Classroom Integration of the Slack Team Collaboration Tool

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Slack is an online tool for team collaboration that was originally developed to help software development teams collaborate and share code. The tool is a real-time team chat environment that allows the use of mobile devices or any web browser for discussing, sharing photos and files, and collaborative editing of code. This paper discusses an initial integration of this tool in a team-focused problem-based learning machine design course that introduces the capstone design course approach on a smaller scale. Use of the tool enabled changes to the classroom dynamic, provided a means for better communication between and inside of student teams, and improved student-instructor interactions. Trade-offs and considerations for adaptation to higher-level capstone experiences are also discussed.

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Introduction

The summative nature of capstone sequences usually results in course content spanning a wide range of outcomes and skills, which are brought together through the solution of complex problems by student teams. This, coupled with a high workload in the courses themselves, requires effective communication both among team members, as well as between teams and instructors/facilitators. Indeed, communication has been studied in various capacities as a critical component of capstone sequences, with respect to project success and student performance in industry post-graduation.[1-3]

From the instructor's point of view, capstone sequences and other intensely problem-based courses can require time-consuming interactions with teams; keeping up with the progress of a given team among many is difficult without direct involvement in team proceedings, or considerable, constant documentation of the team's efforts. From the student perspective, conventional collaboration platforms fail to address the many different forms of communication needed for the team to successfully complete the wide range of tasks required.[4-6] This results in a disjunct repository of communication, causing lost time searching for historical information and missed communications due to the need to simultaneously monitor multiple communication media. As a result, students generally meet as a group in order to complete tasks in a common geographic location, resulting in the expenditure of a high number of person-hours, often for tasks that could be completed remotely both geographically and temporally.

Slack[7] is a communications platform originally developed as a tool for programmers to remotely collaborate on software coding. It is a real-time client that can be accessed through any web browser, and can be integrated with mobile devices such as smartphones, behaving like a texting client. Specifically, it allows easy sharing of photos and other files, sharing and collaborative editing of code, group and private discussions, integration with third party packages such as Google Drive and Google Hangouts, and comprehensive searching of historical communications. This tool could address many of the needs of design teams completing long-term, sophisticated problems, and allows instructors to be involved in and search through team communications for direct coaching and facilitation. This paper discusses an initial implementation of Slack in a problem-based machine design course, and identifies lessons learned over the course of a semester.

Implementation

ME 3700 is a hybrid problem-based machine design course at Ohio University's Russ College of Engineering and Technology. This course has been under development for four years, and features teamwork throughout the semester, and a summative team project as the entirety of the second half of the course content. This problem-based activity allows active learning of concepts originally presented and practiced during the first half of the semester. The instructor interacts with the students during normal classroom hours, observing and coaching teams as they complete project work in the classroom.

The structure of the ME 3700 course is specifically tailored to prepare students for the ME 4701/4702 year-long capstone design sequence. In particular, the

problem-based nature of the course requires students to combine the many fundamentals courses they have previously taken to solve a real-world design problem. The team project in the course generally requires skills including engineering materials, strengths, dynamics, kinematics, drafting, team management, and technical communication. This project is designed to be an experience very similar to the year-long capstone sequence for which the ME 3700 course is a prerequisite.

The ME 3700 course was modified to use Slack as a central communication tool for both the teams, and the class as a whole, with three basic precepts: first, collaboration was anticipated on everything, even individual work. Second, team assignments were constructed in a way that specifically allowed division of work among team members. Third, communication in the general channel, visible to the entire class, was encouraged. Teams were formed with CATME, a useful tool for forming and assessing student teams, using the standard settings for team formation.[8-10] These settings generally group low performers with high performers, making teams relatively consistent in overall performance level. A custom constraint of the grade in the prerequisite course was used, grouping dissimilar results to ensure students with high levels of performance in the prerequisite would be on each team. Six teams of three to four students were formed, and given their own private team channels in Slack, with the instructor as the an extra team member. This allowed the instructor to be brought in on team discussions with a simple tag by any team member, and also allowed the instructor to monitor team progress unobtrusively.

Coursework still included individual tasks, but it was assumed that some collaboration would occur. It was made clear at the outset of the course that individual assignments needed to reflect personal work, but that questions and discussions in Slack were acceptable (since the instructor could observe the discussions). Homework and other formative work was a low portion of the grade in the course. With the expectation of collaboration and the problem-based format of in-class interactions, homework was purposefully difficult, with the goal of forcing students to identify and ask the questions necessary for them to complete the assignments. Lecture elements were posted on YouTube, and embedded in the general channel such that students could independently review a demonstration at any time they wished. Students had either a homework assignment or a team homework assignment (sometimes both) to complete each week of the first half of the course, tapering off in regularity as the team project dominated the second half of the semester. Two exams, a midterm and a final, were given as usual. The same basic team project and rubric was used as previous semesters, allowing some comparison to previous classes.

In addition to required course content, a "random" channel was used for discussions on current events and historical topics of interest. Each week, the instructor posted an excerpt from a historical engineering failure or case study, and posed a provocative question. Participation in this discussion was not required, but some discussion topics were referenced in class to encourage students to participate.

At the outset of the course, an effort was made by the instructor to be vigilant about responding to questions in the general channel, and to invite students to answer each other's questions. Once the students were established in regular use of the tool, the instructor posted less often, allowing students to answer each other's questions. The goal was to reach a point where student leaders became experts in a subject area, such as MATLAB coding or CAD, and would find value in helping other students achieve outcomes. Office hours were listed as "to be determined", with the expectation that Slack would be used to remotely address most of the questions in the course. The instructor instead allowed for students to set up a time to meet face-to-face by appointment if they found it necessary. This happened only twice during the semester.

At the conclusion of the course, a standard CATME peer review was required, and students were asked to complete a survey regarding team communication and the use of Slack as a classroom tool. Results were gathered by the external reviewer and reviewed against student outcome results, Slack participation data and observations, and team performance.

Results

In general, Slack proved to be a useful communication tool for this course. The mobile interface made it useful for students, all of whom had a smartphone or similar device with which they could use the Slack mobile application. Most students reported that they used Slack regularly for communication, with members of two teams indicating that they did more work remotely than through in-person meetings. Notably, these two teams produced the highest quality team projects.

At the outset of the course, the increased instructor activity in the various Slack channels resulted in a relatively constant state of communication with the class. While answering student questions was not generally time-consuming, students seemed to expect constant connectivity through afternoons and evenings. Once the students became accustomed to the tool, the instructor encouraged apparent student leaders to answer questions, eventually disabling notifications outside of normal business hours. This was an

anticipated trade-off, requiring a high level of overall time commitment at the outset of the semester. Students appeared to benefit from common questions being answered in the general channel.

After several weeks of exposure to Slack, team tasks were assigned that could be broken down and completed asynchronously and remotely. Each successive time such a task was assigned, more structure on splitting tasks was given, as was an increasingly short timeline. Teams generally avoided delegation of tasks until they became very difficult to accomplish without doing so. Teams that adopted the remote and asynchronous nature of Slack reported lower difficulty in completing tasks on time than those that continued to work on assignments using a traditional meet-and-complete approach. According to student feedback, homework (both individual and team-based) was perceived to be both difficult and highly useful for learning.

Collaboration on team assignments was strong, and student teams often used the notification feature to bring the instructor into a discussion when they had questions. Data indicated that students used a lot of direct messaging, but the majority of messages were in team channels and the general channel. The two high-performing teams used the code sharing feature to collaborate on MATLAB code for their project work, notably producing high quality code compared to their peers.

Notably, initial results show that Slack metadata was a somewhat reliable indicator of individual and team performance; none of the teams that consistently used the tool to communicate had low scores on the team project. Likewise, none of the individuals who regularly communicated with their teammates via Slack showed low performance among their peers (regardless of the team's performance), as well as in the course as a whole. Since Slack metadata can be easily accessed, this may serve as a low-impact way to target intervention with at-risk students in large capstone courses. Since individual and team performance on minute tasks in between course milestones can be difficult to constantly monitor, the metadata could serve as a proxy during those periods of time to limit the instructor's scope of oversight to those students and teams who need assistance, but might not be asking for it.

The highly collaborative nature of Slack required delineation of tasks students were expected to complete without help and those for which collaboration was acceptable. Mastery-level outcomes requiring individual performance and subsequent assessment were done on the exams, where students were unable to collaborate. Nonetheless, performance on homework assignments remained a reasonably consistent indicator of exam performance.

A majority of students reported that Slack enabled them to do things they wouldn't have otherwise been able to do, mostly involving how they collaborated with their teams. Those who reported that the tool didn't enable them to do things they otherwise couldn't have almost universally reported that it did, however, make normal tasks easier. Achievement of student outcomes was not significantly different from other semesters of the same course.

Recommendations for Future Implementations

In this initial implementation, Slack proved to be a useful tool for getting students to communicate and collaborate on team work. This was a small class, at 21 students, which made observation of the various student teams manageable from the instructor's point of view. A significant increase in the number of teams would likely lead to a higher need for students to notify the instructor to directly observe the team channel; even at 21 students, nearly every Slack user, including the instructor, limited their notifications to direct messages or mentions.

Slack is very easy for students to use, with minimal training and practice. The mobile application is intuitive enough that most students did not require significant additional instruction beyond the first day of use. Teams began using it on their own for other courses they were taking in the same semester, and some students in the ME 3700 course also adopted it as a primary communication medium for their year-long capstone design course. Some capstone design teams used the tool extensively of their own volition in that course sequence.

From the perspective of the instructor, Slack required a higher time commitment to availability early in the course than usual, but less than usual at the end of the course. Students perceived a higher level of instructor availability and communication, even with a lack of formal office hours. Specific planning was required to maintain a manageable balance in the face of high activity levels at the outset of the course. In total, however, the tool reduced the time required for the course, as it provided both a searchable medium for students and the instructor, and it made it possible for students to answer each other's questions, before they had to bring the instructor into the conversation.

Slack can also easily include outside parties such as customers or industrial advisors in the teams' projects. The ME 4701/4702 sequence features numerous interactions between teams and members of the department's industrial advisory board. Each milestone through the capstone sequence is reviewed both by the course instructors and by outside industrial advisors, strengthening the feedback the students receive. Slack could make this process much easier, allowing students to pose questions in an open forum, while allowing industrial advisors to chime in at their convenience.

This could transform the industrial advisory process into a more continuous conversation. Use of this tool would also likely make participation more attractive for the industrial advisors and/or customers, since it could eliminate the need for repeated travel to the university from a remote location, or foster more significant interaction between the student teams and their respective customers.

For capstone design courses, regularly checking on student progress can be made easier by requiring students to tag certain conversations with tags or search words. It is easy to identify or categorize discussions this way, and can serve as a form of 'design notebook' for the team. Extensive historical searching beyond the latest 10000 messages requires subscription to the paid service, so cost may be a factor for large teams or classes. Metadata could likely also serve as a quick way for instructors to identify teams that need more instructor focus.

The use of this tool mimics typical engineering teamwork, where information sharing is usually quite open. This is counter to typical classroom cultures, where individual performance has to be regularly assessed. As a result, clear lines must be drawn to help students identify when collaboration is acceptable, and when it is not. The most effective tactic used in this implementation was to have students identify who would have primary responsibility for a given task on team assignments the outset, and breakout of tasks that specifically disallowed collaboration into exams, where Slack could not be used. It remains to be seen how useful the tool is with a large class size, and future implementations will further develop best practices for its use in a classroom environment.

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