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Collaboration and Teamwork on a MOOC Platform
A Toolset

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ABSTRACT
Teamwork is an an important topic in education. It fosters deep learning and allows educators to assign interesting tasks, which would be too complex to be solved by single participants due to the time restrictions defined by the context of a course. Furthermore, today's jobs require an increasing amount of team skills. On the other hand, teamwork comes with a variety of issues of its own. Particularly in large scale settings, such as MOOCs, teamwork is challenging. Courses often end with dysfunctional teams due to drop-outs or insufficient matching. The paper at hand presents a set of three tools that we have recently added to our system to enable teamwork in our courses. The presented tools are evaluated in terms of success rates of the created teams and workload reduction for the courses' teaching teams.

Author Keywords
Teamwork; Collaboration; MOOC; Massive Open Online Courses; PeerAssessment.

INTRODUCTION
Based on the result of experimental courses on our platform with small numbers (200-500) of participants, we identified three major issues that hinder real teamwork in our MOOCs:

1. The formation of teams needs to be supported, satisfactory self-organization is not to be expected.
2. The teams need to be enabled to jointly edit common task related documents and they need proper communication tools.
3. The teams need a tool to jointly hand-in their solution, which allows the assessment of their work.

In this paper we introduce a toolset, which allows us to employ and assess teamwork exercises in large scale settings and provides solutions for the challenges listed above.

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- The *TeamBuilder*—is a standalone web application to form teams out of a given pool of participants, based on a variable set of parameters. It allows to limit the number of participants that will be admitted to attend the teamwork assignments. The limiter can be applied either on a *first-come/first-serve* basis or on the participants' previous course performance.
- The *TeamCollabSpaces*—provide teams with an area of their own within the course and offer a set of communication and collaboration tools.
- The *TeamPeerAssessment*—extends our built-in PeerAssessment tool and allows teams to jointly submit digital artifacts. The submissions of each team are reviewed and assessed individually by members of other teams. It additionally allows team members to rate the work of their team mates in terms of contribution, organization, and social skills.

THE TOOLSET

TeamBuilder
The term *team building* describes either the process of selecting the members of the future team or the process of transforming a collection of individuals (following their own agenda) to a successful team with a common goal. In the paper at hand the term is used in the meaning of selecting or matching the members for the future team. The *TeamBuilder*, a standalone tool that can be connected to any Learning Management System (LMS) that supports the Learning Tools Interoperability (LTI) interface (see Figure 1), provides a limited set of parameters to be used for the team matching process:

- The participant's preferred language—a limited set of languages is provided. If deactivated, the course language is assumed to be the "lingua franca".
- The participant's location—clustering based on the participants' location to allow face-to-face meetings.

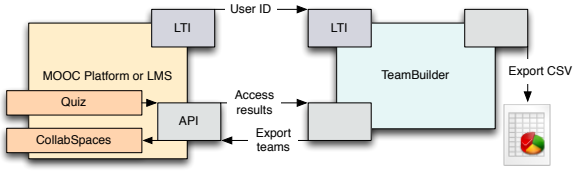

Figure 1. The TeamBuilder can be connected to any LMS that provides an LTI interface.

- The timezone in which the participant prefers to work.
- The participant's area of expertise—options are provided.
- The participant's preferred task—any number of tasks can be defined by the teaching team.

A missing, but yet important parameter is the participant's commitment in terms of time.

The *TeamBuilder* allows educators to activate the parameters that are suited best for their ideas on matching teams. One teaching team's major requirement was to form local teams that are able to meet physically. Another teaching team, in contrary, tried to team up participants with a diverse cultural background. They also required, however, that the participants were able to collaborate synchronously so they had to live at least in the same range of timezones. The example illustrates that the criteria differ significantly between the courses.

Next to the possibility of activating and deactivating certain matching criteria, the tool provides the option to choose if a parameter is to be employed homogeneously or heterogeneously. The *TeamBuilder's* strategy is to build as many as possible teams with a **good** heterogeneous distribution of a certain parameter instead of few teams with a **perfect** heterogeneous distribution and the rest getting more and more homogeneous (depending on the available features of the participants).

The data we gather from the participants is deliberately kept simple and does not include sophisticated and more personal criteria, such as personality traits, or Belbin tests, etc. Our intention is to keep things simple and not to confront our participants with a multi-page survey that asks them to share detailed, fine-grained personal information. On the other hand, all data that we ask from the participants is mandatory. Those who refuse to provide a relevant piece of information will not be considered for the team assignments. The findings of Zheng et al. [4] show that participants that have at least partially answered surveys before joining a team were less likely to drop-out than those who did not take the surveys at all. This supports our idea of requiring the participants to show some commitment before they are allowed to participate in the team assignments.

Next to the selection of matching criteria, the tool allows to define a range for the desired team size. It attempts to build the teams as close as possible to the given upper limit. Finally, the tool allows to limit the total number of participants for the team assignments within a course. This limiter can be employed either in first come/first serve mode, or it can be employed in combination with the results of the assignments that have been handed-in before the team building item is published in the course. First come/first serve simply allows the teaching teams to select the first *N* participants that have applied for the teamwork assignment(s). In case the teaching team decides to employ the results of one or more assignments to decide which participants will be admitted to take the teamwork assignments, the tool allows two different settings:

1. Set a maximum amount *N* of students to be admitted for teamwork—The *N* participants that performed best so far will be admitted.
2. Set a lower boundary for the results in the exams that has to be achieved—In addition to the total maximum amount of participants, a lower limit for the results can be set. Only participants that have achieved at least *X%* of the points in the relevant exams–but no more participants than the total maximum–will be admitted.

While the *TeamBuilder* attempts to build teams fully automated, it still allows manual corrections. The final decisions are made by the teaching team. Participants can be moved from one team to another, new teams can be created and existing ones can be removed, etc. To assist the teaching team, the UI provides meta-information about the created teams, such as the max. local distance between team members or the team's state of heterogeneity concerning a given parameter. The teaching team can flag teams as finalized to override these indicators when they decide that the current state might not be perfect but is as good as it will get. If it becomes obvious that with the requested parameters, a proper matching is not possible, each of the requested parameters can be deactivated for the actual matching process.

Finally, there are two options to export the created teams. The *TeamBuilder* can either create an Excel sheet for further usage, or it can directly create *CollabSpaces* on our platform and add the team members to their respective *CollabSpace*.

CollabSpaces

We have introduced the concept of the *CollabSpaces* in [3]. Basically, the *CollabSpaces* provide synchronous and asynchronous communication tools as well as some co-creation tools to jointly work on digital artifacts. To keep the *CollabSpace* feature flexible, we defined two different collaboration concepts: *Groups* and *Teams*.

Groups—are loosely coupled and have a self-set goal or a common interest. Groups are self-organized, the participant who creates the *CollabSpace* has administration privileges and decides if it is public or private (invitation only). Group members can come and go as they want.

Teams—are tightly coupled and have a common task on which they are collaborating. The task is an essential element of the course and part of the grading scheme. Teams are formed by the teaching team using the *TeamBuilder*. In case teams become dysfunctional, the teaching teams have the possibility to merge teams or to move remaining members to other teams.

In the *TeamCollabSpaces*, the forums have received a slight upgrade. Emails are sent to each team member whenever a new question, answer, or comment is posted. Grade relevant team assignments are enabled by the possibility to add *TeamPeerAssessments*.

TeamPeerAssessment

In all courses that featured teamwork assignments, the teams were provided with a mentor, mostly volunteers. As the platform by then did not provide proper tools to enable graded team assignments, an improvised workaround had to be employed. It soon became obvious, however, that we need a better tool to hand-in team assignments.

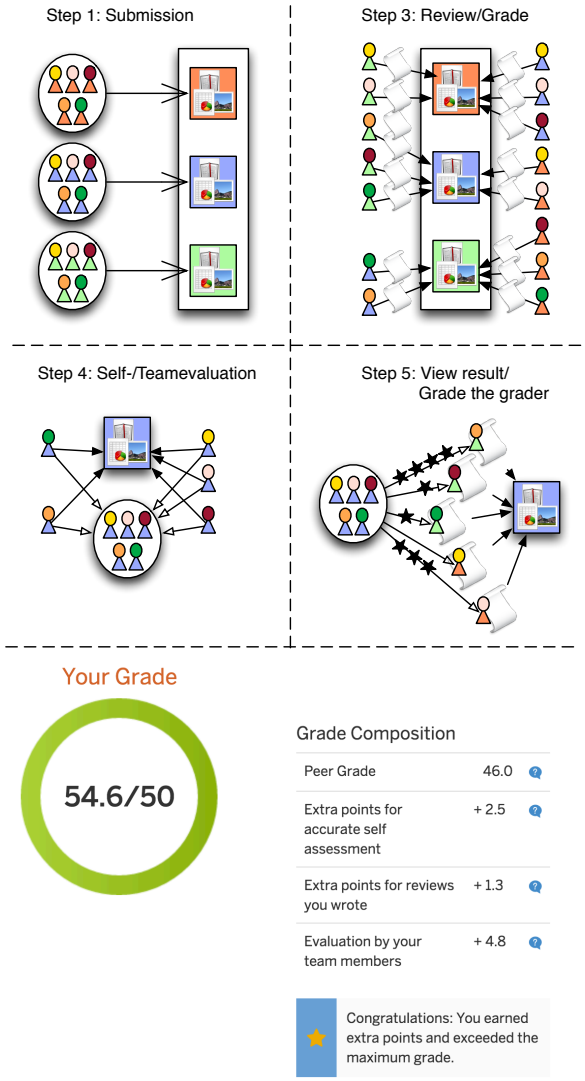

Figure 2. TeamPeerAssessment—Top/down, left/right. Step 1: The team jointly submits a solution for the given challenge. (Step 2: the training step has been omitted for simplicity.) Step 3: individual members of the teams review the work of the other teams. Step 4: individual members of a team assess the solution of their own team and rate the contribution of their fellow team members. Step 5: the team reviews and discusses the results and rewards helpful reviewers with stars. Bottom: screenshot of a participant's results view. The "Peer Grade" component contains the credits that the team received together. The other components contain credits that have been achieved for individual work, which can differ between team members.

A tool that allows...

- ...one team member to hand-in a solution for all.
- ...to review and grade the team work in a scalable manner.
- ...great flexibility in the type of assignments.

We already have a sophisticated peer assessment tool tightly integrated in our platform, which covers two of the three major requirements. We decided to modify this tool in a way that allows teams to jointly hand-in their work. In our original peer assessment tool, the process consists of 3-5 steps: submission, training (optional), peer review and assessment, self-evaluation (optional), results view and reviews rating.

For more details about the single user peer assessment system see [2].

To allow the assessment of teamwork, first of all we had to decide "who grades whom". Should the teams grade the other teams, should individual team members grade the other teams, or should the members of a team grade their team mates?

We decided to go for the second option. This way submissions receive more reviews, while the workload for the team members is kept low. Managing the review process is easier, as the team members do not have to be coordinated and no versioning is required. Participants have less opportunities for free-riding. Even if they manage not to contribute to the actual work, they still have to write their own reviews if they intend to receive credits. Additionally, each team member can rate her team mates in terms of contribution, organization, and social skills. The combination of these two aspects allows us to grade the team members individually. With this we're following established best practices, e.g. Carnegie Mellon's *Eberly Center for Teaching Excellence* suggests to compose grades based on the several components, including the team's final product but also the team processes and the functioning of the team. They also recommend to translate the team's overall performance into individual grades [1]. Just as in the single user peer assessment, participants can report submissions and reviews, whereas reporting submissions is an individual effort, while reporting reviews is a team effort. The team can also reward reviewers that wrote helpful reviews with additional points. Figure 2 gives an impression of the tool's abilities and shows how an exemplary result might be displayed to a participant.

EVALUATION

The tools that have been introduced in the previous sections, so far have been employed in various combinations and stages of completion in five courses on one of our platforms.

- Three iterations of the course *Developing Software Using Design Thinking*—all pilots with a limited amount of participants
- *Designing Business Models for the Digital Economy (BMI)*
- *Enabling Entrepreneurs to Shape a Better World (SBW)*

We focus the evaluation of the toolset on the SBW course here, as this was the first full scale course, which made use of the complete toolset. 12025 participants were enrolled for this course. The course employed the *TeamBuilder's* limiter feature to select the course's best performing participants for the teamwork exercises. 240 participants were admitted for the teamwork as the number of available mentors did not allow for more than 40 teams. The teams had to complete five tasks throughout the course, on which they received feedback from their team mentors. Finally, the teams created a document based on their preliminary work and submitted it to the *TeamPeerAssessment* system, where it was reviewed and graded by members of the other teams. While 32 of 39 teams (80%) submitted their completed work, only 40% of the team

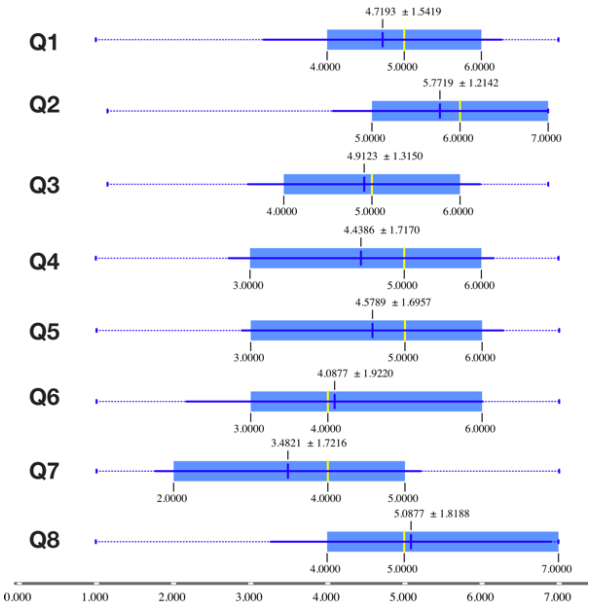

Figure 4. Participants' satisfaction with team challenge. Answers on a seven point Likert scale: Q1: How satisfied have you been with the Team Challenge? Q2: Have the tasks been relevant? Q3: Have the tasks been manageable? Q4: Have the tasks been suitable for virtual teamwork? Q5: Did you enjoy working in your team? Q6: Did you receive valuable support from your mentor? Q7: Did your mentor spent sufficient time with your team? Q8: Did you acquire important know-how through the tasks? 60 out of 240 participants have answered the survey.

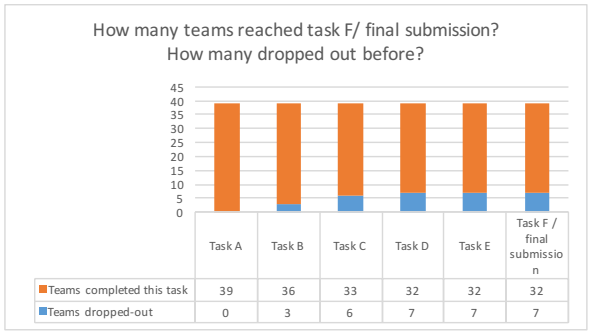

Figure 3. Dropped-out teams

members arrived at that point. Figure 3 shows that most of the teams dropped out during tasks two and three. Having a closer look at the teams, we found that 20 of the 32 teams that went till the end still were functional teams with 3 to 7 members. 8 teams still had two members left and 4 were dysfunctional with only one member left. If we have a look at the submission rates of the intermediate team tasks, we can see that only 228 of the 240 participants of the team challenge actually started by handing in the first assignment. A survey conducted at the end of the course among the participants of the team assignment, shows that the overall perception was rather positive (Figure 4). Mentor support and particularly the time the mentors spent supporting their teams need to be improved however.

FUTURE WORK

Next to optimizations in the tools implementation and features, such as e.g. adding a participant's time commitment for the team work task as a matching criterium, we need to support the mentors with a toolset that enables them to coach teams more efficiently. Even if there was no lack of volunteers to mentor teams in the examined courses, this resource is the major bottleneck to scale up teamwork assignments to full-size courses. From our experience, we doubt that automating the role of the mentors is a feasible option. We still have to prove these assumptions by extending our research in this direction.

CONCLUSION

We presented a toolset to enable teamwork on our MOOC platforms. We have evaluated our work in various stages during four pilots and one regular course on one of our platforms. The results show that our approach has been successful as a majority of teams has succeeded with their tasks. For MOOCs it is a reasonable approach to set high entrance barriers for teamwork assignments. Allowing only those participants, who have already shown a certain amount of commitment to engage in the teamwork assignments reduces the dropout problem in teams, however it does not eliminate it. The introduced toolset provides a good foundation for larger scale teamwork assignments. We have identified the weak points that need to be fixed and see the future of teamwork assignments on our platform with confidence.

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