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Orientation and Social Inclusion: Supporting Students with Visual Impairments in Active Learning Classrooms

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The percentage of undergraduate students in the U.S. who report a visual disability is over 3.5%, and worldwide over a billion people claim a significant visual impairment. As more higher learning institutions build Active Learning Classrooms (ALCs), it's critical to understand how these students experience such a different style of learning environment. Although many students do not register their visual impairments at the college level, this report examines students who sought disability accommodations in their ALC classes to help them succeed. This paper identifies two dimensions, divided into 10 factors, of the learning experience in these classrooms and how students faced the challenge of these environments. To improve the future learning experience for these low-vision students, a list of pedagogical recommendations is included.

In contrast to traditional lecturing, active learning pedagogies have been shown to improve learning outcomes for all students on average (Freeman et al., 2014) and have been found to offer disproportionate gains for underrepresented minority and low-income students (Theobald et al., 2020). The original Active Learning Classrooms (ALCs) were designed in the mid-1990s to reform science teaching and create an optimal space where students could engage in active learning activities (Knaub et al., 2016). ALCs were also built with shared working spaces to take advantage of collaborative learning that also was shown to improve learning outcomes (Smith et al., 2005).

This new style of classroom was a sharp departure from the typical lecture hall that characteristically includes stadium seating and often has a broad stage with a long whiteboard. Most of these lecture halls include some kind of projection system and screens that the lecturer controls. Although instructors have successfully employed active learning strategies in these classrooms, the ALCs were intentionally designed to make active learning easier to enact with a seating arrangement and learning tools that help students collaborate and to promote active learning. Since the focus with active learning is less on the instructor delivering a lecture than on the student engaging with the content and her peers, the ALCs do not call for tiered seating and instead use moveable chairs at tables. With this seating configuration, students face each other and have greater table space for their laptops and class materials. Tables in the larger rooms typically have microphones for large class discussions and call buttons to request assistance. Generally, each table has its own whiteboard so students can work collaboratively or display their group's work. These rooms look vastly different from a lecture hall, and, to someone who is unaccustomed to this setting, the ALCs may be a surprise.

Research has shown that ALCs create superior conditions for students to learn using active learning and that they have a positive impact on student learning outcomes (Baepler et al., 2014; Baepler et al., 2016; Brooks, 2011; Talbert & Mor-Avi, 2019; Walker et al., 2011). Students often perceive these benefits and recognize the alignment between the classroom layout and the participatory pedagogy in their courses (Holec & Marynowski, 2020). The space also affects instructors' behavior. Even when they explicitly tried to replicate their lecture style in ALCs, instructors spent more time interacting with students and less time speaking at the podium (Whiteside et al., 2010). The configuration of the learning space matters for both teaching and learning.

This fundamentally different space, however, can create unintended challenges for students with disabilities. For students who have a visual impairment, for example, the ALCs can be daunting. When a low-vision or blind student who had been expecting a familiar auditorium instead encounters an ALC, she might encounter it as a "black box" whose topography and obstacles are unfamiliar and perhaps daunting. They could perceive the large tables and scattered chairs in an ALC as an obstacle course. Although some students with disabilities welcome the change and value the chance to collaborate, the new classroom environment

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Figure 1. A smaller active learning classroom (ALC) with seating for 45 students. Tables are fixed to the floor, but the chairs are mobile. The projection screen lowers in front of the closet door (at center).

comes at a cost that researchers are only beginning to understand.

As a greater number of ALCs enter the higher education classroom inventory, it's imperative that we comprehend their impacts on students with disabilities. This study seeks to add to our understanding of how students with disabilities navigate ALCs and how they believe the room supports or disrupts their learning. Although recent research has contributed to our knowledge about how students with disabilities engage with active learning techniques (Gin et al., 2020), we have little understanding of how these students view the new physical space that is defined by ALCs and these classrooms' contributions or restrictions to their learning (Baepler, 2021). This study adds to our understanding by focusing on students with visual impairments, though it should be noted that low-vision students share some of the same challenges as those who have mobility impairments. For instance, those students who have a visual impairment may not have specific mobility impingements, but they might nevertheless have to move about a new space with greater caution, especially as they are learning the layout of the room. The research question for this study is: How do students with visual disabilities believe active learning classrooms support or disrupt their learning?

Students with Low-Vision Disabilities in Higher Education

The 2019 Annual Disability Status Report based on the U.S. Census Bureau's American Community Survey described the prevalence of disabilities in the noninstitutionalized population within the United States. They reported that 2.3% of this population described themselves as having a visual disability (2019 Disability Status Report: United States). The picture in higher

education is slightly different. Overall, 19% of U.S. undergraduates report some form of disability (U.S. Department of Education, 2019). The American College Health Association (2002) surveyed over 70,000 students to assess the health of college students in the United States, and 3.5% reported themselves to be blind or to have low vision. More broadly, according to the World Health Organization (2022), more than a billion people have a moderate or severe vision impairment or are blind.

The broader category of visual disability can obscure the range of experiences that these students live. Those who are visually impaired might have near- or far-sightedness that may or may not be partially corrected with lenses. Those who are considered visually disabled present a broad range of conditions, such as visual acuity loss, reduced contrast sensitivity, or visual-field loss that results in a reduction in central or peripheral vision (Ferreira & Sefotho, 2020; Owsley & McGwin, 1999). Students who experience low vision may be able to see writing and screens when the content is enlarged or when they are very near a text or image. Their university peers may not initially recognize them as disabled, and some students who are visually impaired may prefer not to disclose their disability. They may fear stigmatization or feel embarrassed by special treatment. Like most students, they may want to control how they are viewed by their peers and to preserve the benefits of what they perceive as a "normal student identity" (Grimes et al., 2019; Hartman-Hall & Haaga, 2002).

Visually impaired students experience a range of academic and social barriers in a variety of classroom settings and across teaching approaches (face to face, online, hybrid, etc.). For example, students reported difficulty with reading in general as well as experiencing eyestrain and headaches in connection with poor lighting and computer work. Particularly pertinent to the current study, they also reported challenges reading projected presentations (PowerPoint) and found the distance to the professor to be a barrier to learning (Reed & Curtis, 2012). These are important findings in the context of ALCs because ALCs: (a) often include table-adjacent displays that mirror classroom presentations, and (b) are designed so that instructors can walk among the tables and reduce the distance to students.

Some visually impaired students felt it difficult to be accepted or welcomed by their peers (Lourens & Swartz, 2016). Reed and Curtis (2012) noted this social barrier can become particularly relevant in the classroom when peer collaboration is required: "Work in groups was also identified as a barrier for some students. In addition, the students stated that socially they have difficulty participating in group activities and believed that students without disabilities are nervous around them" (p. 423), a finding confirmed by Firat (2021). Again, this observation is critical to the current study because collaborative work is frequently a key pedagogical strategy in ALCs. The natural classroom division by table reinforces small group participation.

Additional challenges for visually impaired students included institutional provision, external student support, attitudes of academic staff, timely availability of written material, students' attitude, and an overreliance on visual teaching methods (Ajaj, 2020; Bishop & Rhind, 2011; Frank, McLinden, & Douglas, 2014; Reed & Curtis, 2012). These specific challenges are independent of the built environment that can be out of date and ill equipped for all learners. As Penrod (2023) argued, teaching facilities, in general, don't make provision to be inclusive, even when adapting space to new delivery modalities:

> Classrooms at many institutions are outfitted with low-cost and low-quality technologies such as boundary microphones and web cameras. Institutions then label these classrooms as "HyFlex" or "hybrid" spaces without a true understanding of the concepts associated with that type of learning. Additionally, the physical spaces themselves are frequently outdated, with inaccessible furniture, touch panels, podiums, and audio-visual equipment. To make matters worse, most institutions have been limited in their ability to address outdated technology and learning space issues after the pandemic due to declining enrollments and budgeting problems. (Assessing section, para. 4)

Methods

Because there is currently little research on students with disabilities and how they interact in ALCs, this study was exploratory and designed to inform future investigations into this experience. This study examines the experiences of students with visual impairments who completed courses in large (50-130 students) classrooms.

This study ran over four semesters, beginning in the spring of 2019. The study site was a large land grant institution in the Midwest and was conducted under the guidance of its Institutional Review Board (Study 00002834). Purposeful sampling was used to identify participants who were recruited via email from both the institution's Disability Resource Center and instructors who had been teaching courses in large ALCs. To be eligible for the study, students had to meet two criteria: They had to (a) have completed at least one course in an ALC and (b) have a documented visual disability. The selection pool was unrestricted and included students who had documented disabilities that were not visual in nature. They were also interviewed, though their data was not included in this study.

As part of the recruitment letter, students were told the purpose of the study and sent a photograph and a written description of a representative active learning classroom in case they were not familiar with the terminology. Those who showed interest in participating were sent the interview protocol so they could determine if they wanted to be interviewed. They were also sent the study's consent form at that time. Potential recruits responded directly to the researcher. Three students met both selection criteria and described a range of visual impairment from blind to low vision. All interviews were conducted in person.

Data Collection

Although there is growing research on how active learning techniques impact students with disabilities, little has been written about how the built environment of active learning classrooms affect this population. To explore this interaction, semistructured interviews were conducted to explore how students with diagnosed disabilities, particularly students with vision loss, experienced the ALCs. Interviews began with the collection of demographic data. An enlarged photograph of an empty ALC was projected to help the student focus on the affordances of the classroom and the particularities of the space. For the student who was completely blind, a description of the room was read aloud and restated mid-way through the interview. The interview items concentrated on the space rather than the details of the impairment. To reduce confusion in the wording of the items, think-aloud sessions were conducted with two undergraduate students, and items were edited to reduce ambiguity.

At the start of the interview, students were asked about the accommodations they requested, those that they received, and those that they wished they had now that they had had the experience of learning in an ALC. Items drew upon the particular aspects of the rooms that make them unique, including the round tables, microphones, call buttons, seating, whiteboards, screens, and the layout of the room (e.g., unlike a traditional lecture hall, the ALC has no tiered seating.) To explore the student experience, participants were also asked about the secondary characteristics of the space, including the effects of not necessarily facing the instructor, how sound carried in the room, the luminosity and quality of the light, and the fluid arrangement of chairs on casters.

Completed interviews were transcribed, and in two cases, follow-up questions were asked over email. Statements regarding the ALCs were separated into those that found benefits in ALCs, those that described challenges of ALCs, and those that were either descriptive or neutral in regard to ALCs. These statements were further categorized to describe interactions with the affordances of the space, with other students, or with the instructor.

Participants

Students were invited to participate in the study through a broadcast email from instructors who taught in ALCs and the institution's Disability Resource Center. Those who contacted the researcher directly were provided with a longer description of the investigation along with a consent form to view in advance of agreeing to participate. Students were also sent the interview questions in advance in order to make a more informed decision about their participation and to allow them extra time to think about how they might want to answer a question before engaging in the conversation. Students who were selected for the study received a $25 Amazon gift card upon completion of the interview.

Since the students were all informed that their identities would remain anonymous, pseudonyms were assigned to each of the three who were selected for the study. All participants had declared majors in STEM fields. All participants had taken courses in large ALC rooms with capacity for more than 100 students. Each had worked with the Disability Resource Center and sought and received accommodations from their instructors. All three participants self-identified as White.

Ali was a sophomore majoring in Biochemistry. He described himself as having a vision impairment due to a genetic disorder. His vision allows him to see at close distances when colors are contrasting. Reading from a whiteboard for him can be challenging, particularly when the colors are anything other than blue or black or the whiteboard is distant from where he is sitting. He was able to walk without assistance of a cane or assistant, so it was possible for him to not disclose his vision loss in some instances, especially when feeling "shy" in new settings and with strangers. For his coursework, he discloses his disability with the instructors and accepts assistance from the Disability Resource Center. His accommodations included receiving slides and handouts in advance; he was also loaned a webcam that he could use to zoom into any part of the class to see that person or activity better. He has taken both Biology and Math courses in large ALCs. He described himself as being Middle Eastern.

Franny was a Chemistry graduate student and hopes to teach at the college level. She described herself as blind. She walked with a cane and accepted the help of an access assistant during classes. Her accommodations included the receipt of any class materials and slides before the class. She also asked for transcriptions of videos that were shown as part of the instruction. She took an education course in a medium-sized ALC. She described herself as Middle Eastern.

Figure 2. A large active learning classroom (ALC). Note the potential challenge of navigating among the tables and chairs.

Sydney was a Food Systems major and a junior, having transferred from a community college after two years. She described herself as blind. Her accommodations included assistance moving in the classroom with aid either from the instructor or another student. During small group work, the instructor required sighted students to join her group rather than compel her to walk to a different table. She had taken courses in sustainability and urban agriculture in ALCs. She described herself as White.

Results and Discussion

Student comments are divided into two dimensions which are separated into 10 factors and reported below. Recommendations for improving the classroom experience for students with vision-related disabilities follow these findings.

Dimension 1: Orientation

Many people with visual impairments take "orientation and mobility" training to help themselves become independent or interdependent as they move through their environment (Long & Giudice, 2010). Because even sighted people can be confused or surprised by the space when walking into an ALC for the first time, the concept of orientation is particularly helpful. In his text on teaching orientation and mobility skills to visually impaired people, William Henry Jacobson (1993) provided a useful definition of orientation as "the ability to use one's remaining senses to understand one's location in the environment at any given time" (p. 3). Remaining senses, in this case, typically means tactile, auditory, and residual visual senses. People with visual impairments rely especially on these senses to glean spatial awareness. With low sight or no sight, they must rely

on a different set of sensory impressions to organize and make sense of the space.

To make the ALC useful, students with visual disabilities need to orient themselves to this unknown space and feel secure in the environment. They need to be able to map the space, know their current position relative to important landmarks in the room such as the instructor, the doors, their seat, their friends, and their proximal classmates (Giudice, 2018). They also need to adapt when changes occur, such as when tables and chairs are moved between classes or students change seats or an instructor moves about the classroom with a wireless microphone. This adapting is difficult because it requires making inferences with imperfect information about a new layout configuration of the classroom. What might be dynamic pedagogical choices for instructors in ALCs—for instance, moving around the room while lecturing or asking students to engage in a gallery walk—becomes a major set of challenges for a learner who is trying to reorient herself to a shifting environment.

While orientation refers to recognizing one's location in space, *navigation* refers to both the ability to move through space (mobility) and the ability to imagine a room and one's interactions within it (spatial cognition; Ahmadpoor & Shahab, 2019). Classrooms with well-defined structures and paths, such as traditional lecture halls with fixed seating, can be imagined and navigated more easily than a less familiar space with mobile seating, tables irregularly spaced, and the elimination of a clear focal point where a teacher would normally remain through most of a class session. Some spaces, because of their predictability, convey information that confirms previous mobility experiences in a classroom, and these spaces are easier to navigate than those that are both new and mutable (Guidice, 2018). Orientation and navigation are critical skills that visually impaired students need to rely on when making sense of any space.

The dimension of Orientation is divided into seven factors: First Impressions, Round and Moveable Tables, Variations in Seating, Moving Through the Room, Sound, Table Focus, and Screens and Whiteboards.

First Impressions

With hours of experience in traditional classrooms, students and instructors alike are frequently intrigued when encountering an ALC for the first time. The mobile furniture, whiteboards, and screens immediately suggest they will engage in a different type of learning experience. For students with a visual impairment, however, the reaction can be more jarring. Franny described her first impression, "The first time I go it's like a black box…but then it kind of comes alive." Sydney had a similar reaction: "The [ALCs], you never know what's where. I just kind of imagine this big room with all these round tables with no concrete idea. It does not really hinder me, but it makes me uncomfortable to move about the space." These descriptions suggest visually impaired students may be disoriented. In Jacobsen's (1993) terms, this means that their remaining senses might not provide sufficient information for them to understand how they will move through the space and feel secure. They'll need to decide where they should sit, locate where the instructor teaches, and define a route to leave the room quickly. These issues contribute to a sense of disorientation and the reason why the room could initially feel like one is staring into a "black box."

To reduce the challenge that the surprise configuration of an ALC presents to low-vision students, instructors or staff in Disability Resource Centers should provide illustrations and written descriptions of the room in advance of the first day. Allowing students to get a sense of the layout of the room in advance of actually having to navigate it may reduce the anxiety of the first meeting. Even providing these materials after the first class may be helpful, as students may still have questions about parts of the room they have not explored or want confirmation about what they have encountered.

Round and Moveable Tables

Moving students from fixed stadium seating to moveable chairs and tables is a key change that underlies ALC designs. Tables provide both a shared space for students to work as well as a defined area that compels students to face each other, a key principle in cooperative learning. In many variations of ALCs, the tables are round, especially in larger classrooms, and can accommodate nine students or three groups of three, convenient numbers for small and large teams (Beichner et al., 2007). With a classroom that is already difficult to imagine for a vision-impaired student, the round tables add to the disorientation because there are fewer tactile clues, such as the table's corners, by which to orient oneself. Sydney described the confusion: "With the traditional lecture hall, I know the orientation of the room, but with the round tables, there could be anything anywhere." She added, "The tables are constantly moving and shifting, like they're kind of always in the general spot but every time I came in the room, they would be moved." In this example, she's referring to the compounded problem of round tables on wheels that may shift position during the course of the day as different classes move them in different configurations. Sighted students can easily adjust to this, but students with low or no vision have greater confidence when they can find their seat and know that the layout of the room is relatively fixed. In general, predictability in the room's layout and seating arrangement is valuable for students with visual impairments.

For rooms in which the tables are moveable, faculty teaching in ALCs should request that your incoming students return the tables to your desired configuration. Make the room as predictable as possible so that it's easy to navigate. Some low-vision students may like to sit by a door, and you might suggest this option. It not only gives them an easy exit, but it helps orient them and gives them a direct route to their preferred or assigned table. If a student makes the choice to sit there, be aware that the seats by the door in a large room can be furthest from the center and therefore more difficult for instructors to see those students' raised hands.

Variation in Seating

Students changing where they sit from class to class can add to the spatial ambiguity of the classroom and attempts to make a reliable cognitive map of the space. People make cognitive maps by locating landmarks and creating routes between those reference points. The space becomes organized into an overview representation that explains the space and can be made more complex as new experiences provide additional landmarks and routes. Over time, a person develops a type of survey knowledge of the space that is often referred to as a cognitive map. Anything that disrupts the identification of landmarks and routes complicates the development of survey knowledge and spatial cognition in general (Casey, 1978; Giudice, 2018; Li et al., 2013).

When a low-vision student is attempting to map where others sit in the room to follow discussions and participate fully, she needs to create a reliable cognitive map that includes where people are located. Franny found this frustrating in the ALC when she could not depend on classmates' locations, explaining, "People were not regularly spaced out throughout the room. I feel like it changed every week, where the empty seats were verses not." Franny was listening to her peers, trying to interpret vocal information spatially. When those voices moved location, they became unreliable as spatial clues or landmarks, and her cognitive map had to be questioned and revised. Sydney confirmed Franny's preference: "I like the predictability of other people sitting in the same space." By the end of the course, however, Franny, who described herself as completely blind, had a strong spatial sense of the room: "I literally have a mental map now, being in the classroom the entire semester, of how the room looks like. I can even draw it out for you."

In large ALC classes, students often mention that they do not feel close to many people beyond their table. Full class discussions are one of the few regular and easy ways to encourage this kind of interaction (Petersen & Gorman, 2014). When setting ground rules for the class, ask students to use the microphones when speaking and name themselves and their table (e.g., "This is Petra at Table 4"). This detail will help all students track the discussion, especially when voices are broadcast through a speaker that makes it difficult for everyone to locate the person who is talking. With ALCs, it typically makes sense to create seating assignments, whether by randomly creating groups or strategically mixing students based on criteria (Oakley et al., 2004). It is both an efficient way of conducting the administrative portions of the class, and it can also help create more equitable groups. For low-vision students, it creates greater predictability.

Moving Through the Room

Another key feature of the ALCs is the whiteboards that circle the perimeter of the room. Instructors often invite students to write answers to questions or other content on the boards and then organize a "gallery walk" that asks groups of students to visit each board in an ordered fashion to read and comment on the posted material. It's typically a useful strategy to generate feedback and prompt discussion, and it's a technique that's nearly impossible to replicate in a traditional classroom where the space does not allow for it. For visually impaired students, however, this activity and others like it are difficult. Simply moving through the room with chairs somewhat randomly arranged as students get up en masse creates an unsafe space to navigate. Sydney noted, "Moving around the room was definitely hard. I always took the table next to the door. I never went any further in the room unless I had to." Because they had chosen seats near the ALCs' doors, which are on the periphery of the classroom, however, students who chose this strategy also felt that the instructor did not see them or their raised hand. This problem is mitigated to some degree when the instructor moves through the class to answer questions.

For safety concerns, unless a student has an access consultant or gives her consent, activities like the gallery walk need to be modified. Asking students to upload before and after photographs of the student whiteboards to the learning management system would make the content available to many students with low vision. Requiring a written summary of key points might also work and be useful for the entire class.

Sound

Sound plays a vital role in orienting to space, creating landmarks and defining routes. Franny explained, "Sound just anchors the thought or the idea that is coming at me when I have a source, a starting point of the sound…. I needed a very auditory focal point." For some students, too, it is not only orienting to the space, but knowing the direction of sound also helps to keep track of ideas. Ali also

felt it was important for him to know where the professor was when he was lecturing: "It is important for me to see where the professor is if I am sitting on the opposite side of the room. How far away he is from me. Yeah, I would say that is beneficial to me." Franny explained that not having a designated front of the room in the ALC made it harder to predict where the instructor was, particularly since he moved around the room with a wireless microphone. "Knowing that my instructor, or that my knowledge is at the front of the room consistently," she said, "helps me to not worry about where it's coming from, and I don't fully understand why."

A useful practice instructors can employ in large classrooms is to narrate what they are doing. For instance, when the instructor is ready to give directions or lecture or lead a discussion, she might use some standard language to reset the moment and to convene the larger class. Using a natural but consistent phrase like, "Let's get back together. I want to discuss…" can signal that she's back at the podium. Similarly, natural descriptive language can signal what is happening on the screen. If she is writing an equation on projector, she might say, "I want to derive the equation. I begin by setting x equal to 1." For most people, it is a small adjustment, but it is enough information so that a visually impaired student can become aware of where the instructor is and what he is doing on the screen, if anything. Ali mentioned that an accommodation he requested was to have each day's slides in advance of the class and the ability to record lecture portions that could be synced to his slides.

Table Focus

In large ALCs, locating the source of voices can be challenging. When the entire class is working in teams, the rooms can generally become loud and distracting. Even during whole class discussions, students might use microphones, in which case their voices no longer carry directional or volume information that would help discern direction and distance. Voices further away from a student with visual impairment become difficult to locate and differentiate, and consequently, those distant students become less important, even unknowable.

However, students at the same table grow in importance. Ali mentioned that he felt that "I interacted more because we are in a group because you are closer. It's a circle so that you can see people and there are a lot of people beside you and around you." Franny noticed a distinct difference between those near her and those at a remove, "I feel like the people within my table, I connected with more, but then there was like a bigger drastic change between me and the rest of the classroom." She explained it best with an image, saying, "We are all little islands in a traditional classroom but I feel like with this one there are a bunch of people at my island, so to speak, and so I interacted with them more closely, but then everyone else's islands were more further away." Although it may be that all students in an ALC will feel a greater affinity with those with whom they interact at their own table, the emphasis on the importance of tablemates for those students with a visual impairment may simply be greater.

Fostering successful small group experiences is critical in the ALCs and especially for students with disabilities. Devising methods for selecting collaborative groups to work on learning tasks and helping students evaluate the effectiveness of the team in an ongoing fashion helps the group be interdependent and effective (Barkley et al., 2014). A lot of informal group work can be conducted in teams of three, so limiting the members of those three-person teams to a single table or a pair of tables provides both stability and variation and reduces the amount of travel among tables.

Screens and Whiteboards

Screens in the ALCs serve multiple purposes. They can mirror the instructor's larger projection screen, making it easier to see, and students can project from their laptops, as when they choose to share a resource or collaborate on a project. Ali, who has low vision and problems with low contrast, found the screens more helpful than the instructor's projection system. "The large ones, I usually had a hard time looking at what's on them, cause they're less clear, I guess, compared to the TVs. In the active learning classroom there's TVs everywhere so I can at least kinda see the slides." When using the table's whiteboards, Ali could use them if the group used only contrasting markers, like blue and black. Franny, who is blind, found the whiteboards impossible to use without help from an access assistant. Sydney found them very challenging, saying, "I needed to communicate with my group with whatever they were writing." How students with visual disabilities experience the screens and whiteboards varies widely, depending upon the level and type of vision impairment the student experiences.

For some visually impaired students, the table screens are easier to see than the larger but more distant projection screen. When designing slides for class, it's important to follow accessible design guidelines (Fandrey, 2017). For instance, for someone like Ali, strong contrast is important for his vision. You can check the colors you choose for your slides and documents with a color accessibility checker, such as the one at https://webaim.org/resources/contrastchecker/. When students typically use a whiteboard, it might be helpful to suggest using a collaborative software product that can be projected on the screen. It is important to note that some screen readers work better than others with particular software packages, so students should be guided to consult the visually impaired student about what might

work for them. Alternatively, instructors could consult with staff at Disability Resource Centers for recommendations.

Dimension 2: Social Inclusion

The framework for universal design for learning (UDL) was originally put forward in the 1980s by Dr. David Rose and the Center for Applied Special Technology. It represents an approach to learning that minimizes barriers for all students and creates a supportive classroom climate. UDL recommendations include fostering community and cooperation to reduce social exclusion and promote social inclusion (Hymel & Katz, 2019). Providing opportunities for positive social interactions and engagement, of course, begins with curricular design, which are made easier to enact in ALCs. Research on the "social context" of learning has shown that classrooms designed for interaction among students begets, among other things, greater informal interactions than those that are not designed in this manner. The informal interactions and connections among students, as measured with the Social Context and Learning Environments (SCALE) survey, are simply stronger in ALCs than in traditional classrooms (Baepler et al., 2016; Walker & Baepler, 2017). While this dynamic alone does not promote better learning outcomes in the general population, it may indeed improve a sense of *social inclusion* among disabled students who frequently feel isolated and excluded.

The dimension of Social Inclusion is divided into three factors: Student Interaction, Active Learning, and Instructor Interaction.

Student Interaction

Making comments in lecture halls can be daunting, but to some degree, a sighted person can glean some feedback through visual cues. She can see heads nodding in agreement or expressions of boredom, she can direct a response to someone she had seen speaking earlier and notice a reaction from that person, and she can see the instructor's facial reaction and body language in response to her comment. Someone with a visual disability who wants to speak up in class might need to compensate for the lack of visual feedback and imagine that people are listening to her. Sydney spoke about how this workaround was less necessary in an ALC. "In a lecture hall, I can't make eye contact," she said, "so I kind of have to project eye contact and imagine this person that I'm talking to. With the round tables, I don't have to do it as much." She went on to describe that she felt that she was more a part of the conversation in the ALCs and had a greater sense that her thoughts were part of the dialogue: "I felt that people listened to me more and were more open to talking and listening to me with circle tables. … If I say something, it's not just lost to the wind. Sitting next to someone in a lecture hall, it's like you can ignore people." To put this in Franny's terms, it's more difficult to ignore people on "your island." Ali, too, noted his level of engagement was greater and attributed this to working with others in the ALCs, saying, "I feel like I interacted more because we are in a group." Peer relationships affect a sense of social inclusion (Croft, 2020), and the ALCs encourage this.

Active Learning

Hymel and Katz (2019) discussed the importance of designing learning activities and how they influence social dynamics. Ali attributed the increased interaction in his experiences not simply to sitting near someone but to the fact that they were doing things together. He said, "The [ALCs] made it less boring… so the notion that it's not so much that you're working with other people nearby you, but that you're doing things, different things… the fact that there's a variety of things, it's not just lecturing." Franny also mentioned engaging in a variety of activities together helped her learn more about her classmates: "I also got to know my classmates a lot better and there was a lot more active learning, activities, that made it possible."

Instructor Interaction

ALCs are designed to promote student engagement with the content, often with some form of cooperative or group learning. Although instructors might provide minilectures or lead short discussions, the role of the instructor changes considerably. She might commence an activity and spend most of her time checking in on tables, posing questions, and clarifying queries. In contrast to what happens in a large auditorium, students might engage more closely with the instructor as she visits tables. Ali noticed this interaction and commented that he felt more connected to the instructor: "The professor walking around and asking a question to each group. I felt closer to the professor. The professor would ask a question specifically to our group. … it is easier to ask him a question without the whole class hearing the question and the answer." In this case, the fact that sound does not travel the distance of the room when everyone is talking plays in the learner's favor, particularly when he feels shy or wary. By allowing for these small group exchanges with the instructor—something very difficult to achieve in a traditional lecture hall—the ALCs bring the instructor physically closer to the student, and the interaction can be more personal and tailored to his questions and comments.

Overall, the ALCs enhance social inclusion by inviting greater participation and interaction among students with visual impairments. Because the classroom is built to

Figure 3. Instructors can approach any of the tables and answer questions more easily in the ALCs. Students say they feel "nearer" to the instructors in the ALCs.

support smaller pockets of collaboration, students who previously had difficulty communicating in big rooms because they could not assess common visual cues by listeners now have a chance to locate and hear people with whom they are speaking at the table. There is less of a need to imagine their listeners' reactions when they might be able to get direct oral feedback from them, perhaps having developed a rapport with them through active learning activities they have worked on together. The practice by instructors of consulting with each of the tables enhances social inclusion, bringing all the students nearer to the teacher. The onus of asking questions in front of the entire class is reduced to the pressure of asking a question, presumably already vetted at the table, in front of just the group.

Limitations and Future Directions

The intersection of visually impaired students and ALCs is currently quite small, and this study with three students reflects that. It also means that the results should be seen as exploratory rather than generalizable. For instance, all three students in this study had positive interactions with their tablemates, but that might simply have been good fortune. Students can have poor group experiences, but that situation was not reflected in this sample. For a variety of reasons, many students, particularly those with medium or low vision, may not disclose their disability in college and prefer to hide this facet of their identity. A future study might explicitly recruit students who receive no accommodation but who nevertheless experience some vision impairment. This approach might broaden our understanding of the varied experiences of partially sighted students.

Because they attended a major university and successfully advanced in their majors, these students likely had at least sufficient financial, family, and social support to undertake their education. If ALCs find greater adoption in high school settings, a future study might be able to look at how more students, including those who have fewer resources, manage the room or fail to succeed in these spaces. It may also be the

case that visually impaired students in college learn that a class they want to take will be conducted in an ALC and avoid taking courses in these classrooms altogether, unwilling to take on the challenges that the room presents.

Within the framework of social context as measured by the SCALE survey, a higher factor of Student-Student General reading suggests a lower final learning outcome for the general population (Walker & Baepler, 2017). The question of whether this measure of informal interactions among students would project the same negative outcome in different populations, particularly those who feel excluded, such as, potentially, students with disabilities, is still open. It may be the case that a greater sense of social inclusion would prompt some students to be more motivated to perform better under these conditions. Future research should investigate whether the SCALE survey might indicate different results for sub-populations like students with disabilities and test the hypothesis that a higher Student-Student General level would predict a neutral or positive learning outcome among these students.

Conclusion

The experience of the ALCs for students with visual impairments has tradeoffs. Large traditional classrooms are familiar and predictable. A student with a disability can sit in a disability section of the room that is likely to be somewhat accessible, visible to the instructor, and safe with unblocked egress to a door. In contrast, the very flexibility that promoters of ALCs tout can create uncertainty and barriers for someone who cannot see well. Round tables can limit orientation, and moveable seats can hinder navigation and mobility. Trying to walk unaided through a room of irregularly spaced chairs is an invitation to frustration and conspicuity.

On the other hand, the ALCs naturally partition the classroom into teams or pods. These smaller groups, especially if they are relatively permanent, can promote social inclusion. Students can grow familiar with their peers more easily when they are facing each other, and even if some students are low vision, they can still locate voices and track reactions through vocal cues. They can be more assured that their opinions are being heard and their contributions included in projects.

It is difficult for the sighted to put themselves in the position of people with low vision. A way forward might be to think how we can operationalize Giudice's (2018) reminder, "Much of what is intuitively considered as 'visual' information is really 'spatial' information and can be specified through multiple sensory modalities, as well as other channels such as language, kinesthesis, and inertial sensing" (p. 18). People with low vision or no sight have skills that can discern spatial information regardless of visual acuity. Understanding those skills can help instructors proactively provide the best guidance for success in the ALCs.

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Appendix

Table 1. Recommendations for Instructors to Support Students with Visual Impairments in ALCs

Dimension	Factor	Recommendation
Dimension 1: Orientation	First Impressions	Provide images and written descriptions of the ALC in advance of the first class.
	Round Moveable Tables	Ask students who first arrive in the classroom to return tables to a specified configuration. Invite a visually impaired student to select their seat and suggest that they might like to be near a door.
	Variation in Seating	Require students to use the microphones, stating their name and table number. Assign seats either randomly or via criteria you have selected.
	Moving Through the Room	Alter activities like a "gallery walk" so that the content is available to all students via written summary or photographs uploaded to the content management system.
	Sound	Use consistent language to signal that you are back at a podium to begin a whole class activity. Narrate what you are doing on the screen with natural descriptive language.
	Table Focus	Formalize at least part of the collaborative experience, including group formation, structuring tasks, and group evaluation. Implement 3-person informal collaborations between a pair of tables to increase exposure to new people and to reduce travel among tables.
	Screens and Whiteboards	Follow slide design accessibility guidelines. When asking students to use the whiteboards, allow an alternative means of collaborating and displaying their work, such as using collaborative writing software and the table screen.
Dimension 2: Social Inclusion	Student Interaction	Design small group projects and discussions that require all students to participate. Though some students don't enjoy icebreaker questions, they can be useful and efficient ways to help students begin to interact with each other.

	Active Learning	Include a variety of learning activities in your lesson plan: Think-Pair-Share questions, jigsaws, problem sets, concept maps. For any activity that might include reading more than a sentence or two, it might help visually impaired students to have the material in advance. Consider giving all students materials in advance.
	Instructor Interaction	Circulate in the room to allow students a few moments to ask questions. Even at the outset of an activity, students might have questions about other aspects of the course and may wish to speak with you. Using natural language, announce your presence near the table so all students, including visually impaired students, know you are there and available for questions. Ask a question or offer a bit of advice that another table found helpful. When you reconvene the class for discussion or direction, signal that you have returned to someplace central to the classroom and that students should focus on the topic or the slides on the screen. Even a request to listen or quiet down can be enough to signal that the focus is again on the entire classroom and that table discussions should conclude.