Journal of Teaching and Learning with Technology, Vol. Vol. 12, Special Issue, pp.72-90.
doi: 10.14434/jotlt.v12i1.36327

UDL for Inclusive Teaching: Offering Choice to Increase Belonging Through Technology

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Abstract: This qualitative case study investigates the impact of the universal design for learning (UDL) framework paired with multiple educational technologies on student engagement and sense of inclusion and belonging in the classroom. Research has indicated that a sense of belonging has a direct impact on success among undergraduate students. I saw increased evidence of belonging among students in my class after incorporating choice for my students in all the ways they interact with me, each other, and the course content. This article summarizes the revisions made to the course, the educational technologies used to implement those changes, and qualitative data that supports my hypothesis that a technology-supported UDL approach can have a positive impact on feelings of belonging among college students.

Keywords: universal design for learning, engagement, inclusion, discussion, alternative assessments, educational technologies, qualitative case study

A growing body of literature indicates that belonging is an important indicator of student success in higher education. It enables inclusive learning environments, creates actively engaged learners, and leads to improved education outcomes and retention (Araújo et al., 2014; Lu, 2023; Strayhorn, 2019; Walton & Cohen, 2011). However, this sense of belonging can be more difficult to create and sustain in diverse college students from underrepresented backgrounds (Gopalan & Brady, 2020; Juarez, 2021) and those with disabilities and/or need for academic accommodations (Moriña & Perera, 2020). Although it is clear that a sense of belonging has far-reaching impacts on student success, what is less clear are the practical pedagogical strategies that can be used to create a sense of belonging in the classroom. This article presents a qualitative case study on a course I teach where a technology-supported universal design for learning (UDL) approach was incorporated into the revision of an undergraduate course. The goal of this course revision was to offer choice, increase engagement, and ultimately foster a sense of belonging for all students in my classroom.

Background and Literature Review

The UDL revision of my course began in response to a specific dilemma: How can I improve student participation in class discussions? Every class I have taught in higher education (at a large, R1, land-grant institution) has been discussion based. I began my career as a first-year general education and professional writing instructor in rhetoric and composition teaching classes of 20–25 students. In these courses, I was never surprised to see the same three or four students raising their hands to participate in discussion during every class. As a general education requirement, the course did not appeal to many of the students; they adopted a mentality of "completing the requirement," rather than "engaging in learning."

Currently, I teach a class on pedagogy to science, technology, engineering, and mathematics (STEM) students who want to be learning assistants (LAs; undergraduate teaching assistants). This one-credit course meets for 75 min, once a week, for 7 weeks. The classes range from 15 to 35 students in each section, and I typically teach three sections each semester (two in person, one asynchronous

online). These students have chosen to be an LA, knowing that my course is a required part of their educational preparation for the job—one step better than the required general education courses that I used to teach. Given their motivation to be an LA, I assumed it would be less of a struggle to encourage participation during in-class discussions. This was not the case. As in my writing courses, the same three or four students continued to answer questions during every class. Throughout my years of teaching, I have wondered why students resist engaging in class discussion, but when I began researching the literature on this topic the reasons became clear.

Engagement, Inclusion, and Belonging

My review of the literature was originally focused on student engagement. I wanted to make sure that I was engaging all students during class, not just some of them. However, the more I read, applied to my own teaching, revised, tested, and tried again, the more I realized that my questions and concerns were about much more than just engagement. They were about inclusion and belonging as well. On the surface, these three ideas look similar in the context of education—they are all concerned with how students interact with their learning environment (Mulvey et al., 2022; Pope & Miles, 2022). However, just because students are engaged does not mean they feel included, and feelings of inclusion do not always lead to feeling as though you belong (Fernandes, 2021; Hanover Research, 2022; Kurfist, 2022; Verlinden, 2022). For example, a student might feel comfortable engaging in a course activity but still feel as if some aspect of their identity keeps them separate from other students in the class. In the same way, a student might feel both engaged and included but might not feel connected to anyone else in the classroom; in other words, they might not feel as if they belong as a full participant in the learning community.

Inclusion in the classroom is well documented in the literature. Hogan and Sathy (2022) defined classroom inclusion as "a culture in which all learners feel welcome, valued, and safe, and it requires intentional and deliberate strategies" (p. 5). The terms "welcome" and "safety" are present in most definitions of inclusive learning environments (Addy, 2021; Cook-Sather et al., 2021; Gamrat, 2022). My goal has always been to create engaging and inclusive classroom environments, as these are generally things that I can plan for and control. They can be implemented through pedagogically sound and thoroughly researched teaching practices. However, creating learning environments where students feel as if they *belong* is more complicated.

There is some consensus on what constitutes a "feeling of belonging" in higher education and how it impacts student learning and performance. Strayhorn (2019), who has written extensively on belonging among college students, said that it is "a feeling of connectedness, that one is important or matters to others" and is a "function of perceived support from one's peers, teachers, and family members" (p. 2). Walton and Cohen (2011) called it "a sense of having positive relationships with others" (p. 1447), and their influential study on belonging among 1st-year college students showed improvements in performance and well-being after a brief belonging intervention. There are also some key types of activities that are important to feelings of belonging, such as "helping students develop relationships with people whom they can go to when they feel disconnected, activities that encourage interactions among students from different backgrounds, and events about important social, economic, or political issues" (Lu, 2023, para. 26). A national study of more than 20,000 students at 2 and 4-year colleges found that feelings of belonging had positive impacts on persistence and mental health; however, the study also found that underrepresented first-generation, racial, and ethnic minority students at 4-year institutions reported a lower sense of belonging than their peers (Gopalan & Brady, 2020).

Despite these different definitions for engagement, inclusion, and belonging, these three concepts are inextricably linked when it comes to their impact in the classroom. Studies have

repeatedly shown that student perceptions and feelings in these three areas have a direct impact on each other. For example, McWhirter and Cinamon (2021) found links between inclusion/belonging and engagement and retention in STEM fields; Mulvey et al. (2022) discovered significant relationships between higher levels of inclusion and belonging with engagement both in and out of the classroom; and Wilson et al. (2015) found that "among five universities and colleges studied, significant links between multiple measures of belonging and multiple measures of both behavioral and emotional engagement are numerous and varied, even when controlling for other known and significant correlates to engagement such as self-efficacy" (p. 768). This research led me to believe that gains in both engagement and inclusion would also have a positive impact on belonging in the classroom. Additionally, my examination of the literature led me to theorize that a UDL approach could address all three of these important aspects of student success.

UDL, Belonging, and Educational Technologies

Addressing these three areas of engagement, inclusion, and belonging were what initially led me to explore the UDL approach that I eventually adopted in my teaching. There is noticeable overlap in how the literature defines a sense of belonging in higher education and how the UDL framework conceptualizes choice in the classroom. The UDL guidelines emphasize the importance of "foster[ing] collaboration and community" through creating varied peer learning opportunities, creating groups according to shared interests and activities, and scaffolding instruction on how and when to ask others for help (CAST, 2021). The UDL framework also "recognizes learner variability as an educational norm" and strives to treat students as individuals with differences (Fornauf & Erickson, n.d., p. 185). By emphasizing choice, instructors invite students to cocreate their learning experiences, thereby cultivating an environment where the connections to others that foster feelings of belonging are more likely to occur.

Additionally, there is a clear link in the literature between the UDL framework and the use of educational technologies. Edyburn (2011) presented numerous examples of how offering choice in the classroom through teaching with a variety of pedagogically tested educational technologies can increase student access to content, enhance engagement, and have a greater impact on diverse learners. Similarly, Basham et al. (2020) argued that the "UDL framework along with the integration of modern technology begins to provide a proactive mechanism to account for learner variability and maximizes student learning" (p. 73). Whereas access to specific technologies can be limited by institutional budgets, many UDL options can be provided using free educational technologies that require no more than access to a device, an internet browser, and an internet connection.

Barriers to Discussion Participation

One of the main ways that I hoped to increase belonging in the classroom through educational technologies was by looking for technologies that would connect students during class discussion. This was my original teaching question that drove me to research the literature in this area. Educational researchers have been investigating student participation in class discussion for decades. The reasons for lack of participation are varied: Some students are naturally quiet and introverted (Medaille & Usinger, 2019); some students do not view their ideas as worthy of sharing (Wade, 1994); some fear they will make a mistake in front of their instructor and peers (Engin, 2017); others experience barriers due to mental health issues or disability status (Marquis et al., 2016); still others are multilingual learners who, although perhaps confident in their ideas, may not be confident in their ability to express those ideas in the dominant language of the classroom (Chew & Ng, 2015; Jackson & Chen, 2018; Yazici & Bavli, 2022). Classes that rely heavily on discussion-based learning may privilege extroverted, outgoing

students who are part of the dominant cultural group and already feel as if they belong on the 1st day of class (Blau & Barak, 2012; Blau et al., 2017; Chew & Ng, 2015, 2016).

Without intentional intervention, research has shown that participation in classroom discussion (whether as part of a whole-class discussion or smaller group discussion) can be stressful for a variety of reasons (Demissie, 2020; Ozment, 2018). Simply asking a question and expecting more than a handful of students to volunteer to answer will not offer an equitable way for all students to participate in class discussion. As I learned more about the scope of student barriers to class participation, I brainstormed other ways that I could encourage students to participate without triggering this anxiety, as there is no way for students to feel engaged, included, or as though they belong if they are anxious or nervous. Most of my ideas involved different types of educational technologies.

Barriers to Other Types of Academic Participation

Once I began investigating the root causes of the lack of discussion-based participation in my classes, I naturally started thinking about other ways my students engage with me, with other students, and with course content. If the style of discussion privileged some students over others, was it possible that I was unintentionally placing students at a disadvantage in other aspects of my course?

At the heart of the UDL approach is student choice (CAST, 2021). UDL is a conceptual framework with foundations in neuroscience that emphasizes designing learning experiences to "incorporate multiple means of engaging with content and people, representing information, and expressing skills and knowledge" (Tobin & Behling, 2018, p. 2). It looks at every aspect of the classroom (content, engagement, and assessment) and asks the same questions I was asking about class discussions: How am I privileging some students over others in the way I present materials? In formative and summative assessments? In all forms of course engagement? And if I am privileging some students over others, is there any way that all of my students can feel as though they belong? As I continued reading and learning about the UDL approach, I questioned every aspect of my course and examined it to see if I was designing learning experiences that worked for all my students. Ultimately, I decided to revise my course using a combination of UDL concepts and several educational technologies to try and address all of these questions.

Case Study Context: UDL Revisions and Technologies

With the overlap of UDL concepts, educational technologies, and the previously cited literature in mind, I wanted to revise my course to offer as much choice as possible by following the UDL framework, and I knew that I would need to incorporate a variety of educational technologies to make these revisions work. My overall goal was to increase engagement and feelings of belonging and inclusivity in my students. I focused on the three areas of the UDL framework: revisions to (1) engagement, (2) representation, and (3) action and expression (CAST, 2021). Many of my revisions involved adding or changing instructional technologies to facilitate the additional student choices, and these technologies were key to making these revisions successful.

Revisions to Engagement

The first area I revised was student engagement, as it was my original impetus for researching the changes to my curriculum. The UDL framework presents engagement in a very specific way; it promotes ways to "connect with student interests…[and] provide multiple methods of engaging with materials" (Tobin & Behling, 2018, pp. 25–26). Engagement should offer choice and make learning

relevant for all students (Posey, n.d.). In my teaching context, engagement fell into three categories: class discussion, office hours, and weekly check-ins.

Class discussion needed to include ways for students to engage and participate without feeling anxious and had to offer more time to think than is typical in traditional classroom settings. Originally, I used a free online tool called Padlet, a digital space where students can participate in a visual discussion using "cards," similar to adding a post-it note to a physical bulletin board. I included each of my discussion questions as a card, and students could respond to those cards anonymously to answer any of the questions or simply raise their hands to answer if they preferred. First, I would call on students who wanted to speak during class to give other students time to type, then I would discuss the anonymous written responses with the class. This is simple enough that it can be done using any online collaborative tool that allows for students to participate anonymously (other options include Google Jamboard, Word Online, or any other collaborative note-taking tool).

Ultimately, I landed on a tool called Top Hat, which my institution has a license for. This interactive presentation tool integrated my uploaded slides with a variety of polls and discussion questions that have options for anonymous participation. Students use Top Hat to log in to the instructor's class presentation, so while I presented my slides, they could follow along on their own devices. Whenever I initiated a poll or discussion question, the question would also pop up on their devices so that it was immediately accessible for them to answer.

Another engagement change I made to my teaching was to require two office-hours visits with either me or one of my own LAs throughout the semester. I have done this in previous classes, but this was the first time I considered office-hours options outside of in-person drop-in hours. I added choice by offering multiple options for how students could meet with us: They could come to regularly scheduled drop-in hours (either in person or on Zoom), or they could schedule time for in-person or online appointments as well. This was one of the areas where I hoped to see improvements in belonging, as developing positive relationships is one of the key aspects of cultivating feelings of belonging.

It is important for me to check in with my students each week, as one of the objectives of my course is to provide support for students in their first semester as an LA. For these weekly check-ins, students who attended class in person could share how their week was going by either raising their hand to talk or typing into a Top Hat discussion at the beginning of each class. If a student missed class or was part of my asynchronous section, they could complete their check-in within the learning management system (LMS) by filming a brief (3- to 4-min) video using a tool called VoiceThread, which allowed me to respond to their videos with a video of my own. This enabled me to provide feedback, answer questions, and address concerns even when a student was not physically present in class. This type of video check-in and response could be done using a video submission tool in an assignment or discussion forum in the LMS as well. This was another area where I hoped to see increased feelings of belonging, as both the LAs working in my classes and I were intentional about responding to every in-person and asynchronous check-in.

Revisions to Representation

The next area for revisions was representation. The UDL framework offers suggestions for presenting all types of course content in multiple ways and in multiple forms—in other words, representing materials in a variety of ways to account for learner variability (Tobin & Behling, 2018, p. 25). This can take the form of offering both a printed and online version of a textbook, creating lecture videos, or letting students join lectures via Zoom. One of the big changes I made to my course was to offer alternative ways for students to access course materials if they could not be physically present in class for any reason. I made attendance "mandatory," but students could either come to class in person or

complete asynchronous tasks that would fulfill the attendance requirement. This alternative attendance included participating in the weekly check-in (mentioned in the previous section), viewing a prerecorded lecture video with discussion questions (the same questions that I ask during in-person classes), and completing a revised version of the in-class assignment that students could do on their own. The prerecorded lecture videos were created in Zoom and uploaded to Kaltura, where I used the automatic closed-captioning feature to add captions and transcripts as an additional option for accessing the materials. The videos were then embedded into either the LMS or Top Hat (we tried both; ultimately using the LMS worked better). This alternative attendance option was available for every lesson, so students could attend the class completely asynchronously and still have access to all the same content as the students who attended class in person. Because I also teach an asynchronous section of this course each semester, I was able to use already created materials across all sections of the course (both in-person and online).

Although these changes meant that physical attendance was not strictly necessary, most students enrolled in the in-person sections still chose to physically attend class. Also, even though there was a slight uptick in absences (one or two more per class), previously those students would simply have missed out on that content. By offering this alternative way to "attend," students always had access to content missed in class and could easily make up any assignments they missed. The largest difference between the in-person and asynchronous sections (and, by extension, in-person students who completed the content of lessons online after being absent) was less student-to-student engagement.

Revisions to Action and Expression

The final area for revisions was in action and expression, or the ways students demonstrate their learning. The UDL framework suggests offering students choice in this area, such as by providing flexible submission options and types (Posey, n.d.). The assessments in the class were all designed as writing assignments, where students would apply the ideas from the course to their own work as an LA and support those ideas with references to our course readings. As a former writing teacher, I recognize the value of students practicing their written communication skills. However, this is not a writing course, and I do not believe that it is necessary to make written communication a graded part of my assignments. Therefore, students could submit their assignments in any format they preferred as long as they followed the assignment instructions. This resulted in alternative submissions that included PowerPoint slides, voice-over PowerPoints, video submissions, audio submissions, outlines, and even—in one notable case—a dramatic skit in which the student acted out his submission with the help of his roommate. To ensure all students felt comfortable with these alternative forms of submission, I included examples of such assignment types from previous semesters. Although it may seem as if the addition of these multiple modes of submission would make assessing learning more complicated, I created a rubric that emphasized the ideas and concepts discussed and how well students addressed the prompts of the assignment, regardless of the genre of submission.

Additionally, I offered flexibility with assignment due dates. Students could submit a form up to five times each semester to receive a 1-week extension on any assignment for any reason (they did not need to provide the reason). This could help with a variety of student issues: illness, family emergencies, travel, events with clubs or activities, mental health issues, or a heavy workload in other classes. This also sounds as if it would greatly increase the amount of time I spent on record keeping; however, this ended up saving me time as I rarely had to field student questions either in person or via email about whether absences could be excused, if they could turn in assignments late for full credit, or if they would be graded on grammar in addition to their ideas.

Purpose of the Qualitative Case Study

The purpose of this research was to examine my students' experiences of the changes to my course, specifically related to engagement, inclusivity, and belonging. Ultimately, I hoped to determine whether the UDL structure and educational technologies used would have a positive impact on my students' experiences in the classroom relating to my concerns. I based my study on the following research questions:

- How does the UDL structure of my course impact student experience, engagement, and feelings of inclusion and belonging?
- How do the educational technologies used in the course impact student experience, engagement, and feelings of inclusion and belonging?

Methods

To gauge the effectiveness of the UDL revisions, I designed a qualitative case study to address my research questions. I designed this case study using a pragmatic stance, which emphasizes the resolution of practical, real-world problems (Biesta & Burbules, 2003). In the context of my own class, these problems were student barriers to discussion-based participation, uneven engagement with course materials, and inequity in representing their knowledge. Following my pragmatic approach, I chose methods best suited to evaluating the revisions to my course that addressed these problems (Kaushik & Walsh, 2019). These methods included interviews, surveys, written reflections, and observations, which generated data that provided insights into student experiences related to the course revisions.

The case study utilized an embedded case design as described by Yin (2017), in which the same intervention is examined across multiple related cases within the same context. I collected data over two semesters and six sections (four in-person, two asynchronous) of my course, which allowed me to test my revisions with multiple groups of students and ensure that the outcomes would not be unique to any one set of students.

Researcher Positionality and Participant Context

It is important to note that I was both the instructor of record and sole researcher for these courses and therefore cannot be completely objective regarding the findings of this case study. There was also a power differential at play due to my position as an authority in the classroom. I tried to mitigate this power differential by making research participation anonymous and voluntary. I provided a small amount of extra credit points on one assignment for any student who wanted to participate in the research, but I also offered alternative ways for students who did not want to participate to complete the survey (also anonymously). Because I was the sole researcher, my perspective was the only lens through which the data were analyzed. In the future, I could include a second researcher as part of the study to establish interrater reliability with my coding scheme.

Additionally, in my teaching context, students are intrinsically and/or extrinsically motivated to assist their peers and receive instruction on the UDL framework and many aspects of teaching and learning, which may skew the results when considering generalization. The coding scheme and themes in a non-LA course could modify (and perhaps expand) the findings. Finally, the students in each section of my course were from a particular set of identity characteristics and cultural groups. Although each section contained a different group of students characterized by their own set of identity

characteristics, follow-up studies with a broader range of identities could also modify (and perhaps expand) the findings.

Data Collection

Over two semesters, 44 students completed a 16-question survey (see Appendix 1) distributed via an anonymous link at the end of the semester to determine their experiences and perceptions of the UDL course changes and educational technologies used in the course. At the end of the survey, students could opt in to be contacted for a follow-up interview. So far, two students have participated in semistructured interviews that were conducted via Zoom and recorded with permission (see Appendix 2). I also included responses to my institution's end-of-semester Student Ratings of Teacher Effectiveness (SRTEs; see Appendix 3) to see if any responses provided information related to my research questions. Finally, I collected my own reflections on my teaching and student interactions both in and out of class.

Data Analysis

Once the surveys and interviews were complete, I transcribed the two interviews and input all student data into Nvivo qualitative coding software. After reading through the responses, I analyzed the data inductively and assigned open codes. Whereas some codes were pulled directly from language within open-ended questions and interview transcripts, other codes were categories based on my experiences and observations. These initial codes included "ability to choose," "multiple ways to submit," "flexibility," "anonymity," and "anxiety," as well as codes related to educational technologies: "Top Hat," "videos," and "alternate assignments." This process is shown in the first and second columns of Table 1. Then, I refined the codes, discarding those that were not related to my research questions, using axial coding methods. For example, "flexibility" was included under "ability to choose" and individual technologies were all included under "educational technologies," as seen in Column 3 of Table 1. Finally, in my third round of coding, I combined relevant codes into two major themes, illustrated in Column 4 of Table 1. This three-round coding process resulted in two themes from survey and interview data.

Table 1. Examples of the three-round qualitative coding process.

Example	Round 1: Open	Round 2: Axial	Round 3: Themes
"It was nice to know that if I did not want to type I could do a video or audio recording."	Video; educational technologies	Ability to choose	Ability to choose
"I feel that having multiple ways to ask/answer questions and make comments is the most important practice. This is because many students often feel too intimidated to attend office hours or approach the front of the classroom. Having the	Ability to choose; Top Hat	Ability to choose; educational technologies	Educational technologies

Example	Round 1: Open	Round 2: Axial	Round 3: Themes
ability to interact in potentially anonymous ways would make student questions much more open and inclusive."			
"Flexible late penalties and extension forms seem most important to me because as a student having multiple assignments due within days of each other can be very stressful. Having an option to get an extension of even one of these assignments and knowing there's always a backup plan relieves my stress."	Flexibility; anxiety	Ability to choose; anxiety	Ability to choose
"It helped lift the stress from needing to follow strict guidelines. I usually feel the need to compulsively check that my assignments are completed in an exact structure, so the freedom here was unique and felt reassuring."	Anxiety; alternate assignments	Alternate assignments	Ability to choose

Additional insights came from reflections on the LAs and my interactions and experiences with students both inside and outside of the classroom, which I coded separately using the same methods. In my teaching reflections, after each class I recorded what went well, what could have gone better, and what I wanted to change in future iterations of the course. Additionally, I included notes on student interactions in and out of the classroom (particularly during office hours and other one-on-one conversations) and notes from weekly meetings with the LAs who work in my class. I coded the data using the same three-round process, which added an additional two themes to my data analysis for a total of four themes.

Findings

Student Responses: The Importance of the Ability to Choose

Throughout the survey, comments on the ability to choose were woven into more than 60 open-ended responses. When asked what aspects of the course structure to keep in future iterations of the course, 20 students offered open-ended feedback on the options available. These findings were mostly related to student engagement and inclusion, which were addressed by this aspect of the UDL revisions of

the course. Some students connected the options to the content: "The content was interesting and helpful, and I liked the options that we had." Other students really liked the options for submitting assignments: "Multiple submission abilities. It made it so fun completing assignments." Interestingly, two students commented that they never used any of the alternative options but appreciated that they were available if they needed them: "I did not use these [alternative] options, but knowing I had the option to go a more creative way felt very inclusive." These comments are representative of many others; open-ended feedback was consistently positive across any question focused on the variety of options available to them as part of the course.

A common subtheme was that the multiple options made students feel welcomed, included, and less anxious in the class. This idea was threaded through responses to multiple different questions. The words "welcome," "included," "comfortable," or "safe" appeared 24 times in the responses, and the various choices were mentioned when talking about relieving anxiety and stress 16 times. These responses often included references to people in the class, not just the UDL structure of the course. Some students talked specifically about me as the instructor. One student remarked, "Ms. Fleming is very welcoming, understanding, and flexible with her students." Another similarly wrote, "Prof. Fleming is very inviting and welcoming. She created a very safe judgement free environment." One more commented, "I am so fortunate for having to take this course. Ms. Fleming did an amazing job and I genuinely liked coming to class every week." Students also commented on the teaching team (me and the class LAs). One wrote, "I felt like the teaching team wanted me to succeed and didn't put unrealistic pressure on their students." Another mentioned that "the teaching staff was very nice." There were no questions on the survey that asked about me or my LAs; these comments were made without prompting.

Student Responses: The Impact of Educational Technologies

Students had a lot to say about how educational technologies were utilized in the course, and many of their comments were about how those technologies were used to offer choice and improve both engagement and inclusion. The most popular technology used in the class was Top Hat for answering questions anonymously, but students took advantage of many of the educational technologies in the course:

- 88% of students indicated that backchannel chat in Top Hat made them more likely to participate in class discussions
- 36% of students said that they viewed class recordings to remind themselves of what happened during class at least once during the semester
- 61% of students said they viewed class recordings to replace attending class at least once during the semester
- 34% of students said that they submitted at least one assignment in a "nontraditional" format (e.g., a slide deck, outline, video or audio recording, etc.)

In addition to asking how students took advantage of the choices offered by educational technologies, I also asked about which they would be most likely to use (or suggest to their instructor) in their own work as learning assistants. In response, 82% chose "multiple ways to ask/answer questions and make comments" (using Top Hat) as a practice they would consider implementing into their own work as LAs. When asked why, 11 students included open-ended comments with explanations. Comments were similar regarding why they thought this practice was important. One student connected this practice with inclusivity:

> I feel that having multiple ways to ask/answer questions and make comments is the most important practice. This is because many students often feel too intimidated to attend office hours or approach the front of the classroom. Having the ability to interact in potentially anonymous ways would make student questions much more open and inclusive.

Another student thought about the implications for active learning: "Multiple ways to ask questions because I want to promote an active learning environment." And another just wanted students to feel comfortable: "I feel the multiple ways to ask questions feature is the most beneficial to students because this ensures that every student is able to express their concerns in a way that makes them comfortable."

The second most chosen practice, which 46% of students would consider including in their own work as LAs, was required office hours with in-person, Zoom, scheduled, and drop-in options. There were nine open-ended responses on this topic. On student suggested that office hours help them know if a student is struggling: "I like the idea of required office hours. I think with the web class I am in now where the LA's aren't available after class, it can be hard to know when a student is really struggling or not so that idea for web classes is a great idea." Another student saw it as an area for connection, writing, "I would like [to use office hours] to connect with the students more." And finally, one student suggested that office hours would be beneficial even if a student does not need help with course content: "I think requiring office hours can be helpful for students because people don't usually know everything. Even if someone has not lost a single point the whole semester, I think that just going can help, even if it is not related to the course material."

Instructor Observations: Increased Participation and Engagement

When coding my own class and student interaction notes, a prevalent theme that emerged was increased student participation and engagement as a result of the UDL revisions to the course. Over two semesters of notes, I made comments related to this theme 14 times. The subtheme I commented on the most was discussion responses using the anonymous Top Hat chat. At one point in early spring 2023, I wrote: "Last year at this time I was lucky if 3-4 students were raising their hands each class period. This semester, most students are answering EVERY QUESTION. I think it might be around 90% participation on every single discussion question I ask during class." At another point in my notes, I commented:

> I started picking out one or two anonymous responses to each Top Hat question and asking if the poster would be willing to expand on their comment or offer further clarification. In the past two weeks, every time I have asked except for one time the student was willing to become "un-anonymous" and add additional context to their response. Sometimes, this even means that students talk to EACH OTHER!

The rest of the notes related to this theme included similar ideas, documenting my observations of student participation during in-class discussion.

Instructor Observations: Belonging

Although I did not use the word "belonging" in my notes, many of my comments indicated increased levels of student connection with me and my LAs compared to previous semesters. These comments—which appeared 35 times in my notes—were all centered on student interactions outside

of class (before/after class or during office hours). When coding this category, I kept in mind the definitions of belonging mentioned previously: I looked for evidence of connection, perceived support, and students coming to the teaching team to talk about issues other than class content (Lu, 2023; Strayhorn, 2019; Walton & Cohen, 2011). My notes included the following numbers:

- four students who came to me with requests, questions, or concerns about graduate school applications
- three students who had questions about other areas of university life that had nothing to do with my class
- six students who wanted to tell me more about their personal lives and home cultures
- four students who showed up to my drop-in office hours "just to talk"
- six instances where my LAs noted students either seeking them out more often than they had in the past or coming to them with questions about content not related to the course

Additionally, over the past year, seven students came to me with sensitive issues and problems involving their LA assignments that I was able to either help them navigate on their own or elevate to someone higher in administration who could address the problem.

One final area where I found indications of belonging was in the asynchronous student check-ins. During office-hours conversations, five students mentioned that they enjoyed the opportunity to check in, report on their work as an LA, ask questions, and discuss areas for improvement since they could not be physically present in class to discuss these issues. All five also commented that they appreciated the individual responses from the teaching team.

Discussion and Implications

My examination of student data and my own observations were guided by my research questions, which asked how the technology-supported UDL structure of the course might impact student experience, engagement, and feelings of inclusion and belonging. The data indicate that all four of these important aspects of student success were positively impacted by the revisions to my course.

Student Experience

One of the first things I was interested in studying when I implemented the UDL revisions to my course was my students' experiences. I was pleased to find that the overall student feedback on the UDL revisions to my course and educational technologies I added was overwhelmingly positive. Of all student feedback across both my surveys and my SRTEs, there were only three negative comments about any aspect of the course, and none of those three comments related to the UDL framework or technologies (all three were about course workload). This indicates that, overall, student experiences of these course revisions were positive.

Engagement and Inclusion

Engagement was where the inquiry into my teaching practices began, and I observed increased engagement in multiple areas of the course revision: discussion, office hours, and check-ins. I was most surprised by both observed changes and student response to class discussion. I anticipated some increased engagement during discussion, but the degree of that increase was unexpected. The types of questions I was asking and the complexity or sensitivity of the topics did not change; the only change

was in the offering of options (traditional "raise hand to answer" or type anonymously in Top Hat). My observations and student feedback support the idea that both the options (based on the UDL framework) and the educational technology used (Top Hat) were responsible for increased engagement in this area. This is in line with the previously cited literature on barriers to discussion participation (Demissie, 2020; Ozment, 2018); the anonymous format of the online discussion responses allowed for all students—regardless of confidence, anxiety, English language proficiency, or personality type—to participate fully and equitably in class discussion. Additionally, more students felt comfortable speaking out loud in class as a result of positive feedback to their anonymous posts online. As mentioned earlier, when I asked for specific anonymous posters to elaborate, comment on, or answer a question about a post, most of the time the student would speak up to claim their post and add to it. This meant that more voices (not just words and ideas on the screen) were engaged in class discussion.

This level of engagement is also an indicator of feelings of inclusion: Students need to feel both welcome and safe to participate in class discussion. Additionally, since most definitions of inclusion involve feelings of welcome and safety (Addy, 2021; Cook-Sather et al., 2021; Gamrat, 2022), that those words (plus "included" and "comfortable") appeared in so many student responses indicates that multiple areas of the course revision positively impacted student inclusion.

Belonging

Since my students did not have a common definition for belonging in the classroom, I worried that it would be difficult to determine whether the UDL revisions and technologies impacted feelings of belonging in the classroom. However, I found plenty of evidence of increased feelings of belonging in both student responses and my own observations, particularly when considering the most common definitions for student belonging found in the literature: that belonging is closely tied to connection, support, positive relationships, and feeling as though one has someone to go to when one needs help or feels disconnected (Lu, 2023; Strayhorn, 2019; Walton & Cohen, 2011). There were two main areas where I saw this occurring: my own experiences meeting with students one-on-one both inside and outside of the classroom, and student interest in required office hours.

As previously mentioned, I required students to attend office hours in previous classes. However, the number of students who scheduled or dropped in to my office hours ready to discuss specific things unrelated to the coursework in my class shocked me. Although I feel that my teaching has improved over the years, I do not believe that it has improved so much as to account for this increase; therefore, the UDL structure and technologies implemented are likely to have been contributing factors. I believe that the UDL revisions and educational technologies added did more than just change my course: They signaled that I cared about my students and their learning. As a result, more than in any previous year of teaching, I was able to help students navigate complex university processes, review graduate school personal statements, and assess resumes for internships. Despite teaching a one-credit course that meets only once a week for 7 weeks, I was asked to be a reference or write a recommendation eight times in the past year—sometimes over other faculty members of three-credit, discipline-specific courses where they spent far more time. This is in line with what I see as one of the most important aspects of belonging: Students felt comfortable with and connected to me enough that they saw me as someone they could trust to help them when needed (Lu, 2023).

Even more exciting for me was the student feedback on why they believed required office hours would benefit the students in the course where they are an LA. Again, even though students were not explicitly given a definition of belonging, that three of the nine open-ended comments included aspects of student belonging is encouraging. This indicates that the structure of my course

and the technologies I implemented did more than just increase belonging in my students; they also had an impact on how my students planned to interact with their own students in the future.

Application in Other Courses

Although the revisions I made to my course were tailored to my specific teaching context, anyone teaching in any discipline could adopt some or all these practices in their own courses. Some would need to be adapted or abandoned in certain contexts (e.g., larger enrollment courses, assignments that require a specific type of submission, limited or lack of availability of technologies, etc.). However, I believe that students in any course would benefit from adding even one additional choice to one assignment or pedagogical practice, and there are plenty of free technologies that could be substituted. Any of these practices have the potential to benefit student engagement, inclusion, and belonging. This less comprehensive type of course revision is supported by the literature; research has indicated that the "plus-one" approach to implementing the UDL framework can positively impact student retention, satisfaction, and motivation in the classroom (Tobin & Behling, 2018). Table 2 summarizes the revisions made and educational technologies used in my course related to each principle of the UDL framework.

Table 2. UDL revisions, educational technologies used, and alternative technology options.

UDL principle	Revision	Technology used	Alternative technology option
Providing multiple means of engagement	Synchronous anonymous discussion; required office hours with multiple options for meeting; virtual check-ins for students not physically present in class	Top Hat; Zoom; VoiceThread; Canvas LMS	Padlet; Google Jamboard; Google Docs; Microsoft Teams; Google Meet; video assignment in any LMS, instructor video responses
Providing multiple means of representation	"Mandatory" attendance with options for asynchronous participation	Zoom, Kaltura, closed captions, and transcript	Record using any video recording app (even your phone!), post to LMS or YouTube using their auto-caption feature
Providing multiple means of action and expression	Flexible assignment submissions; flexible due dates	PowerPoint; Google Slides; YouTube; cell phone recording apps; Kaltura; Zoom; Adobe Premiere Pro (and many more); Google Forms	Any free or institution-supported technology—let students get creative! Survey Monkey; Microsoft Forms

Note. LMS = Learning management system; UDL = universal design for learning.

Future Directions and Conclusion

Researchers have studied how the UDL framework impacts diversity, equity, and inclusion (Burgstahler, 2020; Dalton et al., 2019; Edyburn, 2011; Fritzgerald, 2020; Takemae, 2022), but there is more to be studied regarding how this framework has an impact on belonging in the classroom. Some or all the technologies and pedagogical strategies based on UDL in the classroom that were utilized in this case study could be implemented in other classrooms regardless of discipline, but future research is needed to determine students' personal experiences of belonging when they have a shared definition of the term. In future iterations of my course, I plan to incorporate definitions of engagement, inclusion, and belonging into the curriculum, and I will add a more targeted question to student surveys to gain better insights into how students experience these feelings as a result of the UDL structure of my course. I will also differentiate between in-person and asynchronous students when evaluating survey results to see if there are differences in student experiences based on course modality.

This case study provides one example of how choice and flexibility in the classroom can have a positive impact on student experience, engagement, and feelings of inclusion and belonging. Choice and flexibility were incredibly important, but none of the revisions would have been possible without numerous educational technologies. Although the research presented here is promising, I hope that more faculty who utilize a technology-supported UDL approach will examine and report on how it impacts student belonging in their classes.

Appendix

Appendix 1. Survey Questions

1. How many IST 389 classes did you attend in person during the Spring 2022 semester? [Response was on a slider bar numbered from 0 to 7]
2. To what degree did you utilize the following virtual attendance options within the course?
    a. Viewing class recordings to replace attending class [Response options: every week, at least once every two weeks, 1-2 times during the semester, never]
    b. Viewing class recordings to remind myself what happened in class [Response options: every week, at least once every two weeks, 1-2 times during the semester, never]
3. To what degree did you utilize the following engagement and assignment options within the course?
    a. Top Hat class chat for anything other than pre-class questions [Response options: every week, at least once every two weeks, 1-2 times during the semester, never, not applicable – asynchronous student]
    b. Submitting assignments in any format other than a written submission [Response options: every week, at least once every two weeks, 1-2 times during the semester, never, not applicable – asynchronous student]
    c. Submitting any part of the Capstone Assignment in any format other than a written submission [Response options: every week, at least once every two weeks, 1-2 times during the semester, never, not applicable – asynchronous student]
    d. Contacting the instructor to receive an extension on an assignment [Response options: every week, at least once every two weeks, 1-2 times during the semester, never, not applicable – asynchronous student]

    e. Turning in an assignment late [Response options: every week, at least once every two weeks, 1-2 times during the semester, never, not applicable – asynchronous student]
4. Did you appreciate the variety of options available for submitting assignments in this course? [Response options: yes or no]
5. Why or why not? [Open ended]
6. If you attended class in person, did the availability of the Top Hat chat make you more likely to participate in class discussions? [Response options: yes, no, I participated in class asynchronously]
7. Why or why not? (if you are an asynchronous student, write "asynchronous" below) [Open ended]
8. How would you rate your overall experience in this course? [Response options: very positive, somewhat positive, somewhat negative, very negative]
9. Why did you choose that experience rating? [Open ended]
10. Are there any specific aspects of this course that you believe the instructors should **continue** including in the course for future students? [Open ended]
11. Are there any aspects of this course that the instructors should **change** for future students? [Open ended]
12. Consider the following elements of IST 389. Which of these do you imagine you might use in your work as a learning assistant? Check all that apply. [Response options below]
    a. Multiple ways to complete/submit assignments (i.e., submissions as text, PowerPoint, audio, video, outline, etc.)
    b. Multiple ways to ask/answer questions and make comments (i.e., raise hand to talk and type in Top Hat)
    c. No attendance policy
    d. Flexible late penalties/form to request extension
    e. Required office hours
13. Of the elements you chose, which feels most important to your practices as an LA and why? [Open ended]
14. Which of these elements might you suggest to your instructor as an option for the class where you are an LA? Check all that apply. [Response options below]
    a. Multiple ways to complete/submit assignments (i.e., submissions as text, PowerPoint, audio, video, outline, etc.)
    b. Multiple ways to ask/answer questions and make comments (i.e., raise hand to talk and type in Top Hat)
    c. No attendance policy
    d. Flexible late penalties/form to request extension
    e. Required office hours

Questions 15 and 16 were added in the second semester of data collection.

15. Did the elements of the course in the previous question increase your sense of inclusion and/or belonging in the course? [Response options: yes or no]
16. Why or why not? [Open ended]

Appendix 2. Interview Questions

1. Do you think student choice–offering multiple options to students–in learning is important? Why or why not?
2. [Show list of UDL choices in IST 389] As a student, what specific choices did you appreciate most in IST 389? Why?

3. If given the opportunity, what choices in the class might you suggest to the instructor in the course where you are an LA? Why?
4. Is your experience as a student different than your expectations as a teacher? If so, why?
5. Is there anything about how IST 389 is structured that you have applied to your own work as an LA? Why? If not, is there anything you might apply in the future?
6. We learned about both UDL and becoming an inclusive learning assistant in class [check in to make sure they remember these lessons before proceeding; offer short summary if not]. Do you think there is a connection between UDL and inclusivity in the classroom? Why or why not?

Appendix 3. Student Rating of Teacher Effectiveness Questions

1. Are you taking this course as an elective? [Response options: yes, no, I don't know]
2. What grade do you expect to earn in this course? [Response options: A, B, C or lower]
3. Rate how well this course increased your understanding of the course topics. [Response options: numbers 1–7 with 1 being the lowest rating, 4 being the average rating, and 7 being the highest rating]
4. Rate how well the instructor promoted a meaningful learning experience for you. [Response options: numbers 1–7 with 1 being the lowest rating, 4 being the average rating, and 7 being the highest rating]
5. What aspects of this course helped you learn? [Open ended]
6. What changes to this course could improve your learning? [Open ended]

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