

# Structure and messaging techniques for online peer learning systems that increase stickiness

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## ABSTRACT

Working with peers can help students learn more actively, build richer knowledge structures, and connect the material to their own lives. This paper articulates and addresses three major challenges to global, peer learning online. First, while new kinds of interaction—especially social software—require incentives to spur initial usage, many instructors falsely believe that usage will happen automatically. Second, because online spaces lack peer visibility and awareness, courses and software must work especially hard to help students continue their engagement. Third, under-structuring the interaction leads to awkward encounters. Addressing these issues requires teaching teachers how to design peer-oriented curricula through building up their intuitions for peer interaction at scale. We illustrate and evaluate these three issues through a pair of social-learning software platforms that have been collectively used by 12,500 students, Talkabout and PeerStudio. We measure the efficacy of these interventions through sign-up and attendance rates, course participation and activity, and structure and duration of student interactions.

## Author Keywords

Social learning; online education; peer learning;

## PEER LEARNING: VALUABLE YET UNDERUSED

Many online classes use video lectures and individual student exercises to instruct and assess students. With vast numbers of students in these classes logging on individually, the informal social interactions of brick-and-mortar classes are lost: these online learners are “alone together” [25]. How can software platforms connect these students to increase learning and motivation?

Common social learning strategies include discussing course materials, asking each other questions, and

reviewing each other’s work [3]. These techniques improve conceptual understanding and engagement, in turn increasing course performance and completion rates [10, 20, 23, 25, 28]. When peers construct knowledge together, it helps equips them with necessary critical-thinking skills for life after school [2].

However, most peer learning techniques are designed for small classes with a co-present instructor who facilitates, coordinates, and troubleshoots the activity. In-class peer activities have relied on learning scripts that are enforced by instructors to ensure that students learn from the experience [19]. How might software enable these benefits to scale online? In particular, software needs to carry the burden of social coordination because the instructor is not co-present to structure and facilitate peer interactions. Recent work has introduced peer interactions for summative assessment [18]. How might peer interactions power more pedagogical processes online?

## Three impediments to adoption...and remedies

We have worked for several years developing peer learning tools for massive online classes. Across our experiences, several challenges have recurred. This paper outlines and addresses three logistical and pedagogical challenges to global-scale peer learning. This paper’s quantitative measures of efficacy include sign-up and attendance rates, course participation and activity, and participation structure and duration. For qualitative data, we employ students’ and instructors’ comments in surveys and interviews.

The first challenge: many instructors falsely assume that students will naturally populate the peer learning systems in their classes: “build it and they will come”. These instructors effectively assume that social learning platforms will naturally have the same engagement levels as popular social networks such as Facebook and Twitter. However, students don’t yet know why or how they should take advantage of peer learning opportunities. These platforms sit in an educational setting, which has its own logic of incentives, and both carrots and sticks are required to keep the commons vibrant. For instance, after graduating, many American college students credit their dorms as having played a key role in their social environment. Yet students do not naturally gravitate toward dorm life: universities often have to require that

freshmen live in the dorms to ensure the joint experience. We thus encourage instructors to integrate peer-learning systems into the core curriculum, making them a required or extra-credit granting part of the course, in order to achieve critical mass.

Second, students in online classes lack the ambient social encouragement that brick-and-mortar settings provide [11]. The physical and social configurations of in-person schools (especially residential ones) offer many opportunities for social encouragement [10]. For example, during finals week, everyone else is studying too. Such social motivations are powerful: a highly effective technique to have regular exercise is to have an exercise buddy [22]. However, online students don't typically have awareness that other students are active, or receive the tacit encouragement of seeing others attend classes and study [12, 14]. We hypothesize that this reduced social context online means that courses must work especially hard to keep students engaged through highlighting co-dependence norm setting, and leveraging instructors and students to ascribe meaning to these systems.

Third, the telescope that instructors have for observing peer interaction is extremely cloudy: there are few visible signals beyond engagement (e.g. course forum posts and dashboards) and demographics. Student information is limited online [24], and knowing how to leverage what demographics instructors do know is hard. In-person classrooms use a lot of information about people to structure interactions [21]. For example, instructors in physical classrooms can observe and adapt to student reactions. The lack of information in online classes creates both pedagogical and design challenges [17]. For instance, do students completely ignore the discussion prompts and talk about current events?

This paper reflects on these three challenges and suggests socio-technical levers for addressing them. We draw on our experience with two social learning platforms: Talkabout and PeerStudio. We report on how course behavior varies with changing student practices, teacher practices and material design.

### **Our social learning platforms**

Over the last two years, we have developed and deployed two large-scale peer-learning platforms in large online classes. The first, Talkabout, brings students in MOOCs together to discuss course materials in small groups [19]. Currently, over 4,500 students from 134 countries have used Talkabout in 11 different online classes through the Coursera and OpenedX platforms. These classes covered diverse topics: Women's Rights, Social Psychology, Philanthropy, Organizational Analysis, and Behavioral Economics. Kulkarni *et al* showed the more world regions (e.g., countries) represented in each discussion section, the better those students perform in terms of retention and exam score [19]. We hypothesize that diverse discussions

help students engage in more active thinking and reflection.

The second platform, PeerStudio, is an evolution of Kulkarni *et al.*'s peer assessment tool [18]. PeerStudio provides fast feedback on in-progress open-ended work, such as essays, and has been used by over 3,500 students in two courses on Coursera and Open edX. With PeerStudio, students can receive formative feedback on draft work within hours.

In addition to our experience with these two platforms, we reflect on experience teaching online and in-person to observe similar themes across different types of peer-learning platforms. This paper synthesizes data analysis, observations, and experiences to present three major challenges facing peer interaction at scale.

### **SOCIAL DOES NOT GUARANTEE SOCIALIZATION**

Peer learning systems share many attributes with collaborative software more generally [13]. However, the additional features of the educational setting change the users' calculus. Throughout the deployments of our platforms, we've observed different approaches that instructors take when incorporating our peer systems into their material. Often, instructors dropped a platform into their class, then left it there and assumed that students would populate it. For example, one course simply pointed out Talkabout in the initial course announcement, and thereafter didn't mention it. Across multiple weeks and 20 different discussions, 7000 students signed up. However, only 200 students (3%) actually attended a Talkabout discussion, so many students arrived to find that they were alone. When this theme recurred in other Talkabout courses, it was accompanied with the same outcome: the social interactions languish. Why would instructors introduce a peer learning system, then immediately abandon it?

We found that instructors assumed that a peer system would behave like an already-popular social computing technology like Facebook, where people come en masse of their own will. They were *not* treating the systems like novel learning technology. This point of view resonates with a common assumption that MOOC students are extremely self-motivated, and that such motivation shapes their behavior [4, 17]. Coupled, these two assumptions can lead to the false impression that building a social space will cause students to automatically populate it and learn from each other.

However, we think that an alternate approach to peer learning systems may be in order. Educational experiences that are worthwhile need to be signaled as important in order to hit critical mass. American universities value residential education, and so they often require freshmen to live on campus. Many students agree afterwards that dorm life was a highlight of their freshman year, but might have wanted to opt out at the

time. Online social interactions in an educational setting should be approached with similar vigor. Chat rooms underscored a similar point of the importance of pedagogical interaction. Early, less successful, chat room implementations were easily accessible (embedded in-page near video lectures) but had less pedagogical scaffolding [8]. Later, more successful variants strongly enforced a pedagogical structure and were better received [9].

### Peer software as learning spaces

We propose thinking of these online spaces as learning spaces, not as social hangouts. Even the best pedagogical integration is only visible after students participate in a learning activity, especially with peer learning. We have found that offering even minimal course credit powerfully spurs initial participation, and that many interventions neglect to do this. As one student noted in a post-discussion survey, “I probably wouldn’t have done it [a Talkabout session] were it not for the 5 extra credit points but I found it very interesting and glad I did do it!” Quantitatively, we’ve observed the highest attendance rate, 50%, when formal incentives were offered for Talkabout participation. For example, in an international women’s rights course, before extra credit was offered, Talkabout attendance rate was 31%. After offering extra credit, attendance rate increased to 52%.

Students use faculty-designated incentives, such as what counts toward a grade, as indicators of academic importance. Providing course credit sends a strong signal of the activity’s importance. Repeatedly mentioning an activity sends a similar (but weaker) signal. For instance, courses that consistently mention Talkabout in their announcements have an average attendance rate of 25%, in contrast with the 3% attendance rate in the class that only mentioned it once.

To understand how pedagogical integration and incentives

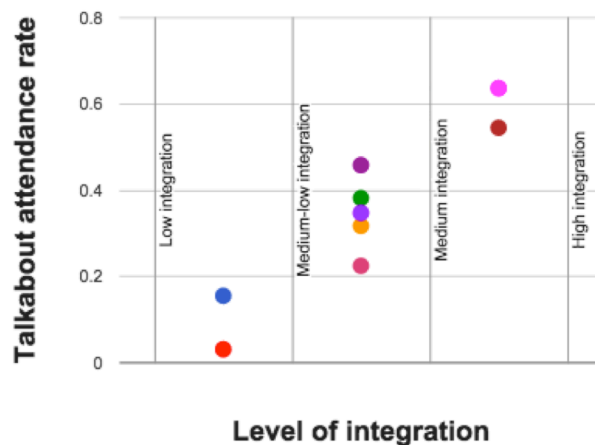


Figure 1: Average attendance rate increases as integration increases. Nine classes are illustrated here, each as a different color.

interact, we divided nine Talkabout courses into three categories, based on how well Talkabout was incentivized and integrated pedagogically (see Figure 1). Courses that never mentioned Talkabout or mentioned it only at the start of the course are labeled minimal integration. Such courses considered Talkabout a primarily social opportunity, similar to a Facebook group. Predictably, few students signed up, and even fewer actually participated: the average attendance rate was 9%. The next category was well integrated but poorly incentivized, classes. These classes referred to Talkabout frequently in announcements and encouraged students to participate and had well-structured discussion prompts, but they had no formal incentive. Such classes had an average attendance rate of 35%. Well-incentivized classes offered course extra credit for participation, and averaged a 59% attendance rate.

When participation comprises even a small fraction of a student’s grade, usage increases substantially. In one class where PeerStudio was optional, 0.8% of students who watched at least one lecture accessed the system. The fraction of users was six times higher in another class where contributed to their grade: 4.9% of students who watched at least one lecture submitted draft work for peer review.

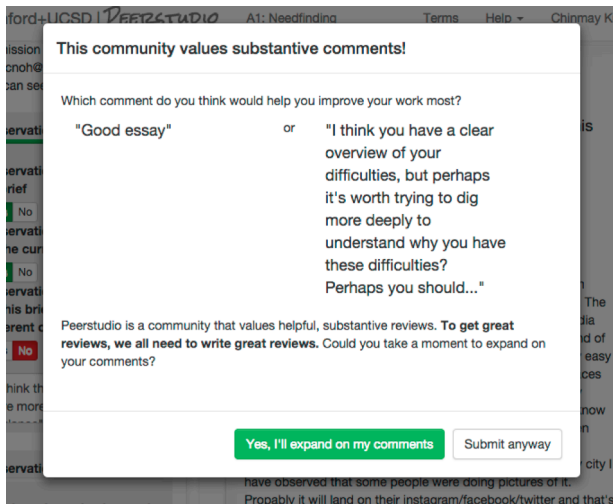
However, strong incentives can be impractical or discriminatory in practice. For instance, Talkabout is not available to some students whose country (like Iran) blocks access to Google Hangouts. Other students may simply lack sufficient reliable Internet bandwidth. Yet, to accommodate students with differing constraints from around the world, systems may strongly encourage, but not mandate use. Such systems may instead rely on other factors, such as those below for participation.

### DAMPENED INVESTMENT IN PEERS’ EDUCATION

Online students are “hungry for social interaction” [14]. Especially in early MOOCs, discussion forums featured self-introductions from around the world, and students banded together for in-person meet-ups. Yet, when peer-learning opportunities are provided, students don’t always participate seriously; they may neglect to review their peers’ work, or fail to attend a discussion session that they signed up for.

We asked 100 students who missed a Talkabout why they did so. 18 out of 31 responses said something else came up or they forgot. Interestingly, while many respondents apologized to us as the system designers, none mentioned how they may have let down their classmates who were counting on their participation. This observation suggests students don’t see how their lack of participation affects the community.

Systems that highlight co-dependence may be more successful at encouraging pro-social behavior [7]. In a peer environment, students are dependent on each other to



**Figure 2: When PeerStudio detects a review without comments, it asks the reviewer if they would like to go back and add comments, in order to make it a good review.**

do their part for the system to work. Encouraging commitment and contribution can help students understand the importance of their participation, and create successful peer learning environments [17].

### Norm-setting in online social interaction

Teachers and platform designers can encourage peer empathy and mutually beneficial behavior by fostering pro-social norms. Norms have an enormous impact on people's behavior. In-person, teachers can act as strong role models and have institutional authority, leading to many opportunities to shape behavior and set norms. Online, while these opportunities disappear with limited presence, other opportunities appear, such as shaping norms through system design.

For instance, when PeerStudio notices that a student has provided scores without written feedback, it reminds them of the reciprocal nature of the peer assessment process (see Figure 2). As a different example, students that are late to a Talkabout discussion are told they won't be allowed to join the discussion, just as they'd not like to have a discussion interrupted by a late classmate. Instead,

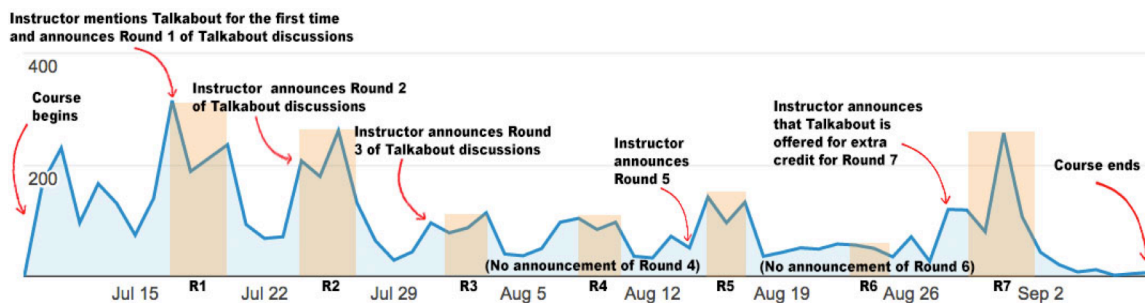
the system provides them an option to reschedule. Systems need not wait until things go wrong to set norms. From prior work, we know students are highly motivated when they feel that their contribution matters [3,20]. As an experiment, we emailed students before their discussion saying that their peers were counting on them to show up to the discussion. Before the email, only 25% of students who signed up for a discussion slot actually showed up for it. After sending the email, attendance increased to 63%.

### How can we leverage instructors and students to ascribe meaning to these systems?

PeerStudio recruits reviewers by sending out emails to students. Initially, this email featured a generic request to review. As an experiment, we *humanized* the request by featuring the custom request a student had made. For example, the generic boilerplate request became the personalized request that the student had written before submitting his draft. Immediately after making this change, review length increased from an average of 17 words to 24 words.

We saw similar effects with Talkabout. When one course instructor made no mention of Talkabout, 0.93% of students signed up for a discussion (140 of 15,000). By contrast, in another course where the instructors discussed Talkabout in the beginning, 3.3% of students signed up (321 of 9,800). Students look up to their instructors, creating a unique opportunity to get and keep students involved. To visualize this, we compared when an instructor mentioned Talkabout in their MOOC to Talkabout's concurrent page views. Figure 3 shows a trend of increased page views following an instructor post. Talkabout traffic was dwindling towards the end of the course, so the instructor decided to offer extra credit for the last Talkabout discussion. Shortly after this announcement, Talkabout page-views spiked.

Instructors are not the only influencers: Forum posts from students sharing their peer learning experiences can help validate the system and encourage others to give it a try. For example, one student posted: "I can't say how much I love discussions...and that's why I have gone through 11-



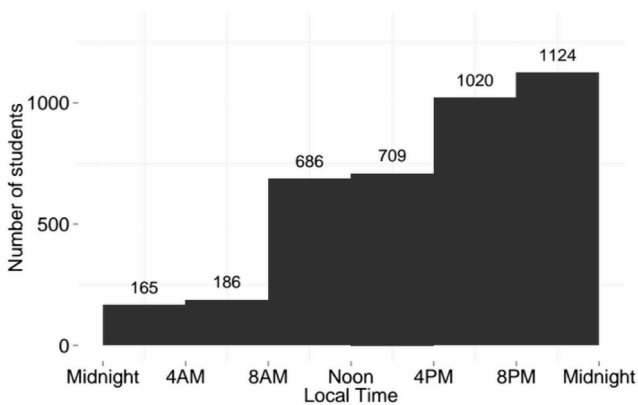
**Figure 3: Instructor course announcements are followed by the largest amount of Talkabout pageviews throughout entire course: International Women's Health and Human Rights. Y-axis represents pageview count, and X-axis shows time. R1 represents Round 1 of Talkabout discussions, and so on, with orange rectangles framing the duration of that round. Shortly after the instructor announces extra credit for Talkabout participation, Talkabout pageviews increase.**

12 talkabout sessions just to know, discuss and interact with people from all over the world.” Although unpredictable [6], this word-of-mouth technique can be highly effective for increasing stickiness [1]. When students shared Talkabout experiences in the course discussion forums (2000 posts out of 64,000 mentioned Talkabout, 3%), 6% of the course participated (2037 students), and 63% of students who signed up for a discussion session showed up. However, the same course offered a year later, did not see similar student behavior (260 posts out of 80,000 mentioned Talkabout, 0.3%). Only 5% of students (930) participated in a discussion and attendance rate was 55%. This suggests that students can ascribe meaning to social learning systems, and that their validation of the systems is important when increasing stickiness.

### DESIGNING & HOSTING INTERACTION FROM AFAR

Like a cook seeing her stew come to a boil and adjusting the temperature as needed, an instructor guiding peer interactions in-person can modulate her behavior in response to student reactions. Observing how students do in-class exercises and assimilating non-verbal cues (e.g., enthusiasm, boredom, confusion) helps teachers tailor their instruction, often even subconsciously [16].

By contrast, the indirection of teaching online causes multiple challenges for instructors. First, with rare exceptions [5], online teachers can’t see much about student behavior interactively. Second, because of the large scale asynchronous nature of most online classes, teachers can’t directly coach peer interactions. To extend – and possibly butcher – the cooking metaphor, teaching online shifts the instructor from the in-the-kitchen chef to the cookbook author. Their recipes need to be sufficiently stand-alone and clear that students around the globe can cook up a delicious peer interaction themselves. However, most instructors lack experience writing exercise recipes that can be handed off and re-used without any interactive guidance on the instructor’s part.



**Figure 4: Data from nine classes and 3400 students shows that, except between the hours of midnight and 4AM, students discuss during all waking hours.**

Consequently, software systems, platforms, and teacher guides must play a larger and more active role in helping teachers create effective recipes. One example of a place where the software can help guide teachers is in selecting discussion times. Time zones are a reliable thorn in the side of many types of global collaboration, and peer learning is no exception. Every Talkabout instructor was concerned about discussion session times, as this a major issue with in-person sections. Instructors often asked if particular times were good for students around the world. Some debated if 9pm Eastern Time was better than 8pm Eastern Time, as more students would have finished dinner? Or would it be worse for students elsewhere?

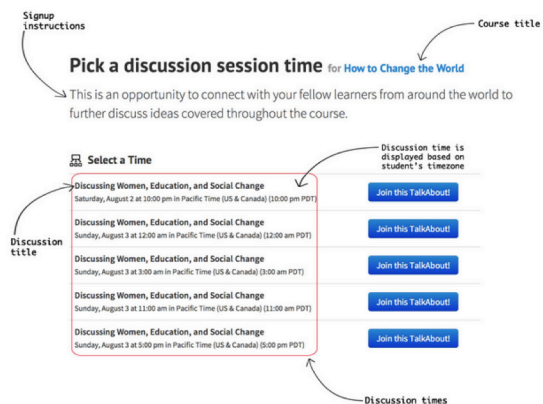
Analyzing when students participate in discussions taught us that evenings are the dominant preference discussions. Also, different students prefer different times, with every day of time being preferred by someone (Figure 4). It’s hard for instructors to know how to find the “sweet spots”. These misconceptions extended beyond scheduling: structuring student interactions was a consistent challenge for instructors.

### Guidelines for writing recipes: structuring peer interactions from behind your computer

Most early users of Talkabout provided both too little student motivation and too little discussion scaffolding; consequently, usage was minimal [19]. Unstructured discussion did not increase students’ academic achievement or sense of community [8]. To succeed, we needed to specifically target opportunities for self-referencing, highlight viewpoint differences using boundary objects, and leverage students as mediators [19]. Some instructors err to the other extreme, with over-long and over-structured agendas. To understand this range of structure, we looked at 3409 discussion sessions from 15 different courses and compared agenda character length and discussion duration.

We hypothesized that short agendas would lead to questioning the legitimacy of the system or awkward silence, while long agendas would lead to fatigue or strain, thus a middle ground would be optimal. We found that increasing agenda size had a small but consistently increasing correlation with discussion length. We split discussions into two categories: long and short discussion agendas, with 1000 characters as the threshold. Average discussion duration was 39 minutes for short agendas and 60 minutes for long. All discussions were only required to be 30 minutes long for credit; students were staying the extra time voluntarily.

We often worried that over-structuring an interaction would leave no space for informal bond-building. However, when there is sufficient structure, students find it easy to veer from the schedule and socialize: exchanging social networking information, offering career advice, and mingling. Yet we’ve found that these socializing tendencies vary across classes. For instance,



**Figure 5. Annotated example showing the parts of the instructor's Talkabout interface**

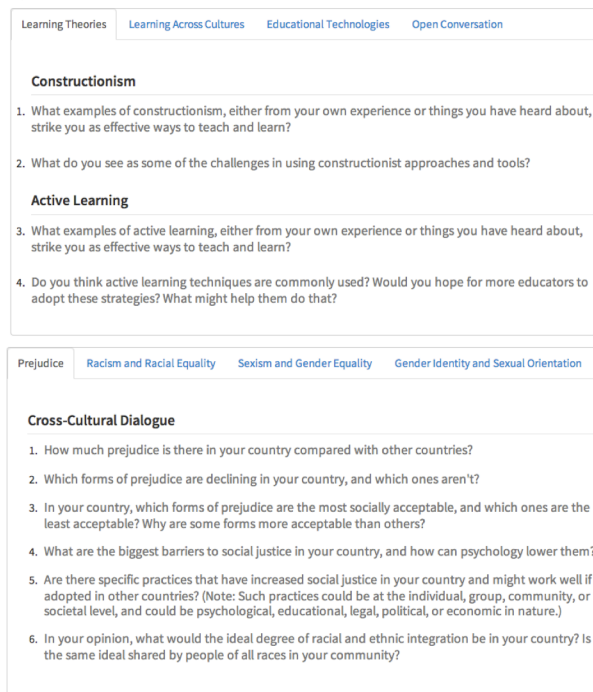
93% of students shared their contact information for an international women's rights course while 18% of students did in a course on learning. We encourage instructors to find ways to incorporate these social tendencies into the discussion structure, while noting that this is not a "one-size-fits-all" solution: certain course topics might inspire more socializing than others.

### TEACHING THE TEACHERS

Even a potentially fantastic pedagogical innovation is useless when there is a mismatch between curricular materials and platform affordances. We observed many well-intentioned teachers using our tools and navigating both passive misconceptions and active errors in peer instructional design. When the curricula were not matched to the needs of the setting, the learning platforms languished.

We emphasize the importance of *teaching the teachers*: creating designs and introductory experiences that nudge teachers toward the right intuitions. This is of course always true with educational innovation. Because the online education revolution is a particularly dramatic change of setting, teacher scaffolding is particularly important.

One of the easiest and most robust techniques we have found for guiding teachers is to provide successful examples of how other teachers have used the learning platform. In many domains, from design to writing research papers, a common and effective strategy for creating new work is to template off similar work that has a related goal [15]. To help instructors navigate the interface and create effective discussion prompts, we added an annotated example of a Talkabout discussion (see Figure 5). Still, we observed that many instructors had difficulty creating effective discussion structures. As an experiment, we walked an instructor through Talkabout – in a Talkabout – and showed an excellent example agenda from another class. This helped onboard the new instructor to working with Talkabout: she was



**Figure 6. Two discussions prompts, the bottom one used as a template to show a new Talkabout instructor an excellent example. The top prompt was generated based off the example.**

able to use the example as a framework that she could fill in with her own content (see Figure 6). The next step was to help instructors gain an understanding of what occurs during their discussions. To do this, we showed an instructor a video clip of a Talkabout discussion along with a full discussion summary. In response, the instructor said, "The most interesting point was around the amount of time each student spoke. In this case, one student spoke for more than half of the Talkabout. This informs us to be more explicit with time allocations for questions and that we should emphasize that we want students to more evenly speak." For the next discussions, the instructor added reminders to share the floor and to encourage each other to speak equally. By helping her visualize the discussion through an example, she was able to restructure her discussion prompts in order to achieve her desired discussion goal; in this case, discouraging one person from dominating the conversation.

### CONCLUSION

In this paper we provide evidence for three challenges and offer three corresponding socio-technical remedies. We reflect on our experience from developing, designing and deploying our social learning platforms: Talkabout and PeerStudio. We looked at student practices, teacher practices and material design, and assessed the relationship between those and course behavior. We found that stickiness increases when peer systems are integrated into the curriculum, the social context is

illuminated, and interactions are structured while allowing room to breathe.

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