Collaborative Learning in a MOOC Environment

Thomas Staubitz
Hasso Plattner Institute
Prof.-Dr.-Helmert-Str. 2-3
Potsdam, Germany
thomas.staubitz@hpi.de

Tobias Pfeiffer
Hasso Plattner Institute
Prof.-Dr.-Helmert-Str. 2-3
Potsdam, Germany
tobias.pfeiffer@student.hpi.de

Jan Renz
Hasso Plattner Institute
Prof.-Dr.-Helmert-Str. 2-3
Potsdam, Germany
jan.renz@hpi.de

Christian Willems
Hasso Plattner Institute
Prof.-Dr.-Helmert-Str. 2-3
Potsdam, Germany
christian.willems@hpi.de

Christoph Meinel
Hasso Plattner Institute
Prof.-Dr.-Helmert-Str. 2-3
Potsdam, Germany
christoph.meinel@hpi.de

ABSTRACT

In recent years, Massive Open Online Courses (MOOCs) have become a phenomenon presenting the prospect of free high class education to anyone by offering the possibility to teach Thousands of participants simultaneously. The word of a *disruptive technology*–rendering universities obsolete– rumbled through the media. By now, as the dust has settled, a more conservative pattern is emerging: MOOCs are a highly effective and valuable tool in the context of lifelong learning. The format is facing a couple of challenges, however. Next to high drop out rates, the pedagogical concept is often criticized for its behaviorist background and frontal teaching styles. The MOOC format itself, originates in the connectivist teaching paradigm, which propagates a very different style of teaching and learning. In this tradition, learning is experienced as the collaborative act of creating a network of learners and digital artefacts, each focussing on certain aspects of a topic. The main problem here is that this approach is limited in its scalability; particularly in its outreach to an audience that is less committed and passionate or just limited in its access to resources, such as time and personal energy. The paper at hand examines the current situation in terms of collaboration features on various MOOC platforms and explores options to foster collaboration amongst participants in this context.

Categories and Subject Descriptors

H.5.3 [**Group and Organization Interfaces**]: Computer-supported cooperative work, Asynchronous interaction, Synchronous interaction, Web-based interaction

General Terms

Human Factors, Collaborative Learning Environments

1. INTRODUCTION

openHPI is the MOOC platform offered by the Hasso Plattner Institute (HPI). The HPI is associated with the University of Potsdam, Germany and offers study programs in IT-Systems Engineering and Design Thinking. On this platform the HPI has offered about twenty self produced courses on various ICT topics since September 2012[1]–hosting between 5,000 and 19,000 participants per course. According to recent research, deep learning and the development of critical and higher order thinking skills only occurs through interaction and collaboration [4, 21, 23]. In the HPI's offline curriculum, collaboration and team work play a vital role in the students' education. The Design Thinking tracks at the HPI's d.school or e.g. the bachelor projects, which are extending the traditional bachelor's theses with hands-on, project based teamwork are the most prominent examples for this approach. Collaborative learning, however, is only poorly supported on most MOOC platforms. In general, the standard model is to present a pre-defined set of learning materials to the learners, often enriched with self-tests and some additional communication possibilities (such as forums or direct messaging). openHPI, similar to the other MOOC platforms, in the past did not provide sufficiently sophisticated options for the users to interact and collaborate. The paper at hand examines the status quo of support for collaborative work on several MOOC platforms and explores the possibilities of incorporating a more collaborative learning approach into the existing MOOC concept. Furthermore, it presents an online collaboration toolkit for MOOCs on the openHPI platform. We discuss which tools for collaboration and communication are useful and required within this context. The presented toolkit has–at least partially– been implemented on the openHPI platform. We evaluate its current acceptance amongst the course participants and suggest further steps to be taken.

During 2013, the code base of the openHPI platform has been completely redesigned. Whereas, until March 2014 an existing monolithic learning management system (LMS) served as the foundation of the platform, openHPI is now based on a micro-service architecture that has been built completely from scratch. The new platform's architecture allows us to more easily include research oriented topics and

[1]including those, which are scheduled for 2015

features, such as the collaboration toolkit, into the platform.

The remainder of the paper at hand is structured as follows:

- Section 2 gives an overview of the available body of research to find the advantages, challenges and necessary prerequisites for successful online collaborative learning.
- Section 3 examines existing concepts of the most prominent MOOC platforms.
- Section 4 describes the concept's implementation on the openHPI platform.
- Section 5 examines how the toolkit is accepted by students and teachers.
- Finally, section 6 lists planned improvements and section 7 concludes our findings.

2. COLLABORATIVE ONLINE LEARNING

This section takes a look at the benefits and challenges of collaborative learning to identify the desirability of the integration of more collaborative features within MOOCs. The available body of knowledge is surveyed to establish a profound basis for further feature development in this context.

Research has been carried out in several directions: Computer Supported Collaborative Learning, Distance Learning Groups, Open Distance Learning, Asynchronous Learning Networks and Computer Supported Collaborative Work, to name just a few. Most of these areas are concerned with traditional online courses, which have been around before the MOOC hype swept the educational landscape. The main difference between traditional online courses and MOOCs can be observed in the number of participants per course and in the resulting technological requirements. Therefore, the findings about collaborative learning from the pre-MOOC era are still relevant and can be adapted to the context of MOOCs. Additional interesting research stems from topics such as distributed software development and the communication schemes employed there. MOOCs are offered remotely and in an asynchronous manner. Thus, it is rather unlikely that the participants of a MOOC ever meet the teaching team or their peers in person[2]. Any of the course-related actions can happen anywhere at any time. Course participants do not need to be present in a class room, hence they can take the course from almost anywhere in the world (provided that there is a good Internet connection). The benefit of these characteristics is that a wide variety of people is enabled to participate. The original MOOCs have their origin in the connectivist learning theory. These are referred to as *cMOOCs*. Most current MOOC platforms, however, offer so called *xMOOCs*. The high level of user interaction and collaboration that has ben a major feature of cMOOCs has been sacrificed in exchange for a better scalability of the courses. According to Downes [8] the degree to which a wide array of different participants and points of views are involved and how much learners of differing opinions interact is a vital part of the connectivist theory. To leverage these interactions and discussions by providing a toolset to assist the users in a variety of ways, therefore, has to be considered as a highly promising way to improve the learning situation in current day xMOOCs.

To begin with, we will define the term collaborative learning: According to Stofberg et al. it is "active learning in groups with the purpose of achieving competence and generating/creating knowledge by co-operating, communicating, sharing and exchanging" [34]. Laal and Ghodsi further highlight that collaboration includes respecting other group members as well as a shared authority and responsibility [23]. This form of learning comes almost naturally in a class room setting. As students are not alone on-campus, they tend to ask their peers for help if a certain aspect is not understood. Often, the communication is accelerated in the eve of upcoming assignments when problems are encountered. In addition, some tasks are designed with a group in mind so that they should be solved by two or more students. These dimensions of exchanging knowledge and effortless interaction between students are much harder to realize in an online setting and are often only insufficiently supported by current MOOC platforms (see section 3).

2.1 Advantages and Challenges

Collaborative learning is associated with many benefits ranging from better learning outcomes to improved social skills. This section summarizes the advantages as seen by different researchers. Deep learning, long term retention, improved social and communication skills, and the formation of social relationships are the benefits of collaborative learning as described by Kreijns et al.[20]. Laal et al. [23] categorize the benefits of collaborative learning into social (such as the improvement of soft skills, and building social support systems), psychological (such as reducing potential anxiety), and academic (such as the students' active involvement in the learning process, leading to better class room results and increased critical thinking skills).

An early field study of many courses by Hiltz et al. found that the results achieved in online collaborative learning can be as good or even better as in a traditional class room setting [17]. This study did not only consider the measurable outcomes, but also encompassed the students' perceived learning experience, using questionnaires. Online learners that studied alone served as a control group, their results turned out to be the poorest of all groups [17]. Better learning outcomes are one of the recurring themes among the advantages of collaborative learning. A statistical evaluation of the first two courses at openHPI found that high forum participation directly correlated with better overall results [12][3] .

Apart from the learning outcomes a lack of learner satis-

[2]Phenomena such as the office hours provided by Dr. Chuck, the instructor of a Python course at Coursera (https://www.coursera.org/course/pythonlearn) during his travels at selected locations around the globe or the meet-ups organized by participants of some MOOCs have to be considered as exceptions that only apply for a minority of the course participants

[3]This might be a hen or egg problem, however. It cannot be stated for certain if the number of postings has to be accredited to previous knowledge in the topic or if the learners improved by actively participating in the forums

faction in distance courses is associated with a feeling of loneliness [22, 27]. Providing learners with communication tools can help to counteract this issue by creating a sense of community [22].

In order to effectively learn together, a sense of community must exist [37]. A feeling of community however is hard to achieve in a group of tens of thousands of participants. A phenomenon that can be observed e.g. in the Coursera forums is that participants are forming study groups within the general course forum. Such a study group creates a more private atmosphere and, therefore, lowers the barrier for shy students to participate. Particularly, more advanced users often restrain from posting in the public course wide forum for fear of making fools of themselves. In a recent comparison of two courses on openHPI, we found evidence that this–in combination with language restrictions–is the most probable reason for the significant difference in the amount of forum posts between these courses [24]. A study conducted by Stacey found that learners feel more comfortable communicating in small groups. Participants felt inhibited when interacting with all participants, while this problem did not occur in smaller groups [31]. Meinel et al. share this opinion, stating that many participants feel lost within a large group and are looking for the comfort of smaller groups [26]. A major concern is the lack of social skills of many learners resulting in poor collaborative experiences. This is aggravated by the fact that online interactions are different from normal face to face communication and therefore require new competences which are often not taught [4].

Within the context of an xMOOC, reaching the performing stage of Tuckman's definition of group development [36] is difficult–due to the relatively short course length, typically four to ten weeks [32]. On openHPI the course length is even shorter, varying from two to six weeks depending on the course format. While Tuckman claims that almost all groups reach the last and most efficient performing stage regardless of their life span [36], Brindley et al. stated that even a semester length of 12 weeks is too short for this endeavor [4].

2.2 Community

It is important to determine how to create an environment in which collaborative learning is possible and successful. Such a construct is often referred to as a *Learning Community*. The importance of such a community is highlighted for instance by Rourke [28]: "If students are to offer their tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others' critiques as valuable rather than as personal affronts, certain conditions must exist". These conditions are then further defined as trust, a feeling of belonging and closeness. Wegerif seconds these findings by stating that a sense of community seems to be a required first step for collaboration [37]. Palloff et al. identify a shared purpose, guidelines, reflective practice and social presence as the basic requirements of an online community [27].

Originating in social constructivism, the model of a *Community of Inquiry* infers that efficient and deep online learning requires the development of community [35]. According to Rubin and Fernandes [29], knowledge "is intrinsically tied to the social context of the class; learning in online courses occurs through the interaction of the faculty, student, and course materials, mediated by technology". A community of inquiry is characterized by social presence, teaching presence, and cognitive presence [29]. Meaning is constructed through sustained communication amongst the learners [9]. This concept was developed for online communities and is highly applicable to the MOOC context. It defines the necessary components for a good and deep online learning experience based on computer mediated communication [9].

2.3 The Role of Instructors

Much of the available literature emphasizes the importance of teaching assistants, guides and tutors for a successful online collaboration experience [21, 9, 22, 27]. Their role is defined to moderate discussions, enforce rules and help learners use tools [19]. An important role of instructors is to stimulate discussions and group activity e.g. by posting discussion triggers. These are discussion threads about a topic related to the course context which the participants should discuss [13]. For this purpose openHPI provides teachers with the possibility to mark forum posts as sticky and thus keeping their visibility high as they will always appear on top of the list. In forums dominant or even abusive behavior can occur, leading to learners avoiding the forums completely [25]–hence moderators are needed to subdue offending behavior. The amount of support and guidance through instructors per user, however, does not scale well, as instructors are a limited resource [21]. A mentoring model, where course alumni of previous iterations return to mentor the course appears to be a feasible solution. Almost 50% of the participants of a survey conducted amongst openHPI users stated that they would be willing to volunteer as mentors for future iterations of the course [32]. The self regulatory feature of online communities often shows in forums. Members try to enforce the rules of behavior even without an official title [12]. Promoting outstanding community members to moderators and provide them with additional rights, e.g. to close discussions or to edit answers also is worth to be considered.

3. COLLABORATION FEATURES IN THE CURRENT MOOC LANDSCAPE

Looking at the manifold advantages of collaborative learning it is interesting to compare how collaborative learning is supported in current xMOOC platforms. Therefore, we will now give an overview on the collaboration features that are offered by the current versions of the major MOOC platforms. The following list has been extracted by exploring the listed platforms as a registered participant in randomly chosen active courses and by doing a desk research of papers related to this topic. Naturally, all of these platforms are a moving target as they are constantly improved and new features are added. So this overview can only reflect the state at the time of the writing of this paper [4] and does not pretend to be exhaustive.

- **Coursera**[5] The main collaborative feature that is offered by Coursera is a course wide forum. Only a minority of course participants takes an active part in

[4]March 2015

[5]https://www.coursera.org/

the discussions. The Edinburgh MOOC report finds that only 15% have posted in the forums [11]. For the university of London courses, held on the Coursera platform, the participation rates of active learners in the forums were even worse [10]. They ranged from 4% to 7% in the first week and between 2% and 3% in the sixth and final week [10]. It has to be considered however that forums are often used passively, as many of the questions that occur to a learner have often been posted and answered by other learners previously. Unfortunately there are no numbers from these institutions indicating passive forum usage. Coursera also offers the students the opportunity to create study groups within a forum. Furthermore, Coursera offers Google Hangouts for up to 10 course participants to join. The groups formed by these hangouts are a volatile construct that vanishes when the hangout session is closed. More collaborative features have been announced in the context of the 2013 round of funding [16].

- **edX**[6] Similar to Coursera, the main collaboration feature is the course wide forum. According to edX's about page they are working on online discussion groups and wiki-based collaborative learning [1]. Some courses on edX employ third party tools, such as e.g. Google Hangouts for special purposes. The course 'BerkeleyX: CS169.1x Engineering Software as a Service' e.g. made use of Google Hangouts to experiment with pair programming on homework assignments [2]. The platform that serves as the foundation for edX, is available as an open source solution and is employed by other providers, such as e.g. France Université Numerique (FUN)[7] or XuetangX[8] in China.
- **Udacity**[9] sports a discussion forum and a Wiki. Furthermore, it offers mentor-supervised projects as part of the course certification requirements.
- **MiriadaX**[10] is offered by Telefonica and Universia, a collaborative network of universities, which is sponsored by Banco Santander. MiriadaX is the world's second largest MOOC platform, and the first in Spanish language. According to their press release at the day of their global launch, MiriadaX is based on collaborative learning [3]. The only collaboration feature mentioned on the platform, however, is the forum.
- **iversity**[11] is the largest German MOOC platform. The majority of courses are offered by European Universities of Applied Sciences. Iversity's main collaboration tool is a course wide forum. Some courses, however, employ additional, external Web2.0 tools to augment the limitations of the platform. In the course Architecture 101 e.g. Instagram is employed.
- **imoox**[12] A small Austrian MOOC platform offered by the TU Graz, also offers only little active technological support for collaborative activities. In this case the forum is not even separated by course, but an overall forum for the whole platform.
- **openHPI**[13] (and its partner platform openSAP[14]) also offers a course wide forum. Next to that a range of additional features to support various aspects of collaboration has been implemented during the recent months. Amongst these are
  - Collab Spaces–featuring more private discussions than the course wide forum, allowing members to communicate via Google Hangouts. In some selected courses, the Tele-Board has been included, a smart-board that has been developed to support collaboration in distributed Design Thinking teams. See Gumienny and Gericke [14] for more detailed information on the Tele-Board.
  - a Social Graph–allowing registered users to manifest their existing offline (or online) 'friendship' on the openHPI platform [33]. Due to delays in our operating procedures, the feature is not live yet and thus has not been evaluated.
- **cMOOCs**[15] [16]– The connectivist learning theory forms the educational foundation of the highly collaborative cMOOCs. This theory was established by George Siemens in 2005 [30]. In general, cMOOCs have a completely different structure by their nature as they do not make use of specialized MOOC platforms but rather employ LMS Systems, Wikis, or Blogs as their basis and extend them with the existing plethora of Web2.0 tools.

4. COLLABORATION TOOLKIT

As we stated in section 2, successful collaboration requires an atmosphere of security and trust, which is only hard to achieve in a group that extends a certain size. We, therefore, decided to offer the participants the option to form learning groups within a course and support these groups with *collab spaces* In these collab spaces we provide the users with the following toolset:

- A 'private' forum
- Google Hangouts
- Together.js
- Tele-Board

The remainder of this section provides more detailed information about the collab spaces and the tools they offer and motivates why they have been chosen.

4.1 Collab Spaces

The collab spaces provide a virtual location for learning groups to meet and collaborate. Every learning group forms a sub-community within the larger course community and

[6]https://www.edx.org/
[7]http://www.france-universite-numerique.fr/
[8]http://www.xuetangx.com/
[9]https://www.udacity.com/
[10]https://www.miriadax.net/
[11]https://iversity.org/
[12]http://imoox.at/wbtmaster/startseite/
[13]https://open.hpi.de/
[14]https://open.sap.com/
[15]http://cck11.mooc.ca/
[16]http://www.moocmooc.com/

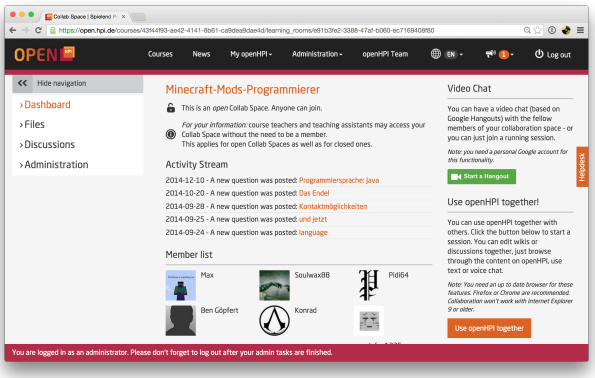

Figure 1: Collab space with list of members and activity stream

is automatically provided with a collab space. All learning groups and their collab spaces are part of a course, platform wide collab spaces spanning several courses are not offered. Only inside these collab spaces, learners can use the featured collaboration toolset. Each participant can create any number of learning groups. By creating a group, the participant automatically receives the status of a group administrator. Learning groups can be open or closed. Open groups can be joined and viewed by any other participant of the course. To join a closed group, a membership request has to be approved by a group administrator. Group administrators can promote other group members to the role of a group administrators, accept membership requests, and exclude members. Members of the teaching team and platform administrators have full access and administration rights for both, open and closed, groups to prevent and stop misuse. As stated by Brindley, Walti and Blaschke, participation in a group can be experienced as a burden by learners seeking flexibility. Forcing learners into groups that have not been self-selected, often results in rejection of the concept [4]. Therefore, it is not compulsory to join a learning group in order to complete most courses. We are, however, experimenting with obligatory team work in a *Design Thinking* course experiments on our partner platform openSAP, as, in this case, team work is an essential part of the course's learning objective. Main use cases for our learning groups are:

- Study groups–focused on going through the course together, a concept adopted from classical university education. These groups are often formed based on a common property, such as working in the same company or spatial proximity.
- Topic focused groups–diving deeper into a specific course topic. Typically these groups go beyond the scope of the actual course.
- Teams–working together on one or multiple assignments or a project given as an essential part of the course.

4.2 Collaboration Tools

4.2.1 Communication

Effective communication is of utmost importance for online learning groups. Without communication support, collaboration is not possible. Students need communication channels to their peers to ask questions, help others, share resources or just engage in casual off-topic conversations. Generally, communication channels are categorized in two distinct types: asynchronous and synchronous communication. Synchronous communication is characterized by getting answers immediately. There is a low turnaround time leading to quick feedback. Synchronous communication requires participants to be available at the same time. Meetings have to be scheduled. Examples include face-to-face communication, telephone calls and video calls. Asynchronous communication is identified by not expecting an immediate response. A message is sent and at some point in the future an answer is received. Learners do not have to be available at a specific time, which resonates well with the general concept of MOOCs. Hence it is the predominant form of communication used in today's MOOC landscape. Examples include e-mail and online forums.

We will now examine a couple of requirements towards communication tools and further on describe the tools that we selected to be included in our toolkit. *Media Richness Theory* measures the effectiveness of certain media types when conveying intended information from the sender to the receiver [5]. High Media Richness also fosters the notion of social presence perceived by the communication partners [22]. One of the major research topics in this context is the collaboration of remote software development teams [15]. On a scale measuring the effectiveness of transmitting information, face-to-face communication sports the highest media richness, while unaddressed documents are shown to have a very low media richness [5]. In a scenario that requires technical support, video conferencing gets closest to face-to-face communication. E-mails and forums rank low on the list due to their lack of nonverbal communication. Communication tools with high media richness are to be used when the message has a high equivocality [22]. Despite being widely popular, there are critiques of Media Richness Theory. As such the use of media as suggested has not proven to be most effective in studies, particularly in the context of computer mediated communication [7, 6]. *Media Synchronicity Theory* described by Dennis, Valacich, and Fuller [7, 6] defines synchronicity as "a shared pattern of coordinated behavior among individuals as they work together" [7]. It further defines the two primary purposes of communication as conveyance and convergence [7].

Conveyance is the transfer of as much information as possible to allow the recipient to form a mental model. Convergence is the discourse about these the mental models to reach a common understanding. Convergence typically requires quick feedback and exchange of small amounts of data one at a time. The theory suggests an effective communication process along with suitable tools. At first, information has to be distributed (conveyance). This can efficiently be done by using asynchronous media, such as documents, forums or mail. Later participants need to reach a shared understanding, make decisions, or clarify misunderstandings (convergence). This is best done in face-to-face communication or video conferencing.

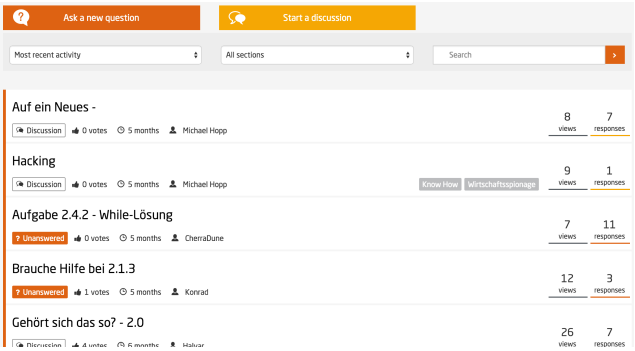

Figure 2: Forum embedded in Collab Space

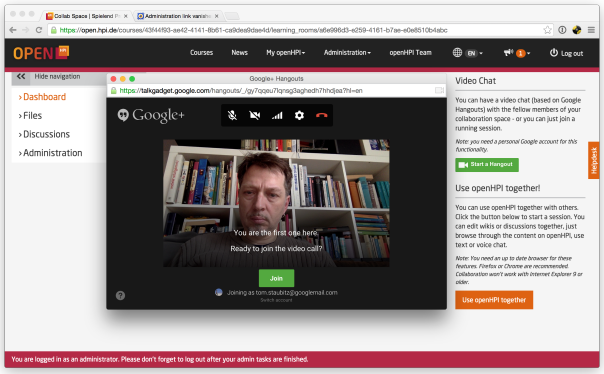

Figure 3: Google hangout, embedded in collab space

Questions and Answers
The most basic form of online collaboration and communication on a MOOC platform are *question and answer* systems also known as forums. One of their main use cases is to ask and answer questions or to discuss about course contents or assignments. Question and answer systems give learners the opportunity to act as teachers by explaining the course contents to their peers. The benefit of this is not to be underestimated. As Hunt notes, teaching "clarifies your own understanding and reveals many of your underlying assumptions" [18]. Forums are characterized by high rehearsability, reprocessability, and parallelism. The available symbol sets depend on the concrete forum, but embedding more than just text is desirable; many forums feature at least images, others also allow the possibility to embed videos. The transmission velocity varies from low to medium, depending on whether other users are online at the same time and answer immediately. With these characteristics, forums are well suited for conveyance processes. The questions and answers format seems to be widely popular and has a huge potential for valuable contributions, as revealed by an openHPI survey. More than 73% of the survey participants state that they benefit from explanations of complicated matters. At the same time 79% of the surveyed users enjoy explaining topics. The question and answer format is of high value to both, active and passive, learners. We, therefore, added a forum to each collab space. The threads of the forums in the collab spaces are not listed in the course wide forums and hence are of a more private nature. All forums on openHPI allow to embed images and links to other resources. We differentiate between questions and discussions, whereas questions can be marked as answered by the participant who posted the question. Other participants also can vote for questions, answers, and discussions if they consider them to be particularly helpful (see figure 2).

Video Conferencing
Scheduling synchronous communication in the globally distributed and highly asynchronous environment of MOOCs is challenging. Still, as outlined before, synchronous communication is extremely powerful and important. One possible use case for synchronous communication is the explanation of a complex topic after asynchronous explanation attempts have failed. Explanations about misunderstood points are very hard to do asynchronously, as the time from posing a question to receiving the response is too long. In a synchronous context each question can be explained one after another, reaching a shared understanding much sooner. It can also be beneficial for discussions within a team. Decisions require the consideration of many different view points, advantages and disadvantages. Collecting all of them and then discussing them in an asynchronous manner can be very inefficient. Moreover, synchronous communication has a positive effect on social presence. Increased social presence then results in an increased trust and overall group cohesion, which subsequently result in better group performance and a decreased feeling of loneliness. Synchronous communication has a high information velocity by nature. Reprocessability, in contrast, is low to medium. As reprocessability is very important, it is suggested to pair synchronous communication with triggers to persist the information, e.g. by asking the users to write a summary of their communication.

Google hangouts have been added as a video conferencing tool to the collab spaces. For the time being this was the most convenient way to get things started. The disadvantage of this approach is that the participants are required to possess a gmail account in order to use this feature. Furthermore, we are not in possession of the video data, which confronts us with a couple of disadvantages ranging from research restrictions to privacy issues.

Real time collaboration
Together.js[17] is a JavaScript library and service from Mozilla to add collaboration features to every website. Using together.js, web pages can be browsed together and forms can be edited simultaneously. Users see the mouse cursors of other users , as well as the page they are on. Synchronization and mouse cursor display happen on the DOM level, so that different screen sizes do not pose a problem. Moreover together.js adds additional collaborative features to the web application, such as text or audio chat during the collaborative session.

4.2.2 *Sharing Resources*
Participants need to be able to share interesting resources with their fellow learners. Sharing can basically take two forms: share the content itself or share a link where the contents can be found. Sharing resources, in general, is not directed at a specific person or part of a direct conversa-

[17] https://togetherjs.com/

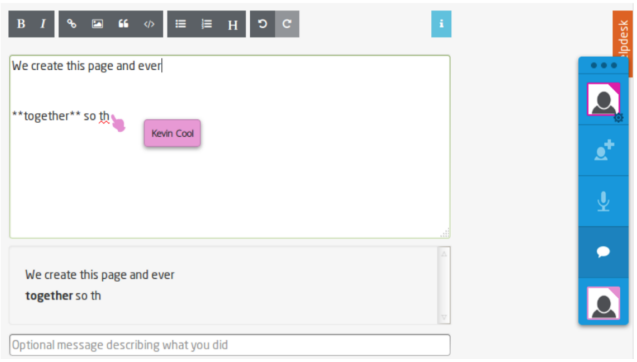

Figure 4: Real time collaboration with together.js

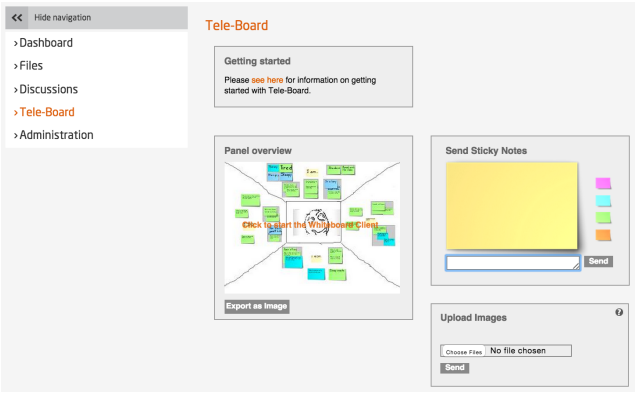

Figure 5: Tele-Board integration in collab spaces

tion. It can not be expected of a platform to allow uploads of large files (e.g., larger than a gigabyte). Should this become necessary, it is preferable that to use external storage services and then just share the link. For sharing resources high reprocessability is of utmost importance, as the access to the media has to persist. Unfortunately, the previous statements bare the potential to contradict each other. We provided the collab spaces with the possibility to upload files and share them within the learning group using that collab space. Allowed file formats and file sizes are restricted.

4.2.3 *Knowledge Documents*

The members of a learning group should be able to create documents together. When new knowledge is created within a group, perhaps through discourse or interaction, users should be able to persist the information. This information should be editable for all members, so that they can extend and correct the document. The created knowledge documents depend on the main use case of a group and the problems they encounter. A study group might want to share digital manuscripts of lectures this way or keep a record of solved problems. Learners seemingly want this feature to freely edit texts in groups, as shown by the answers to an openHPI survey. In the survey 34% said that they would be motivated to write a digital manuscript that can be shared and edited in groups. More than 37% of the users in the openHPI survey stated that they "would be more motivated to use a video annotation function when it worked like a wiki (with formatting and editing options for group members as well as a history)". A *gollum*[18] based wiki has been implemented but currently has not been deployed to the productive system for reasons that are beyond the scope of this paper.

4.2.4 *Group Awareness*

Kreijins et al. introduce the concept *Group Awareness*. Being aware of the social presence of fellow participants is beneficial for successful collaborative learning [21]. Group awareness is a crucial concept when thinking about collaboration in MOOCs. As learners are online at different times it is hard to get a feeling of social presence if there is no trace of the actions of the other group members. A group awareness tool pulls data about recent events from all other collaboration tools used in the collab space. It recognizes if a new question was posted, a document has been edited or if a video call has just started. Kreijins et al. introduce the concept of *Social Affordances* for computer-supported collaborative learning environments [21]. A social affordance is a trigger for social interaction and communication amongst the participants. Next to the basic information about the underlying event, messages are accompanied with the social affordance to take action by adding a link to the source of the notification, so that the participant is enabled to immediately interact with it. Currently, the group awareness information is summarized on the collab spaces' dashboard (see figure 1).

4.2.5 *Special Purpose Tools*

While many collaboration tools are universal as they organize information or allow communication, some courses might need specialized tools. This is especially true for the team use case of the collab spaces depending on the group assignments. E.g. in a coding course a coding environment where participants can edit and share code would be beneficial. For now we have included the Tele-Board for the Design Thinking experiments on openSAP.

5. USER ACCEPTANCE

As mentioned in the introduction, the platform has been rebuilt from scratch in 2014 to address a variety of issues that have emerged during the first courses on the old version of the platform. Since the second course we had enabled a learning group feature on version 1 of the platform. The acceptance of this feature amongst the users was rather low, however. In the Web Technologies course, that took place in 2013 on the openHPI platform, of the about 7,350 course participants only around 300 (4%) joined a learning group. Moreover the collaboration features within these groups were rarely used [32]. A survey among openHPI users in early 2014 supports these numbers. Only 27% of the survey participants indicated a positive reaction to the question if they like learning in groups. 37% on the other hand expressed a negative reaction to the statement, while almost 33% stayed neutral (remainder to 100% is no answer). All in all the neglect of collaborative features along with the strong preference for individual learning seem like an overwhelming vote against group-based collaborative learning.

Figure 6 shows the amount of learning groups per course

[18]https://github.com/gollum/gollum

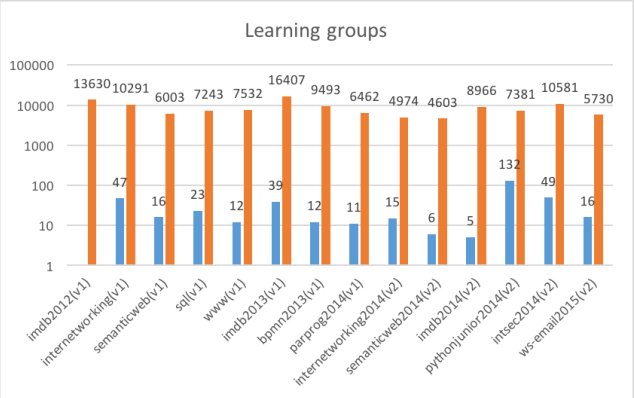

Figure 6: Learning groups vs. enrollment numbers per course.

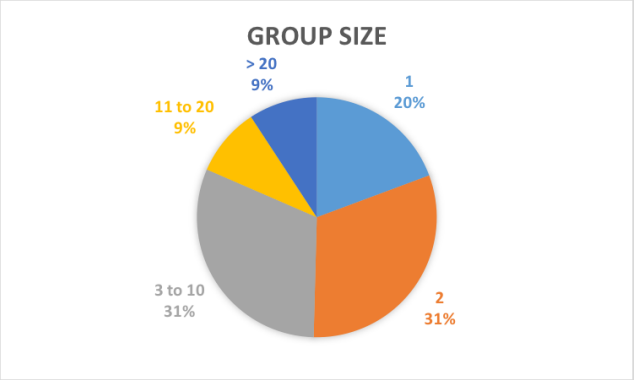

Figure 7: Size of learning groups in PythonJunior2014

in relation to the number of enrolled participants. During the first course collaboration features have not been available. With the start of the second course learning groups have been enabled on openHPI(v1) 49 learning groups have been created by 673 of 10,291 enrolled participants. Even if the Web Technologies course that has been quoted above had–in comparison to the other courses–a rather bad learning group per enrolled user ratio it still is a valid statement that the user acceptance of these tools leaves room for improvement. The most interesting numbers are concerning the course PythonJunior2014. This course was special in a couple of aspects. It was the first course on openHPI that addressed particularly school children and also the first course in our new hands-on format. Hands-on courses span only over four weeks and have a strong focus on practical hands-on assignments. Currently, this format features only programming courses. Figure 7 shows that we have to subtract 20% of the total amount of learning groups in this course as they consist of only one member. The names of some of these one-member groups allow an educated guess about their nature. Group *Wolfgang* probably just tried to explore the features of the platform, while group *Leon and Chris* appears to have encountered either a technical or a social problem.

Despite those discouraging numbers we decided to reintegrate the learning group feature on the new version of the platform for the following reasons:

- From the amount of created learning groups we see a need for the feature.
- The usage of the collab spaces' features indicates that their usability needs to be improved and that they require better integration to the course concepts.
- The feature is essential for certain courses, such as the Design Thinking experiments.

At an early stage of the implementation of the collab spaces we conducted an interview with two main stakeholders: the organizers of the openSAP Design Thinking MOOC experiments. As mentioned before team work is an elementary part of the course concept and the subject matter to be learned. These courses up to now are limited in the amount of participants (about 250 invited students of partner universities). The participants had been grouped into teams to collaborate on assignments. The Tele-Board integration was implemented specifically to aid these courses. The interviewed experts agreed that the Tele-Board, and its integration into openHPI, is a great tool to facilitate Design Thinking courses in a distributed manner. Forum and file upload have been well accepted. Due to the structure of the target audience, however, many of the course participants were co-located and hence preferred to meet in person, which resulted in a less than expected usage of the collab spaces. Those teams that have used the Tele-Board integration and the collab spaces were satisfied with the experience. The course organizers plan to advertise and include both Tele-Board and the collab spaces more in the coming iterations of the course to promote their usage.

6. FUTURE WORK

One of the most important missing features in the context of the Design Thinking experiments is the possibility to share the teams' results with other teams for discussion. Possible implementations would be to provide course participants that are not members of the group in question with a visitor state, allowing them to access areas of the collab space that have been marked as public by the group administrators. The Design Thinking courses also have started to experiment with a mentoring concept by assigning more experienced users, e.g. participants of previous course iterations to the teams. These mentors also are provided with group administrator rights. It is further suggested that these mentors, as well as teaching team members are provided with a badge that clearly identifies them as such. Currently, we are evaluating how to automate the team building process for the Design Thinking courses, which is a prerequisite for scaling them to a larger amount of participants. In the long term the Google Hangouts will be replaced by a video conferencing tool that has been developed at the HPI and relieves the users from being required to possess a Gmail account. The Tele-Board currently is a Java Application. Depending on the operating system and the settings of the participant, the integration is a little rough. It is currently being rebuilt as a web application. Group awareness information should also be available via in-app notification and e-mail.

The evaluation of the current usage data highlights that it is important to familiarize the users with the opportunities that are offered and to promote the collaboration features by including them more closely in the course concept. Furthermore, the user experience within the collab spaces needs to be improved.

7. CONCLUSION

The current state of our collaboration toolset is a good basis but leaves sufficient room for improvements. The availability of the technology alone, is not sufficient. It is important to actively promote and trigger collaboration and group work; not alone because educational practice during the last centuries has done a good job in discrediting collaboration. Collaboration, especially in the context of team work assignments, requires more initial effort for the learner, while having a risky outcome with unknown co-learners. That said, we have presented and implemented a toolset that allows collaboration in a variety of flavors on the openHPI MOOC platform.

This toolset consists of a general virtual space for collaborative online learning. It supports study groups, topic focused learning, and teams, both in open public groups and closed private groups. For online communication, a mixture of synchronous and asynchronous tools have been added. The collab spaces provide the learning groups with the opportunity to share artefacts. The possibility to create Wiki-style knowledge documents has been integrated but not deployed to the productive system yet.

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