Slack in the classroom: survey and pilot study

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I. INTRODUCTION

Engineering capstone classes at Drexel such as ECE Senior Design require a tool that provides the appropriate technology for communication between instructors, mentors, and peers, contributes to the overall educational value of the classroom, and does not introduce additional technological or social burdens onto students. We hypothesize that Slack is the appropriate tool to accomplish this; to test this hypothesis, we developed a survey to measure student use of Slack and gauge overall approval of the tool within the context of the engineering capstone course at Drexel.

A. Slack

Slack[1] is a cloud-based messaging service that was released in 2014 and has been lauded an as excellent communications tool. Its main feature is the use of 'channels' or specialized groups that can be private or public and can include any or all members of the 'workspace', or group server. File sharing is native, but users can also integrate over 1500 apps or services including Google Drive, Dropbox, and Office 365[1]. It is used in industry (Panasonic, Oracle, [2], Vox Media [3]) as well as research – Drexel physicists working on the IceCube Neutrino Observatory[2] use Slack to reach other scientists and engineers all over the world [4].

Channels Slack is specifically known for its 'channels', which are effectively group chatrooms. Each workspace generally has two types of channels: public (in which every member of a workspace can view and post) and private (which limits conversation to only a few members). Any member of a workspace can create a private channel. This goes beyond the private direct messaging system by allowing users to notify groups of people about a message, similar to an email mailing list.

We suspect that students will make good use of private channels when broken down into groups for ECE Senior Design. Students will also have access to public channels for common questions that may affect the entire class, but will be able to work and create independently from the class as a whole. Instructors may want to create public channels for different types of questions (syllabi, midterm review, homework help, etc) while students may want to form private channels for study groups. Slack also has direct messaging, which can be useful for students attempting to communicate with an instructor or teaching assistant in real time.

Channels work especially nicely for asynchronous communication – questions can be dropped into the chat and responded to by anyone within the channel on their own time. Users can use commands such as '@[username]' or '@here' to specifically notify a user or entire channel about a particular message.

Pricing Slack has a free option which offers a full workspace and unlimited channels but limits the number of saved files and apps that can be integrated. Additionally, while Slack offers video calls, the free service limits the calls to two participants. Paid plans (Standard at \$6.67/user and Plus at \$12.50/user) open up file sharing (20GB per user), unlimited integrated apps, and up to 15 video call participants. The free plan offers basic analytics including how many messages are sent and by whom, but paid plans open up data based on channel and user as well. For a classroom environment, with some planning, the free model of Slack works well enough; this will add no additional financial concerns.

Security and Technical Support Slack was not designed to be FERPA compliant, which can lead to problems with the university. Communication about student grades, accommodations, or other sensitive information should not be shared on Slack but should be taken to a FERPA compliant forum. Slack's terms-of-service[3] claims that the customer is responsible for complying with FERPA – this is especially dangerous for 1st year classrooms where students may not yet be 18. If this is the case, permission must be granted by the students' parent or guardian for Slack to collect information about a student and the school or educator is responsible for collecting this consent. If students are over 18, they commit to these terms when they sign up to Slack for the first time.

Because Slack is not a native Drexel tool, there will also be some amount of technical expertise that the instructor will have to provide as IT specialists on campus will probably not be able to help if problems arise. Additionally, some universities require particular messaging tools that will provide transcripts to the university if legal issues arise. Because Slack is not associated with Drexel, this may be a problem for use within Drexel classrooms.

Slack does take security seriously, and has two-factor authentication (2FA) that can protect accounts from

[1] www.slack.com
[2] https://icecube.wisc.edu
[3] https://slack.com/terms-of-service/

hacking. Their integrated authentication apps (i.e. Duo Mobile, Microsoft Authenticator) are also those that are compatible with Drexel's multifactor authentication (MFA), which will not require students to install any additional apps. Additionally, a workspace manager can require all accounts to register with a 'drexel.edu' account which limits users to Drexel students only.

II. LITERATURE

This study was primarily based around a survey developed by Ross [5] for use comparing learning management systems (LMS) like Blackboard to Slack in the classroom. Ross surveyed his marketing classroom at University of Massachusetts Lowell and found that students reported that Slack improved group work skills and made students more comfortable asking questions of both the instructor and their peers.

Northey et.al.[6] studied the benefits of asynchronous learning by looking at classes with and without Facebook pages that students could post on for questions and clarification. They argued that asynchronous messaging made learning paces up to the student and allowed students to determine the best time for them to engage in learning. Students also then would be given more time for understanding and consideration of the material before responding to a prompt; face-to-face interactions offer no such time. Northey et.al. found that students who participated in the Facebook group were more likely to engage in class and were more likely to earn higher overall course grades, suggesting that asynchronous learning is associated with greater academic outcomes.

While the classes surveyed by Ross[5] and Northey et.al.[6] were courses for marketing majors, it is reasonable to expect similar feedback in an engineering course at Drexel; students in both types of courses are likely only mildly familiar with Slack before the course, are likely to use Slack in a future setting (prompting interest in developing a technological skill), and are generally of the same generation (maturing in a digital age where technological adaptation is commonplace). Slack has not been a particularly popular tool to study within engineering classrooms, and literature evaluating its usefulness in a research setting is scarce.

However, at the most recent meeting of ASEE, Gaines et.al. presented findings from using Slack within a first-year engineering design course at the University of South Florida[7]. Students in this course collaborated in groups of five to create a new product within the span of one 15 week term. Instructors identified four themes within the use of Slack: increasing engagement using Slack's social features, use of app integration, clear expectations of how students should use Slack, and clear expectations of what benefits Slack provides to students. These themes should also be considered in the implementation of Slack at Drexel, and this study should seek a response to those themes. Results from [7] suggest that Slack increases communication between peers by providing both flexibility and organization through the design of its channels. Instructors were easily connected with groups' private channels and set up notifications based around key words (such as 'help' and 'confuse') so that issues could be addressed in a timely manner. In addition, a career counselor ran one channel specifically to address career questions and concerns, advertise career workshops, and introduce professional engineering organizations.

Gaines et.al. reported some setbacks with Slack, namely the limitations of message and document archiving in the free version. Students and instructors both brought up concerns about notifications – course participants would miss important messages because they were not in the correct channel or had opted out of notifications. Finally, some instructors lamented that some students never became engaged in Slack, instead choosing a more traditional form of communication like email despite course integration. In future courses they recommend integrating a document host (such as Google Drive or Dropbox) for course files, and clarifying expectations for how and how often students should be engaging their peers and instructors on Slack.

III. SURVEY

A. Survey Development

The Slack survey presented here was based on several questions from the survey developed by Ross [5] and citations therein including Clark et.al.[8] and Rinaldo et.al.[9]. Questions on the usefulness of Slack features and opinions on the effect of Slack on quality of learning were of particular interest for a comparison study. Many questions were retained but some changes were made to the survey by Ross. Nearly all references to LMS services like Blackboard were removed, as Blackboard is not of primary focus of this survey. Additionally, questions were parallelized and any 7-point Likert scales were reduced to 5-point to improve flow and decrease completion time. All references to the marketing classroom used in Ross were replaced with engineering (or for the pilot study, computer science). Additionally, questions about previous employment were replaced with questions about class year and number of co-ops respondents had participated in.

Several questions were added to focus on issues of particular interest to this study including how often students met with their peer group, the primary tools for communicating with instructors, teaching assistants, and peers, and what tools would be possibly perform better than Slack for this purpose. The full survey used in this pilot study is attached as an appendix.

Course	N(possible)	N(responses)
CS265 + CS283	106	14
CS370	31	2

TABLE I. Possible responses and rate of response for each set of surveys. CS370 was also asked additional questions about survey construction.

B. Expected Distribution

We expect this survey to be distributed to Fall 2019 ECE Senior Design students near the end of the term. Students will be asked to complete the survey; incentive for completion is still undetermined. Additional faculty members have agreed to distribute this survey within their courses at the end of the Fall 2019 term, for a comparison study across disciplines inside and outside of STEM as well as across campuses. The survey has been built within Qualtrics, which allows for ease of distribution, control of access, and anonymizes responses with no extra effort from researchers. Analysts have no access to personally identifying information.

C. Pilot Implementation

As a pilot study for future implementation, the survey was released to three computer science courses at Drexel during the Summer 2019 term: CS265 (Advanced Programming Tools and Techniques), CS283 (Systems Programming), and CS370 (Operating Systems); see table I.

Students in CS370 were presented with additional survey construction questions: to rate the usefulness of this survey, data were collected on whether the survey was too long, if the survey should have included additional questions (if so, which ones), if 5-point scales had enough options, and if any questions were particularly confusing.

Between both surveys, we collected 16 completed responses. Respondents identified as 56% male, 25% female. Ages ranged from 19 to 22. Students identified as 2nd, 3rd, and 5th years with no students identifying as part-time. Interestingly this survey yielded 4 responses from commuter students which is of particular interest (see section V B). Due to the limited response rate, it is unlikely to glean statistically significant information from these results if divided by demographics, so most results presented in the following section are cumulative.

IV. RESULTS

A. Classroom communication

Students reported that when communicating with their instructor they primarily used Slack (56%) or email (13%), or spoke to their faculty instructor in person (19%) – see table II. This pattern was similar with teaching assistants (TAs) although students were far more likely to speak in person than over email. When speaking with peers, however, students were much more likely to communicate in person than over Slack; this is also the only type of communication where SMS/MMS was an answer.

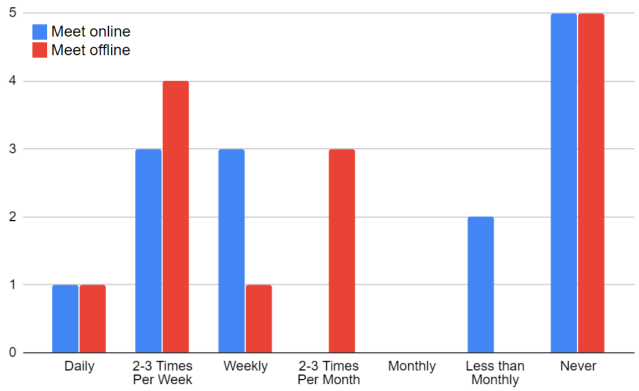

FIG. 1. How often did you meet with your in-class peer group on- or offline, excluding class time? (N=16)

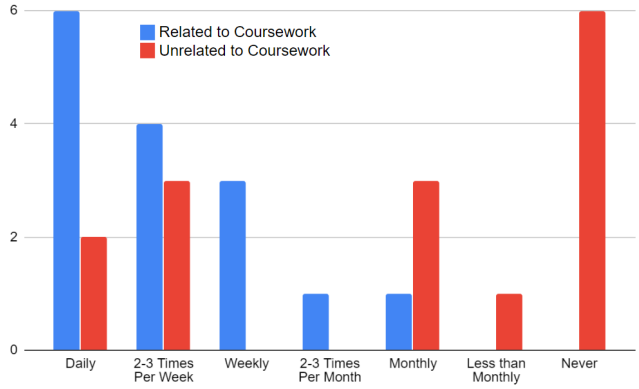

FIG. 2. How often did you check the classroom Slack for materials or discussions (un)related to this course? (N=16)

Students were also asked how often they met with peer groups both online and in person, see figure 1 for results. Generally, if students met at all, they tended to meet at least weekly with little preference for online or in-person.

B. Familiarity with and use of Slack

All respondents reported being at least somewhat familiar with Slack. When asked in what context they became familiar, most responded that they had used Slack in a previous course at Drexel (87%). Additionally, 68% of respondents reported using slack in the workplace. 18% reported using Slack for socialization unrelated to academics, including gaming.

Which of the following was your primary tool for communicating with your...	Faculty Instructor (%)	Teaching Assistant (%)	Peer-group (%)
Slack	56.3	43.8	12.5
Email	12.5	6.3	0
In-Person	18.8	31.3	68.8
SMS/MMS	0	0	6.3
Other	0	6.3	0

TABLE II. Primary tools for communication between students and their instructors, their teaching assistants, and their peer-group. (N=16)

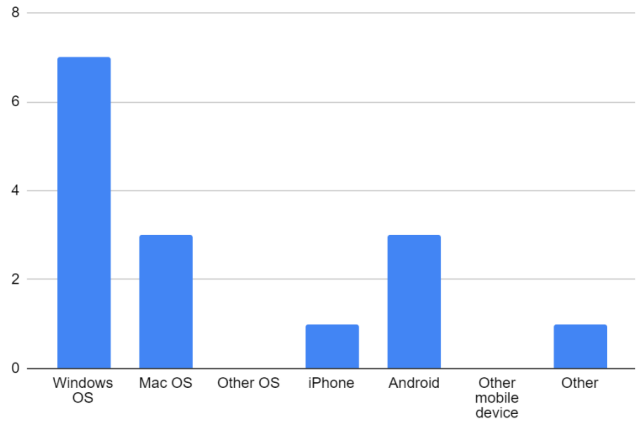

FIG. 3. On which device did you primarily use Slack for this course? (N=16)

In terms of coursework-related use of Slack, students reported that they checked Slack regularly for coursework, with most students checking at least weekly (see figure 2). Students were far less likely to check the classroom Slack for unrelated work, with most respondents reporting using it less than once a month.

Due to an error in survey collection, a question asking students to check any and all devices they accessed Slack on was not made available to most participants. However, respondents did report on the device on which they *primarily* used Slack – results are in figure 3. Students generally used Slack on a Windows computer, but were also likely to use it on their mobile devices.

C. Opinions of Slack

Survey participants were asked to rate how important specific Slack features were to learning in the course on a 5-point scale ('not at all important' to 'extremely important'). The results can be found in table III. Although the response rate was low, respondents rated certain features as especially important in a significant way: compatibility between web/mobile devices, realtime chat, and the ability to direct (private) message instructor(s). The final feature is of particular interest to this study and is discussed further in V A.

Students were asked what type of channels they used most often; as discussed in section I A, we expected respondents to report using private channels more often due to the group nature of the engineering capstone class. For a computer science course like the ones used in the pilot survey, the group dynamic is far looser and this is reflected in responses. Students reported overwhelmingly that they used open class channels most often, with private channels and direct messages used approximately at the same rate but less often. However, Slack analytics suggest that there was some confusion over the definition of 'public' or 'private' channels: no 'private' channels existed in the workspace (see figure 4). This question will need to be modified going forward.

Participants overwhelmingly reported that using slack helped them learn and understand course material, made them more satisfied and involved with the course, and contributed to career skills and real-world experience (see table IV). Participants also reported that Slack made them more comfortable asking questions to clarify material or instructor expectations. They also found Slack to be useful and made the course more enjoyable. Finally, participants rated Slack as accessible and agreed that Slack made it easier to make their voices heard (see table V). Interestingly, CS370 respondents tended to rate Slack less favorably across all questions than their CS265 / CS283 counterparts.

Students reported that Slack (or a similar technology) would have been useful in a previous class, but nearly all respondents had also used Slack in a previous class at Drexel so it is not possible to disentangle whether they are rating that Slack was useful in a class or were thinking of a class that did not use Slack and should have done so.

In asking what tool, other than Slack, could be used in the same way, there were four total responses. One argued nothing would perform as well as Slack. One didn't have a specific replacement but argued that Slack had too many issues:

I'm not sure exactly what tool, but I have

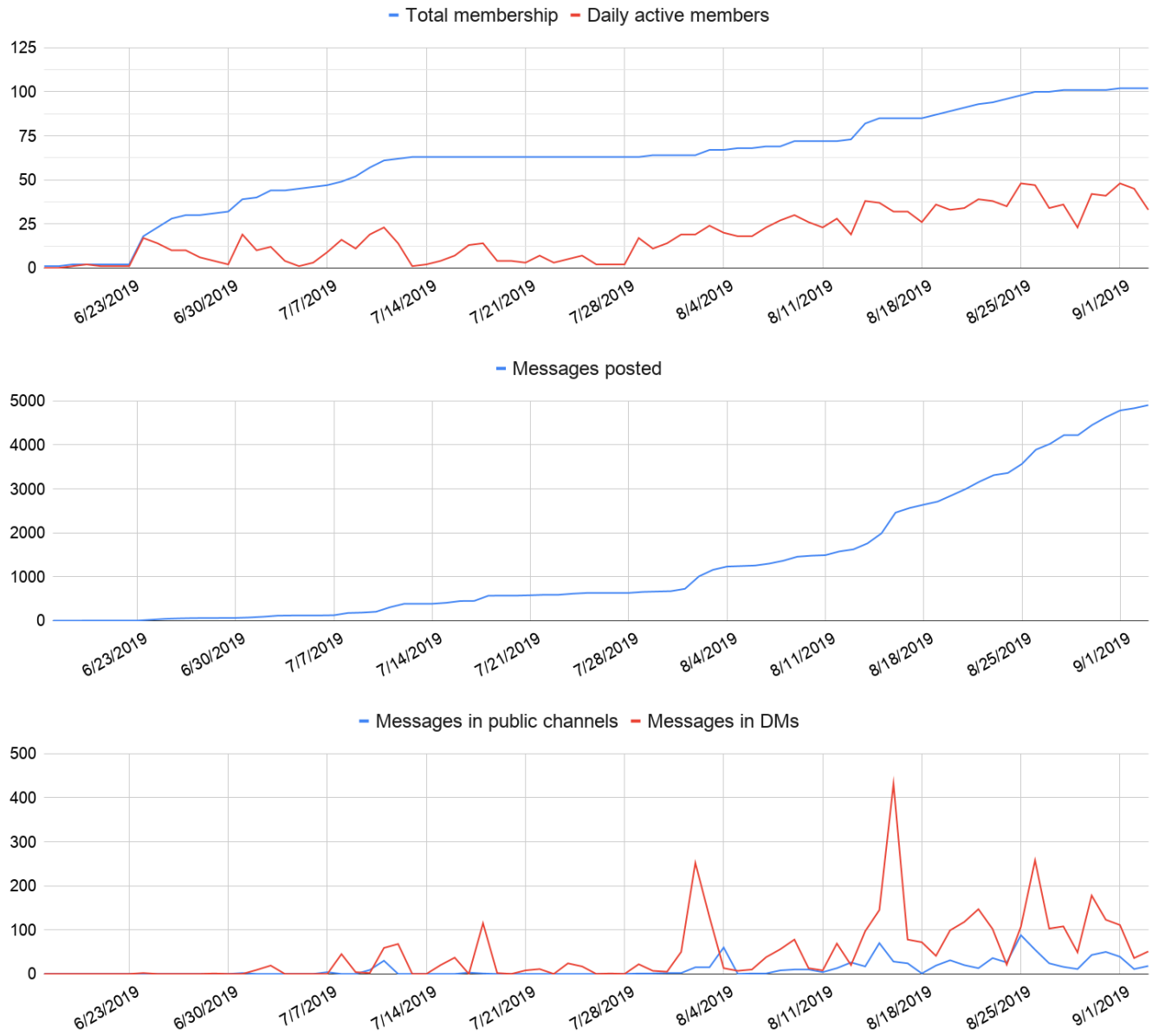

FIG. 4. Data from the CS courses' Slack workspace. Top: percentage of messages sent in public channels and direct messages. There were no private channels. Bottom: weekly active members (viewed at least one public channel). Data from Slack analytics (www.slack.com) and presented from one week before the course started through the final exam.

> *found Slack's notifications to be awful. Most of the time (no matter the settings) I miss messages. Something with more reliable notifications is needed.... Slack is too unreliable to be trusted for important announcements. I often miss messages and have messages not send. I like classroom discussion tools for group projects, however a messaging tool should always just work.*

The other two responded that Discord, another popular messaging tool, would be a better alternative:

> *Discord because I'd argue it is more prevalent and simpler to use and customize compared to Slack.*

> *Discord. Better group hierarchy and allows a single account instead of multiple tied to a single username.... I prefer Discord to Slack but understand that Slack allows MFA with an enterprise email account.*

"MFA" refers to multi-factor authentication, a security tool to prevent account hacking; two-factor authentication is part of the freemium version of Slack so it is unclear to what this student is referring. Discord as an alternative will be discussed further in section V C.

D. Survey construction

Students in CS370 were offered additional questions to rate the construction of this survey. Unfortunately, only two responses were recorded. One respondent also answered only a few questions – so the following results should be viewed with some serious reporting-bias.

Participants agreed that the survey was of an appropriate length and that they would not want a larger Likert scale (this survey used a 5-point scale). Free response questions allowed students to report what part of Slack was most important to evaluate, and one respondent answered with"the collaborative aspect of it". Additionally the two participants argued that Slack is not the ideal technology for this purpose, suggesting Discord.

Finally, the survey asked whether email or Slack was a better communications method for classroom or department announcements, department events, or student events. One student answered that Slack was okay for classroom announcements, but otherwise for all other cases respondents wanted their news and announcements via email.

V. DISCUSSION

A. Communication with instructor

Slack's ability to virtually connect students with instructors through direct (private) messaging was one of the most highly rated features among the pilot study. Students also believed that Slack made it easier to ask questions about material or clarify instructor expectations. While this result was not unexpected, it underlines the ability of Slack to engage students and develop a community within a classroom. We expect this behavior to be confirmed with future data.

Due to the low response rate it is difficult to determine any statistically significant gender differences out of this survey but we can make some observations to confirm or refute with further data. First, no women answered that their primary mechanism for communicating with their faculty instructor was Slack (in-person preferred with 66%, then email with 33%) but women were more likely than the class as a whole to use Slack to reach their TA's. Men predominantly used Slack (87%) to communicate with their faculty instructor; more data is needed to confirm, but further research could disentangle why women are less likely to communicate with their instructor via Slack.

Interestingly, women were more likely to rate Slack features (table III) and statements (tables IV,V) more positively than their male counterparts. In fact, women rated all features and statements neutrally or favorably with a couple important exceptions; one respondent shared that they did not feel more comfortable using Slack to discuss sensitive issues as well as believing that Slack did nothing to enhance the understanding she gained from this course. Given that she rated the rest of the survey favorably it could be that she had a particularly bad experience with sensitive issues on Slack, or it could have been a misinterpretation of the question.

B. Accessibility

All groups agreed that Slack was accessible; but the term 'accessible' was not defined within the survey and leaves some interpretation to the participant. It wouldn't be surprising for an able-bodied person to interpret this question differently than a student with a disability or a student with limited access to educational technology (perhaps due to lack of phone or computer). I suggest rewording this question in a future survey to parse if Slack is easy to use, easy to access, or accessible to students with disabilities; a semi-structured interview may work better for this purpose.

Four respondents were commuter students, which are of particular interest to a Slack survey as a virtual communications tool can be a strong connection to campus even and most especially when students cannot meet in person. Commuter participants followed class trends consistently. One student reported that they rarely or never checked Slack for materials related to coursework, but responded negatively to possible reasons for this posed by the survey so it is unclear why the student didn't use Slack. Commuter students were more likely to rate direct messages as their most-often used channel, but rated all Slack features positively. Commuter students most negatively rated statements about Slack (table IV) contributing to their real-world or career experience.

C. Slack alternatives

There were a few responses within our pilot survey that suggested Discord as an alternative to Slack. Discord is also a cloud-based communications application that functions similarly to Slack ,in that it also has workspaces and channels as well as private messaging, but there are some key differences. First, Discord allows a user to log in to all workspaces at once – while it is fairly simple to switch between workspaces on Slack, it requires logins for each one.[4] Discord also has no limit to the number of messages and files it saves, and is free for any number of users. Discord's video chat is also meant to work in the background which means its far more user friendly and quality focused than Slack.

Discord is not necessarily a trivial switch however. The platform was originally designed to connect video gamers

[4] I am a part of at least six Slack workspaces. I have to log on to each one individually for each device I use to access Slack. That's at least a dozen logins if I happen to get logged out.

Feature	N	μ	σ	t-test	p-value	Cohen's d
Web/Mobile compatibility	15	4.13	0.65	6.76	<0.01	1.75
Direct (private) messaging with instructor(s)	13	4.00	0.92	3.91	<0.01	1.08
Realtime chat	13	3.85	0.90	3.39	<0.01	0.94
Topic channels	14	3.71	0.92	2.91	0.01	0.78
Push Notifications	15	3.60	1.31	1.78	0.09	0.46
Embedded content from traditional course materials	14	3.50	1.11	1.69	0.10	0.45
Search functionality	13	3.62	1.31	1.69	0.10	0.47
Asynchronous chat	12	3.50	1.08	1.60	0.11	0.46
Direct (private) messaging with peers	13	3.69	1.60	1.56	0.12	0.43
Private groups	12	3.42	1.24	1.16	0.19	0.34
Uploading your own content	11	3.36	1.50	0.80	0.28	0.24
Embedded content from other media	14	3.14	1.27	0.42	0.36	0.11

TABLE III. How important do you feel each of the following Slack features was to your learning in this course?

Using Slack...	N	μ	σ	t-test	p-value	Cohen's d
helped me learn the course material better.	13	4.15	0.90	4.63	<0.01	1.28
helped me understand course material.	13	4.08	0.99	3.91	<0.01	1.08
increased the educational value of this course.	13	4.08	0.69	5.66	<0.01	1.57
made me more satisfied with this course.	13	3.85	0.75	4.09	<0.01	1.13
made me more involved in the course.	14	3.79	0.74	3.97	<0.01	1.06
contributed to my career skills.	14	3.79	0.74	3.97	<0.01	1.06
contributed to my real-world experience.	13	3.77	0.79	3.50	<0.01	0.97
made me a more competent scientist or engineer.	13	3.77	0.79	3.50	<0.01	0.97

TABLE IV. Thinking specifically of this course, how much do you agree with the following statements?

and streamers, and suffers from all the issues of the gaming community including trolling, anonymized harassment, and doxxing [10–12]. This mostly comes from the fact that Discord workspaces rely on moderator vetting. Additionally, Slack surpasses Discord in its access to third-party app integration – Discord only integrates a few other technologies which are all related to gaming (Xbox Live, Steam) or streaming (YouTube, Spotify). Further integration comes from user-built 'bots' which are mostly crowd-sourced and could be unreliable. At the moment, Slack is far more reliable and a safer choice for implementation in a classroom environment.

D. Next steps

Although Ross [5] does not report standard deviations, it is possible to check if responses from this survey are consistent with literature. Questions that are similar or identical to Ross all had consistent responses across both surveys. It would be prudent to complete this survey with a larger sample size in order to directly compare in a statistically thorough way.

It is also clear that there should be some amount of incentive to have students complete the survey when implemented fully in the Fall 2019 term. The low response rate from a class familiar with Slack was surprising, and may be improved in the future with class time set aside for survey taking, or an extra credit boost for completion.

Thank you to Dr. William Mongan for allowing us to pilot our study in his courses, and to Dr. Spencer Ross for sharing his survey with us.

Statement	N	μ	σ	t-test	p-value	Cohen's d
Slack made me feel more comfortable asking questions about material I did not understand.	13	4.38	0.85	5.86	<0.01	1.63
Slack made me feel more comfortable asking questions to clarify instructor expectations.	13	4.38	0.85	5.86	<0.01	1.63
Slack was useful.	14	4.36	0.37	13.63	<0.01	3.64
I found Slack to be accessible.	14	4.07	1.21	3.32	<0.01	0.89
Slack made it easier to make my voice heard.	12	4.00	0.83	4.16	<0.01	1.20
Slack made this class more enjoyable.	13	3.85	0.90	3.39	<0.01	0.94
Slack helped me seriously consider differing points of view.	12	3.83	0.81	3.58	<0.01	1.03
I understood the material better using Slack.	12	3.83	0.97	2.97	0.01	0.86
I felt more comfortable using Slack to discuss sensitive issues.	11	3.82	1.06	2.57	0.02	0.77
My skills in working with groups improved because of Slack.	13	3.38	1.16	1.20	0.19	0.33
Slack did nothing to enhance the understanding I gained from this course.*	14	2.29	1.92	1.39	0.15	0.37

TABLE V. Thinking specifically of this course, how much do you agree with the following statements? (*Reverse coded)

[1] College of Education (University of Massachusetts Amherst), Online Tools for Teaching and Learning: Slack (2019).

[2] Slack, With 10+ million daily active users, Slack is where more work happens every day, all over the world (2019).

[3] J. Herrman, Slack Wants to Replace Email. Is That What We Want? (2019).

[4] Slack, One for the team (2015).

[5] S. M. Ross, Slack It to Me: Complementing LMS With Student-Centric Communications for the Millennial/Post-Millennial Student, Journal of Marketing Education **41**, 91 (2019).

[6] G. Northey, T. Bucic, M. Chylinski, and R. Govind, Increasing Student Engagement Using Asynchronous Learning, Journal of Marketing Education **37**, 171 (2015).

[7] J. E. Gaines, O. Akintewe, S. K. Small, and T. Henry, Engineering Design Instruction Using Slack for Project Support and Teamwork, in *2019 ASEE Annual Conference & Exposition* (Tampa, FL, 2019).

[8] I. I. Clarke, T. B. Flaherty, and S. Mottner, Student Perceptions of Educational Technology Tools, Journal of Marketing Education **23**, 169 (2001).

[9] S. B. Rinaldo, S. Tapp, and D. A. Laverie, Learning by Tweeting: Using Twitter as a Pedagogical Tool, Journal of Marketing Education **33**, 193 (2011).

[10] N. Grayson, Discord Explains How It Handles Harassment, Doxxing, And Threatening Behavior (2019).

[11] D. Patterson, 8chan users are moving to Discord, where your kids are playing video games (2019).

[12] E. Gera, Overwatch Contenders Team Loses Female Player After Community Harassment (2019).

Appendix A: Suggested changes to the survey

a. Q4/5/6 The phrase 'Group messaging software' could, to some participants, include Slack. The survey was designed to include answers alphabetically so as to not bias toward Slack, but this could be a problem in the future.

b. Q18 Reword this question to make the distinction between 'private' and 'public' channels more clear.

c. Q22 We should change the logic of this question to only allow responses from students who reported they had not used Slack in a previous class. We could also reword the question: "Thinking back to classes in which you did *not* use Slack, would Slack (or a similar technology) have been useful?".

d. Q23 There were some calls for the use of Discord, so it may be a worthwhile comparison in the future.

e. Q39 This question was only asked in the meta survey, but it really should be part of the main survey in order to better grasp how students would prefer to recieve information.