Journal of Teaching and Learning with Technology, Vol. Vol. 13, Special Issue, pp.22-27.
doi: 10.14434/jotlt.v13i1.38335

Leveraging Technology for Targeted Student Support in Large-Enrollment Chemistry Courses

Meghan Porter
Indiana University Bloomington
mmulcron@iu.edu

Kim Arnold
Indiana University Bloomington

Abstract: Large-enrollment courses present unique challenges in providing student support. Despite instructors' efforts to provide various help sessions throughout the week, it is inevitable that not all students can attend, and individual meetings are not feasible. Students may hesitate to ask questions on previous topics, feeling that they will slow down their peers. To address these challenges in three large-enrollment chemistry courses, we have implemented digital whiteboarding and established directed help sessions in the ALCOVE (Active Learning Classroom of Valuable Experiences) classroom. This approach enhances accessibility and provides targeted support, fostering an environment that encourages active engagement and collaboration among peers. Utilizing digital whiteboards in help sessions allows students to access content afterward, alleviating concerns about missing crucial details that may be erased. This accessibility benefits students unable to attend, providing them with a means to review discussed content without placing an additional burden on the instructor. Additionally, while students are studying, they can leave digital sticky notes for the instructor to address at the next session, decreasing the stress of asking questions live in front of their peers. Weekly targeted help sessions, using OneNote, a digital notebook, organized by weeks and topics, enables students to focus on specific content areas they are struggling with.

Keywords: collaboration, community, digital whiteboarding, office hours

Large-enrollment courses (>100 students) present unique challenges in providing student support. Despite instructors' efforts to provide various help sessions (office hours) throughout the week, it is inevitable that not all students can attend these sessions owing to differing course schedules and outside commitments. However, holding regular individual meetings with hundreds of students is not feasible for an instructor. Even when students can attend, they may hesitate to ask questions on previous topics, feeling they "should already know it" and not wanting to "slow down" their peers, thus, not receiving the help they need regardless of their attendance. Additionally, the fear of information being erased from the board after a problem leads students to focus more on copying information or taking pictures, rather than truly engaging with the problem-solving process. To address these challenges in three large-enrollment chemistry courses (Table 1) we have implemented digital whiteboarding and established optional directed help sessions aimed at students struggling with course content. This approach enhances accessibility for students and provides more targeted support, fostering an environment that encourages active engagement and collaboration among peers.

Table 1. Chemistry courses and average enrollments

Course	Subject	Sections per semester	Students per section
C103	Preparatory Chemistry	2	~300
C117	General Chemistry I	2	~350
N331	Inorganic Chemistry	1	~150

Employing Digital Whiteboarding to Improve Access and Foster Collaboration

Help session formats vary across disciplines and courses. In our large-enrollment chemistry courses, we offer numerous weekly opportunities for students to seek help. These sessions aim to help as many students as possible, fostering a welcoming environment for students to ask questions, receive help, and connect with the teaching team and their peers. Digital whiteboarding technology using Microsoft Whiteboard offers an interactive platform for study sessions. The instructor can create a new whiteboard for each exam, topic, or other content. When students run into an issue while studying independently, they can leave digital sticky notes with their questions on the whiteboard. Instructors can then address these notes at the beginning of the next session. Additionally, students who may be uncomfortable speaking up in front of peers can still have their questions addressed by leaving a sticky note beforehand. Students with tablets or laptops can access the whiteboard via a shared link during sessions, allowing real-time student-to-student and student-to-instructor collaboration on problems. This enhances student engagement in the learning process, an aspect shown to lead to improved motivation (Johnson, 2019; Prince, 2004) and long-term content retention (Beard & Wilson, 2006; Conduit et al., 2017; Johnson, 2019). Finally, the whiteboard remains accessible after the session, shifting the students' focus from copying all the information from the board during the session to engaging fully in the problem-solving process. For students who cannot attend, they are able to review content covered and find answers to some of their questions. This approach has been employed by our instructors in standard classrooms and help session spaces and has been well received and well used by students.

Targeted Help Sessions to Foster Student Engagement and Collaboration

Because of the high number of students in our courses, we must reserve campus rooms to hold our help sessions. We have been fortunate to hold these sessions in active learning classrooms on campus, specifically in the ALCOVE (Active Learning Classroom of Valuable Experiences) classroom to utilize the classroom technology (go.iu.edu/alcove). The technology in active learning classrooms, specifically the ALCOVE, has allowed us to offer more directed help sessions: "Bottleneck Fridays" (C103), "Question Crushers" (C117), and "Topic Takedowns" (N331). In all courses, these sessions are open to anyone but aimed for students struggling on assessments, providing a safe space to ask questions, revisit previous material, and receive help on more challenging aspects of course content.

The ALCOVE classroom allows students to exchange ideas and insights as they tackle each topic, writing collectively on the screens (Figure 1). The classroom has six pods made up of moveable desks, and each pod is equipped with a computer, large touchscreen monitor, and two digital pens. When possible, we assign a peer mentor to each pod for small-group assistance. Working together during these active learning sessions allows students to foster relationships and articulate their reasoning (an essential skill for exams), building critical thinking skills and giving them greater ownership of their learning experience (MacVaugh & Norton, 2012; Mok, 2014).

Figure 1. Students working collaboratively to solve problems.

In C103 and C117, these directed sessions focus on the most challenging content from the current week. Each week, the course instructor creates a new section in a OneNote digital notebook with problems addressing the challenging content. Each pod gets its own copy of these problems through different notebook pages (Figure 2) and the link is shared on Canvas for student access. This setup allows for organization of problems by week and allows each group their own workspace. During sessions, students and peer mentors collaborate on practice problems using the touchscreen monitors or their tablets (Figure 3). The course instructor can move between pods and answer questions as they arise, but the focus is on students using their collective knowledge to arrive at an answer. Students who miss a session can still access problems, view worked solutions, and check the answer key.

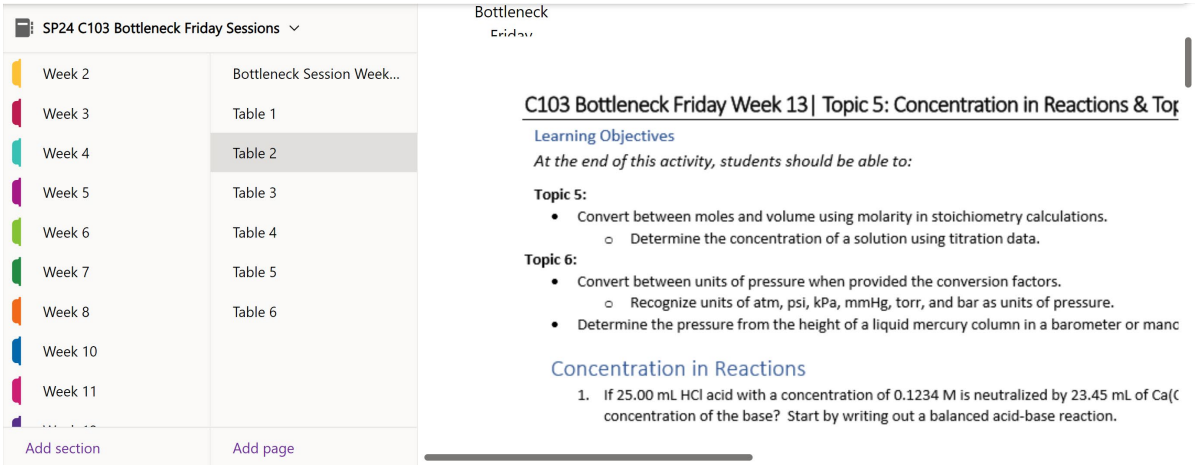

Figure 2. Screenshot of organization of a OneNote page for a C103 Bottleneck session.

Figure 3. Students working in groups during a Bottleneck Friday session.

In N331, the focus of these sessions is to help students solidify understanding on different topics, regardless of when they were covered in the semester, removing the "I should already know this so I can't ask a question" barrier to seeking help. As for the earlier courses, the instructor creates a new section in a OneNote notebook for each week and within each section separate pages are dedicated to each topic previously covered that semester (Figure 3) and each pod is assigned a different topic. Students can choose which topic they want to focus on each week or move between topics during a session. In N331, students are not allowed to use their own devices during the session but must work collaboratively on the touch screen to articulate and document their thought process. Students who attend sessions can access the notebook afterward, so they do not spend time trying to copy everything down, allowing them to fully engage with each other and with the content. Students who cannot attend the session can still access the problems for each topic and view student work to get extra practice (Figure 4).

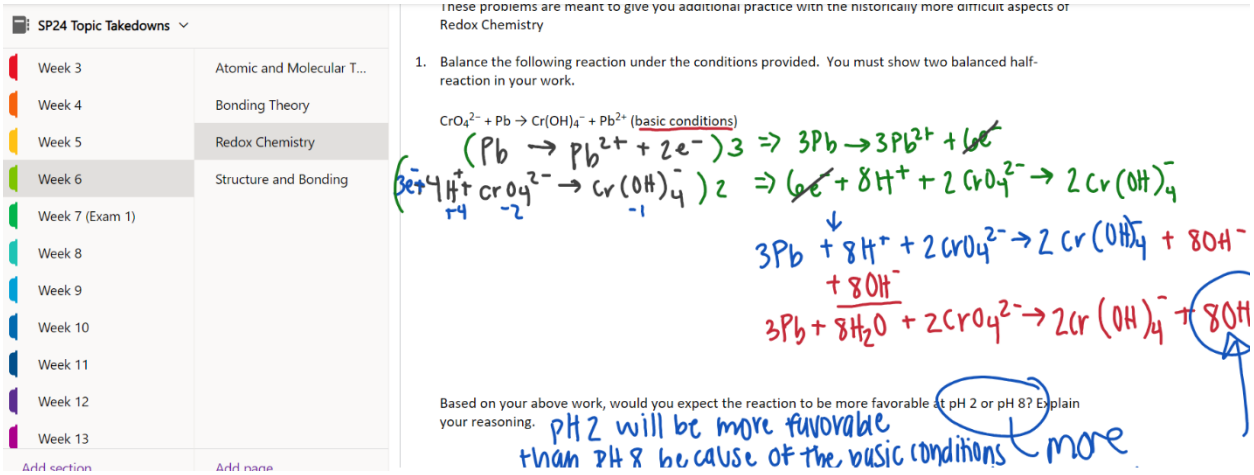

Figure 4. Organization of an N331 Topic Takedown session on OneNote and an example of collaborative student work.

Although the technology in the ALCOVE provides a wonderful setup for these targeted help sessions, not having access to an active learning space does not mean this approach cannot be used by instructors. In a standard space, students can work in groups and access the online notebook through a single student's device. Each group can then work together on a single device, maintaining the collaborative aspect of these sessions. Outside of the ALCOVE space, the digital whiteboarding and targeted help notebooks can be easily set up by the individual instructors as long as they have access to Microsoft Office tools.

Observations and Qualitative Student Feedback

After multiple semesters employing digital whiteboarding and targeted help sessions in the ALCOVE, we observed increased student-to-student and student-to-instructor engagement. The technology facilitated dynamic discussions and collaborative problem solving. Students who could not attend benefited from access to saved session content, preventing them from falling behind. The digital sticky note feature maintained ongoing dialogue between students and instructors outside of sessions. Feedback showed students valued the structured yet flexible support system. A group of C117 students reported that they looked forward to weekly Question Crushers because it helped their confidence, and they got to meet students from other lecture sections. Since students are not working with the same group each week, they develop a wider support system of their peers and often end up exchanging phone numbers or forming study groups. Students can then take these support systems with them into future courses. One student mentioned that working through the problems in a group left her confident she understood the logic behind *how to solve the problem*, not just the final answer. This feedback supports reports that active learning environments have a positive impact on attitudes toward learning (Valverde et al., 2002) Another student specifically said they could not make help sessions but accessed the whiteboard regularly outside of sessions and was often able to find the clarification they were looking for.

As instructors, it was rewarding to see students collaborate and teach each other, enhancing the learning experience for everyone. By combining digital whiteboarding, targeted help sessions using OneNote, and post-session accessibility, we created an inclusive and supportive learning environment that can reach more of our students. These strategies empower students, promote collaboration, and lessen common challenges associated with large-enrollment classes. To learn more about the Microsoft tools we used (OneNote and Whiteboard) or to think through planning something like this for your study sessions, we suggest contacting your campus Teaching Center for support.

References

Beard, C., & Wilson, J. (2006). *Experiential learning: A best practice handbook for educators and trainers*. Kogan Page Publishers.

Conduit, J., Plewa, C., Ho, J., & Lu, V. N. (2017). Facilitating student interaction capabilities: The interplay of individual, group, and course-related factors. *Journal of Strategic Marketing*, *25*(2), 114–127. https://doi.org/10.1080/0965254X.2016.1182575

Johnson, K. (2019). Implementing inclusive practices in an active learning STEM classroom. *Advances in Physiology Education*, *43*(2), 207–210. https://doi.org/10.1152/advan.00045.2019

MacVaugh, J., & Norton, M. (2012). Introducing sustainability into business education contexts using active learning. *International Journal of Sustainability in Higher Education*, *24*(4), 439–557. https://doi.org/10.1108/14676371211190326

Mok, H. (2014). Teaching tip: The flipped classroom. *Journal of Information Systems Education*, *25*(1), 7–12.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Valverde, C., Allen, K., Small, C., & Carr, W. (2022). Active learning interventions in a predominantly Black, urban college increase positive attitudes toward class participation. *International Journal of Science, Mathematics and Technology Learning*, *30*(1), 17–30. https://doi.org/10.18848/2327-7971/CGP/v30i01/17-30