and career.

If instructors (or their supporting organizations) cannot address the challenges we have discussed, the instructors will naturally begin to reconsider their original motivations and may decide the benefits are simply not worth the cost. Even worse, a single large failure could cause their professional reputations to be ruined. For example, if instructors are unable to manage their time when teaching a MOOC, the potential opportunities for MOOC-embedded research could disintegrate and their professional growth could be stalled. If extreme criticism from students are made public, an instructor's reputation may be tarnished, perhaps putting him or her at risk for tenure or other career milestones. Finally, a breakdown in communication between the MOOC instructor and any of the MOOC collaborators could jeopardize the success of the MOOC. Thus, we must recognize and leverage instructors' motivations while alleviating their concerns and difficulties.

Supporting Instructors' Motivations

Prior literature has also discussed reasons why instructors choose to teach MOOCs, including intrigue, personal rewards, and altruism [17]. Our results generally align with this classification, but our findings also provide the underlying rationales that go along with these motivations. Therefore, our work provides anecdotal evidence that can be used more easily to incentivize MOOC instructors based on their needs. For example, to support instructors' motivation to conduct research during a MOOC, platform designers might provide instructor-friendly APIs to help them more easily deploy research studies within their MOOCs. University Institutional Review Boards (IRBs) can also support such endeavors by developing standard procedures for conducting research experiments within MOOC settings. These mechanisms would reinforce their motivations for teaching MOOCs by helping their professional growth, research productivity, and better valuing their overall contributions.

Maximizing Benefits over Costs

We found that a number of MOOC instructors have quit teaching or contemplating doing so in the future. From their perspectives, the costs (e.g., workload, emotional distress, reputation risks, etc.) are higher than the incentives or benefits gained. Ultimately, if MOOC instructors feel that these challenges are insurmountable, they will quit teaching MOOCs or their teaching quality will suffer. Currently, most universities do not to offer extra incentives, monetary or otherwise, to teach MOOCs, so instructors must draw upon their intrinsic motivations to teach, even though the costs of doing so are high. Simply put, if the cost-benefit equation of teaching MOOCs remains at the status quo, MOOC instructor turn over may increase and MOOC quality will suffer.

We can help avoid such outcomes by addressing the challenges instructors experience and reinforcing the initial reasons why they chose to teach MOOCs in the first place. Scaling expectations, for instance, is a prominent challenge for instructors; it is also, of course, the unique hallmark of MOOC teaching. While technology is a massively scalable resource, the instructor's attention and human resources are not. On one hand, universities should provide more funding and human resources to support MOOC instructors; on the other hand, MOOC platforms should design services for better managing and connecting to a massive student population. A few researchers are beginning to reconceptualize MOOC platforms to better deal with scale [41, 42], but more research is needed in this particular area.

Reframing MOOCs as a Collaborative Ecosystem

MOOC teaching is about more than the instructors, the course delivery platform, and the students. Our analysis revealed a number of otherwise "invisible" systems and actors. To illustrate our point, we offer a model (**Figure 2**) that illustrates the multiple subsystems that are necessary to support MOOC administration, noting that many of these systems are not currently supported through technology. Within current MOOC platforms, instructors mainly interact with students, TAs, and technical coordinators during the implementation phase of a MOOC.

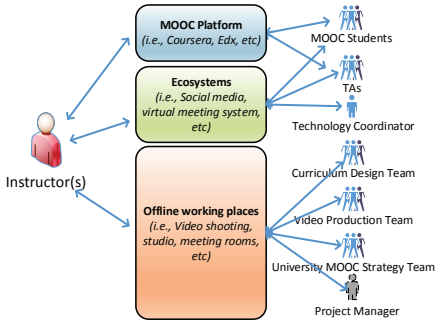

Figure 2: MOOCs Ecosystem

The MOOC *ecosystem* represents the supplemental technologies that support the entire process of MOOC teaching. This includes student engagement outside the platform (e.g., social media pages and virtual meeting platforms), as well as interactions with other actors in the overall system. For instance, instructors may collaborate with TAs or some other technical coordinator to make their social media page attractive or run virtual office hours. Instructors must collaborate with many other people (e.g., for curriculum de-

sign, lecture shooting, etc.) during the preparation and feedback phases of MOOC administration. Some of these collaborations may take place *online* (using tools like social media or virtual meetings), but they often occur in *offline* working places with little technology support. From this model, we can see that instructors need to interact with a range of collaborators, but that the system support only exists for collaborations that are *student-facing*. This may be because of the student-centered emphasis of MOOC implementation, design, and research.

Because our study emphasizes a new perspective, from that of the instructor and the holistic process of teaching a MOOC, our findings provide new insights for MOOC system design and administration support. Indeed, prior literature has analyzed MOOCs as a collaborative system [41, 42]; here we expand this view to view MOOCs as a *collaborative ecosystem*, one that involves many actors, processes, and support systems. As designers and practitioners, our attention should not be limited to MOOC platforms and student outcomes, but also extend to ecosystems that provide support for MOOC instructors and their associated collaborators during *all* stages of MOOC administration.

IMPLICATIONS

Based on our findings and key themes as discussed above, we present recommendations to improve MOOC instructors' teaching experiences. Many of these are directed at redesign or extensions of technology infrastructure, whereas others are aimed at education institutions.

Facilitating Work and Collaboration

Our data shows that instructors have difficulty managing the complicated logistics of MOOC teaching. One factor contributing to this is the lack of pre-defined coordination rules to follow. As we mentioned in the challenge section, the guidelines provided by universities are often too vague to tangibly follow. Different instructors experienced very different procedures even within the same university.

Lack of consistent and unified constitution makes the complicated logistics more difficult to organize. Moreover, without prior experiences and guidance, the process proved tremendously difficult. This causes considerable *uncertainty* to emerge as logistical issues arise. For example, there is no suitable place for instructors to obtain a MOOC-trained a TA, nor is there a consistent facility for video production. According to prior literature, uncertainty has a negative effect on organizational effectiveness [3]. One approach would be to define coordination rules [3] that instructors can reference when they are uncertain of what or how to proceed.

Another logistical challenge is unsuccessful or difficult collaborations. Collaborating with colleagues should effectively distribute responsibilities, reduce pressure by reducing workload, and solve time management problems through *human scaling*. Unfortunately, we found that the challenges of managing the many collaborations involved in MOOCs can get in the way of the main goal of teaching. Further, the collaborative norms associated with MOOC administration are misaligned: Instructors feel that they lose teaching autonomy, but at the same time, they also feel solely responsible for the MOOC's success. This is the classic problem of having "responsibility without power."

The norms for MOOC teaching must change. Either the responsibility should be better distributed across all parties involved, or the MOOC instructor should be viewed as the final authority in all decisions. One way to accomplish this is through business rules and systems that guide coordination practices. For example, an organization might create a collaborative project management system where instructors assign tasks to collaborators, and in turn, collaborators are responsible for accomplishing these tasks. Such a system could also enhance collaboration awareness, enabling more effective and efficient collaborations [7, 13]. Of course, upper-level administration and incentive structures within institutions would have to support a hierarchical structure for MOOC administration and to clearly and publicly define roles and responsibilities.

Alleviating Retention Concerns

Retention of students in MOOCs differs from that in traditional courses [19]. One reason is that students have very diverse motivations for enrolling in a MOOC, and their view of "finishing" is often not based on whether they complete all activities offered [41]. Although the instructors we interviewed know that students have different motivations for enrolling in their course, most of them still take the drop-out rate very seriously and perceive low retention rates as failure. MOOC platforms currently only provide summary reports for retention based on the number of students who enroll and drop out; there has yet been no effort to provide a more nuanced view that considers students' motivations and goals as a measure of MOOC success. For example, if MOOC offerings were modularized by different learning objectives (instead of viewed as a monolithic course), instructors may be able disentangle students' objectives for learning instead of focusing on overall dropout rates. If such views can be constructed, instructors might feel less panicked because they can formulate a better understanding of *why* student drop-outs occur.

Designing a Feedback Service

Collecting feedback is a very important step for instructors seeking to improve a MOOC. However, current platforms (e.g., Coursera, Edx) neglect this activity. Thus, one implication is that MOOC platform designers should investigate opportunities for supporting the feedback stage. For example, the platforms could provide a streamlined approach for collecting student feedback throughout a MOOC's implementation and use intelligent algorithms to compile meaningful summaries for instructors during or at the end of the course. In fact, current research has begun to explore this issue, developing tools, sensors and algorithms that allow

instructors to gather student feedback quickly and accurately [25, 39].

Embracing the Larger Ecosystem

MOOC instructors use various social media platforms, such as Facebook, Google+, and Twitter to help them better manage their course (part of the MOOC ecosystem). We see this as a classic example of appropriation [6], in that both instructors and students are reaching out and adapting existing and familiar systems to new needs, such that they become a part of the overall system [29, 34]. In our case, MOOC instructors mainly used social media to maintain student engagement and to better organize discussions to identify urgent messages. MOOC platform designers might reach out to popular social media platforms to enhance integration and simplify linkages. Alternatively, the MOOC carriers might build or enhance the features it offers, for instance, an instant notification center for urgent messages.

Building a Community for MOOC Instructors

Educators and researchers often encourage the building or enhancing of learning communities for students in a course [30], hoping to offer them a more friendly and helpful environment to learn. We wish to point out that constructing similar communities for instructors is equally meaningful and urgent. Within such a MOOC instructors' community, individuals might psychological and practical support, reducing stress levels and improving teaching quality.

Improving Policies and Guidance

In some cases, technology will not be the solution. Instructors also need more support in offline environments since many important collaborations happen face-to-face. For example, institutions could offer video production training to MOOC instructors, preparing them for the challenges of recording lectures. Universities could also provide policy support for MOOC instructors, such as reduced teaching loads or added resources (e.g., time management or team building courses, student retention counselors, marketing and reputation management consultant). Systematic training on how to administer a successful MOOC could be very beneficial for instructors teaching a MOOC for the first time. Alternatively, for instructors who want to focus solely on teaching, universities might hire "project managers" to offload the main orchestration tasks associated with MOOC teaching. In short, our mission should be to make the ecosystem surrounding MOOC administration one that is supportive and collaborative to ensure the success of MOOC instructors.

LIMITATIONS AND FUTURE RESEARCH

Before we conclude, we would like to discuss some of the limitations of our current research, which can be used to inform future areas of inquiry. First, saturation of theory given our sample size does not necessarily imply generalizability of our results. Future studies with larger sample sizes and more varied populations should empirically validate our findings through more confirmatory methods, such as surveys or experimental designs. Second, our intention is not to advocate for MOOC instructors over students or other MOOC stakeholders. Instead, we simply emphasize that instructors be given equal attention when evaluating the benefits, challenges and design implications associated with the rapidly emerging and evolving MOOC paradigm. Finally, our practical recommendations are based solely on the comments of instructors and the implications we have drawn require additional scrutiny to determine if they are viable solutions for overall MOOC success.

CONCLUSION

In this paper, we applied grounded theory to make sense of an in-depth interview study with MOOC instructors. We have decomposed the steps of administering a MOOC as a process model: preparation, implementation, and feedback. We also described the complex and iterative nature of this process. We identified four motivations that inspire instructors to teach MOOCs and five challenges they experienced in organizing, delivering, and managing their MOOCs. A main finding is that successful MOOC administration requires a team effort (e.g., instructors, curriculum design, video production, teach assistants, etc.), and that often the support needed for collaboration is lacking. By enhancing support for collaboration, we may be able to improve outcomes for all MOOC stakeholders. Our study provides actionable guidance for supporting instructors as part of the MOOC community. It also advocates for a view of MOOCs as complex collaborative ecosystem, in addition to existing research that examines MOOCs as a novel learning pedagogy. We discuss implications and future directions for our research, with the general goal of helping improve the activities and outcomes for all MOOC participants.

ACKNOWLEDGMENTS

First, we would like to thank all our participants—MOOC instructors—for accepting our interviews. Also, this research is supported by COIL Research Initiation Grants. Third, we appreciate reviewers' very helpful comments on the previous version of the paper.

REFERENCES

1. Anant Agarwal. 2012. 'Circuits and Electronics', MITx. Chronicle of Higher Education, 59(6), B10.
2. Gad Allon. 2012. 'Operations Management', Udemy. Chronicle of Higher Education, 59(6), B10–11.
3. Linda Argote. 1982. Input uncertainty and organizational coordination in hospital emergency units. Administrative science quarterly, 420-434.
4. Yvonne Belanger & Jessica Thornton. 2013. Bioelectricity: A quantitative approach. Retrieved on May 7 from http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6216/Duke_Bioelectricity_MOOC_Fall2012.pdf
5. Lori Breslow, David Pritchard, Jennifer DeBoer, Glenda S. Stump, Andrew D. & Daniel T. Seatoon. 2013. Studying learning in the worldwide classroom. Re-

search into edX's first MOOC. Research & Practice in Assessment, 8, 13–25.

6. John M. Carroll. 2004. Completing Design in Use: Closing the Appropriation Cycle, In Proc. of the ECIS.
7. John M. Carroll, Mary Beth Rosson, Gregorio Convert, & Graig H. Ganoe. 2006. Awareness and teamwork in computer-supported collaborations. Interacting with computers, 18(1), 21-46.
8. Doug Clow. 2013. MOOCs and the Funnel of Participa-tion, in: Proceedings of the Third International Confer-ence on Learning Analytics and Knowledge, pages 185-189.
9. Dave Cormier & George Siemens. 2010. The Open Course: Through the Open Door--Open Courses as Research, Learning, and Engagement, Educause Review (45:4), pages 30-32.
10. Derrick Coetzee, Armando Fox, Marti A. Hearst, & Bjorn Hartmann. 2014. Should your MOOC forum use a reputation system? In Proc. CSCW 2014 (pp.1176-1187.
11. Juliet Corbin & Anselm Strauss. 2007. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage Publications, Incorporated.
12. John Daniel. 2012. Making Sense of MOOCs: Musings in a Maze of Myth, Paradox and Possibility. Journal of Interactive Media in Education.
13. Paul Dourish, & Victoria Bellotti. (1992, December). Awareness and coordination in shared workspaces. In Proceedings of the 1992 ACM conference on Computer-supported cooperative work (pp. 107-114). ACM.
14. Mitchell Duneier. 2012. Teaching to the world from central New Jersey. Chronicle of Higher Education, 59(2), 24.
15. Armando Fox & Patterson Dean. 2012. Crossing the Software Education Chasm, Communications of the Acm (55:5) (pp. 44-49).
16. Keith Head. 2013. Massive open online adventure. Chronicle of Higher Education, 59(34), B24–25.
17. Khe Foon Hew, & Cheung Wing Sum. 2014. Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. Educational Research Review, Volumn 12, pages 45-58.
18. Toru Iiyoshi, MS Vijay Kumar, and J. Seely Brown. 2008. Opening up Edu-cation: The Collective Advancement of Educa-tion through Open Technology, Open Content, and Open Knowledge. Mit Press.
19. René F Kizilcec, Chris Piech, & Emily Schneider. 2013. Deconstructing disengagement: analyzing learner subpopulations in massive open online courses. In Proceedings of the third international conference on learning analytics and knowledge, pages 170-179.
20. René F Kizilcec, & Emily Schneider. 2015. Motivation as a lens to understand online learners: Toward data-driven design with the OLEI scale. ACM Transac-tions on Computer-Human Interaction (TOCHI), 22(2), 6.
21. Jeremy Knox, Siân Bayne, Hamish MacLeod, Jen Ross, & Christine Sinclair. 2012. MOOC Pedagogy: the challenges of developing for Coursera. International Conference on Networked Learning 2010 (pp. 266–275). University of Lancaster: Lancaster.
22. Steve Kolowich. 2013. The professors who make the MOOCs. Chronicle of Higher Education, 59(28), A20–A23.
23. Jeremy Knox, Siân Bayne, Hamish MacLeod, Jen Ross, & Christine Sinclair. 2012. MOOC Pedagogy: the challenges of de-veloping for Coursera. International Conference on Networked Learning 2010 (pp. 266–275). University of Lancaster: Lancaster.
24. Apostolos Koutropoulos, Michael Sean Gallagher, Sean C. Abajian, Inge de Waard, Rebecca Joanne Hogue, Nilgun Ozdamar Keskin, & Osvaldo Rodriguez. 2012. Emotive Vocabulary in MOOCs: Context & Participant Retention. European Journal of Open, Distance and E-Learning, 1.
25. Dalit Levy. 2011. Lessons learned from participating in a connectivist massive online open course (MOOC). In Proceedings of the Chais conference on instructional technologies research 2011: Learning in the technological era (pp. 31-36).
26. Jenny Mackness, Sui Mak, & Roy Williams. 2010. The ideals and reality of participating in a MOOC. In L. Dirckinck-Holmfeld et al. (Eds.), Proceedings of the 7th International Conference on Networked Learning (pp. 266–275). University of Lancaster: Lancaster.
27. Alexander McAuley, Bonnie Stewart, George Siemens, & Dave Cormier. 2010. The MOOC Model for Digital Practice. Re-trieved from http://www.elearnspace.org/Articles/MOOC_Final.pdf
28. Raul Medina-Mora, Terry Winograd, Rodrigo Flores, & Fernando Flores. (1992, December). The action workflow approach to workflow management technology. In Proceedings of the 1992 ACM conference on Computer-supported cooperative work (pp. 281-288). ACM.
29. Sun Young Park, & Yunan Chen (2012, May). Adaptation as design: learning from an EMR deployment study. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2097-2106). ACM.
30. Michael S. Roth. 2013. My Modern Experience Teaching a MOOC. Chronicle of Higher Education, 59(34), B18–21.
31. Daniel M Russell, Scott Klemmer, Armando Fox, Celine Latulipe, Mitchell Duneier, & Elizabeth Losh.

2013. Will Massive Online Open Courses (MOOCs) Change Education?, In Proc. CHI 2013 Extended Abstracts on Human Factors in Computing Systems (pp. 2395-2398.

32. Susan Leigh Star, & Anselm Strauss. 1999. Layers of silence, arenas of voice: The ecology of visible and invisible work. Computer supported cooperative work (CSCW), 8(1-2), 9-30
33. Kjeld Schmidt, & Liam Bannon. 1992. Taking CSCW seriously. Computer Supported Cooperative Work (CSCW), 1(1-2), 7-40.
34. Marvin E Shaw. 1964. M Communication networks. In L. Berkowitz (Ed.) Advances in experimental social psychology. New York: Academic Press (pp. 111-147).
35. Leif Singer, Fernando Figueira Filho, Brendan Cleary, Christoph Treude, Margaret-Anne Storey, & Kurt Schneider (2013, February). Mutual assessment in the social programmer ecosys-tem: an empirical investigation of developer profile aggregators. In Proceedings of the 2013 conference on Computer supported cooperative work (pp. 103-116). ACM.
36. George Siemens. 2011. The race to platform education. eLearnspace. http://www.elearnspace.org/blog/2011/10/13/the-race-to-platform-education/accessed 2012-09-21
37. George Siemens. 2012. MOOCs are really a platform. eLearnspace. http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform/accessed 2012-09-21
38. Lucy Suchman. 1995. Making work visible. Communications of the ACM, 38(9), 56-ff.
39. Haohan Wang, Yiwei Li, Xiaobo Hu, Yucong Yang, Zhu Meng, & Kai-min Chang. (2013, June). Using EEG to Improve Massive Open Online Courses Feedback Interaction. In AIED Workshops.
40. Li Yuan, Stephen Powell, & JISC CETIS. 2013. MOOCs and open education: Implications for higher education. Cetis White Paper.
41. Saijing Zheng, Mary Beth Rosson, Patrick C. Shih, & John M. Carroll. 2015. Understanding Student Motivation, Behaviors and Perceptions in MOOCs, In the Proceedings of the 2015 ACM Conference on Computer Supported Cooperative Work.
42. Saijing Zheng, Mary Beth Rosson, Patrick C. Shih & John M. Carroll. 2015. Designing Massive Open Online Courses as Interactive Places for Collaborative Learning. In the Proceedings of the 2015 ACM Conference on Learning at Scale.