Communication Tools for Engineering Educators Conducting Class Projects with Dispersed Students

Mr. Michael Roger Straus, North Dakota State University

Michael Straus received his BS in Mechanical Engineering from North Dakota State University.

Mr. Stanley Shie Ng, University of North Dakota

Stanley Ng received his BS in Biomedical Engineering from University of California Irvine and MS in Biomedical Diagnostics from Arizona State University. Since then, he has been faculty of engineering at Biola University and currently serves as the Director of Engineering Programs. He is currently pursuing a PhD in Biomedical Engineering at University of North Dakota.

WIP: Communication Tools for Engineering Educators Conducting Class Projects with Dispersed Students

Introduction

Communication is one of the most vital skills required for any given educational or work environment. Without effective communication, the efficiency of projects and coordination of tasks tend to suffer. Technical expertise lends to the overall vision and path of an intended research project, however, poor communication can easily cause a project or group to flounder. In addition, situations like the Covid-19 crisis forces individuals to be dispersed and isolated, which hinders work and communication efforts [1].

One of the major trends in higher education is supplementing traditional modes of education with online learning platforms and environments [2]. Schools have collaboratively developed asynchronous learning environments that allow for up-to-date lectures with on-demand access, making courses available to students with differing schedules [3]. Beyond a lecture-exam mode of instruction, institutional programs are creating courses that allow students to engage in innovation-based learning. In addition to learning course basics, students are required to form groups to tackle a group-defined project where success is marked by the degree of impact outside of the classroom and beyond the university.

This paper seeks to provide a case study of a specific student course group within a Cardiovascular Engineering I course. This group consisted of six students with several factors considered to be limitations for effective communication, including geographic separation, educational background, and cultural differences. Despite the challenges, this group accomplished all necessary tasks due to the tools used to break down these barriers of communication. The individuals of the group relayed their experience of using certain tools that helped the group work progress. A qualitative analysis was used to analyze the themes of each tool used to summarize its effectiveness. Lastly, this paper provides a summary of the tools used and a project toolbox for similar courses to implement.

Methods

In the Cardiovascular Engineering I course, innovation-based learning project groups were formed by the students from an assignment on Flipgrid. Flipgrid is a web-based software where the instructor can assign a timed, video response to a question [4]. Students were asked to pitch a 30-second project of interest and students would find their own ways to connect with one another. Nine groups were formed for the following reasons:

- Similar project topic (e.g. students were all interested in electrocardiogram)

- The familiarity of a topic (e.g. continuation of a master's thesis or equipment availability at an accessible lab)
- Previously formed social acquaintance (e.g. friends of each other, same research group, similar academic year)
- Regional (e.g. formed groups with those on the same campus)
- A broad range of skills (e.g. each individual had expertise in a particular skill)

Of the nine groups, one group stood out to the instructional team due to the variation of members. This select group of six members was uniquely established due to several factors that were evaluated as possible added barriers to communication. These barriers include geographic location, educational experience, and cultural background.

After the successful completion of the project and course, this group was given a survey to provide feedback on software tools that they thought fostered efficient communication between group members. Qualitative analysis was completed on NVivo to identify the limiting factors of communication.

Geographic Location

All members were dispersed geographically across the United States. Two members were located in California, one at University of North Dakota, two at North Dakota State University, and one in Massachusetts. Geographic barriers not only created a physical separation but also an added time constraint to host meetings [5]. These factors were concerns for the instructional team of the course.

Educational Experience

The different education levels and experiences were identified as a barrier to communication due to aspects such as power dynamics, work-distribution, and career goals [6]. Two members were undergraduate students, one was a master's student, and three were doctoral students.

Cultural Background

It was important to consider the personal dynamics of varying backgrounds and cultures of students. Depending on many factors such as upbringing and past experiences, these factors can create unintentional barriers to communication [7]. It was important to identify how tools can be used to enhance inclusion efforts in distance education.

Tools Used and Evaluation

The tools used by this group were selected based on the group members prior experience used in academia or industry. For greater accessibility and to minimize costs, free web-based programs were used. These tools include Slack, Trello, Zoom, Google Suite, and Github.

Slack

Slack was used as the primary means of communication with one another. The tool allowed users to directly message individuals, create subgroup channels, and share files. According to the surveys, there were 26 instances of positive feedback. Overall, the tool provided a means for easy communication. Limitations were few and related to technical difficulties such as variant notifications, limited free space, and software organization. One student indicated Slack was difficult for non-native English speakers due to the need to communicate via text.

Trello

Trello was used as a project management tool. It allowed for a timeline to be created that tracked milestones and tasks completed by group members, which kept group members accountable for the tasks they needed to accomplish. According to participant surveys, Trello provided a visual view of the overall progress of the project. While robust and easy-to-use, some students thought that Trello may not have been necessary for the scope of the semester-long project. Also, Trello was only effective as participants kept project statuses up-to-date.

Zoom

Zoom was used as the video conferencing tool and a common program used across many universities. According to the surveys, Zoom provided a personal connection with face-to-face conversations. The additional tools, such as recording meetings, allowed for greater accessibility and kept absentees updated. While Zoom was a good way to keep group members connected, some participants still preferred in-person meetings as it was sometimes difficult to see the physical aspect of the project. In one response, Zoom allowed cultural misunderstandings to be better discussed and helped the group continue to operate more efficiently with a better understanding of cultural differences.

Google Suite

Google Suite provided a host of tools that were useful in many ways (Docs, Sheets, Slides, and Forms). Participants found that Google Suites provided a file management system to share and organize larger and multiple files, allowing for greater collaboration. Simultaneous editing in Google Docs made it easy to write and edit group projects between group members. The familiarity was an advantage for many. However, like many cloud-based solutions, Google Suites was limited in storage space, and some participants mentioned how they preferred the native desktop apps.

GitHub

GitHub was the primary repository for software code. The ease-of-use and accessibility allowed all group members to access and evaluate a vital component of the project. However, GitHub was primarily used by those who were working on software and has a fair learning curve for others. While GitHub is popular for many software and programming individuals, it was also redundant when used with Google Suite for file management.

Discussion

Depending on the individual, success can be defined in many ways. For some, it could be completing the necessary tasks for the desired grade. For others, it may be having a high-external impact activity like a poster presentation, a paper publication, or filing a patent. Regardless, project groups are becoming more diverse in many aspects and engineering educators are always finding ways to improve communication between group members. So far in this study, using these tools show greater effective communication for successful collaborative work in an asynchronous learning environment. Content delivery in higher education is rapidly shifting, so future work of this project will continue surveying additional groups that have various factors of communication barriers.

Bibliography

[1] C. Quintana, "College closings: More than 100 colleges cancel in-person classes and move online," *USA Today*, Mar. 11, 2020. [Online]. Available: https://www.usatoday.com/story/news/education/2020/03/11/coronavirus-college-closings-list-online-classes/5022256002/. [Accessed Mar. 11, 2020].

[2] G. Garrett, "The Most Important Trends in Online Education," *Wharton Magazine*. [Online]. Available: https://magazine.wharton.upenn.edu/digital/the-most-important-trends-in-online-education/. [Accessed Mar. 13, 2020].

[3] R. F. Hodson, D. C. Doughty, and D. P. Heddle, "Combining Synchronous And Asynchronous Learning Networks In Engineering," in *1999 ASEE Annual Conference*, Jun. 1999, pp. 4.130.1-4.130.9. [Online]. Available: https://peer.asee.org/combining-synchronous-and-asynchronous-learning-networks-in-engineering. [Accessed Mar. 12, 2020]

[4] "Adjust the Maximum Recording Time for Student Videos," *Flipgrid Help Center*. [Online]. Available: http://help.flipgrid.com/hc/en-us/articles/360013185814-Adjust-the-Maximum-Recording-Time-for-Student-Videos. [Accessed Mar. 13, 2020].

[5] F. Toney, *The Superior Project Organization: Global Competency Standards and Best Practices*. New York: Marcel Dekker, 2002, pp. 18.

[6] T. Anderson, "Understanding Power Dynamics Will Make You More Persuasive," *Kellogg Insight*. [Online]. Available: https://insight.kellogg.northwestern.edu/article/understanding-power-dynamics-will-make-you-more-persuasive. [Accessed Mar. 16, 2020].

[7] F. T. Anbari, E. V. Khilkhanova, M. V. Romanova, M. Ruggia, C. H.-H. Tsay, and S. A. Umpleby, "Cultural Differences in Projects - culturally aware leadership." in *PMI® Research Conference: Defining the Future of Project Management, Washington, DC. Newtown Square, PA: Project Management Institute, July 14, 2010.* [Online]. Available: https://www.pmi.org/learning/library/differences-projects-multicultural-culture-leadership-6478. [Accessed Mar. 10, 2020].