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Creating a Community-Focused Lab Section in a Large Computer Science Course (Experience)

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Abstract

The introductory computer science class (CS1) at our large public university has grown to over 1,200 students. The learning environment in a large class makes it hard for students to connect with instructors and other students. While some students thrive in an independent learning environment, others thrive through participating in a supportive learning community. At our school, a long-running Academic Success Program (ASP) has supported their students through creating smaller instructional class sections that foster community within large science and math courses. This program provided a model for how we might create community within CS1.

Through an analysis of student grades, we found that CS1 was not adequately supporting ASP-affiliated students, motivating us to partner with ASP. We were especially concerned by this disparity because the ASP-affiliated students in our class are much more likely to come from populations that experience inequities elsewhere in their educational experience – as examples, 60% of ASP students are first-generation college students, 27% are Black, and the median household income of ASP students is much lower than that of other students in the course.

In partnership with the ASP program, we developed a new lab section reserved for ASP students which focused on creating a supportive learning community. Our pilot started with two sections enrolling 20 students each. A first emphasis was building community between students. To foster community, instructors provided students with multiple, structured opportunities to engage with one another during lab, including working together in lab teams and reflecting on and sharing their values and interests. We also built connections between students and instructors by creating dedicated office hours that were staffed by the ASP lab instructors (non-ASP students use a system where the instructor assisting may not be known by the student), requiring office hour attendance at critical times during the semester, and reaching out to students to offer encouragement and support. While many of these practices would be beneficial for all students, the constraints of running the large class meant that these measures were not previously implemented.

A pre-post survey measured the ways the dedicated ASP sections had an impact. Because not all ASP students were enrolled in the section, we were able to examine differences in ASP students' experiences inside and outside the dedicated sections, with the caveat that students self-selected into the sections. As highlights of our findings, 91% of ASP respondents in the dedicated labs reported feeling comfortable asking questions in lab, as opposed to 63% of ASP respondents in

the non-ASP labs. 100% of ASP respondents in the dedicated lab found office hours helpful, as opposed to 63% of the ASP respondents in non-ASP labs. Despite these successes, the dedicated section did not lead to higher grades in the course, showing that we have more work to do in order to address the many ways that students in ASP still undergo inequitable experiences and outcomes in our course.

Introduction

Large-enrollment introductory courses do not offer equitable structures for learning to every student. At our large state institution we have between 600 to 1,200 students per semester taking the introductory computer science course (CS1). To accommodate this large number of students the class consists of lectures of 150+ students and optional lab sections of 32 students. This large class structure works well for students who thrive working independently, but may not provide adequate support for those who learn better when working in a supportive community.

To combat this, our CS1 course is currently engaged in a three-year course redesign process in partnership with our on-campus teaching center. Through this partnership, we are seeking to learn about student experiences in the course to identify and address structural barriers that negatively impact student learning, particularly with respect to inequities that impact minoritized students.

One of the first populations we examined in the data was students who were enrolled in an Academic Support Program (ASP). ASP provides advising and academic support services to a wide variety of students at our institution. Students are admitted to this program based on "circumstantial criteria such as their first-generation college status, under-performing / under-represented high school or neighborhood, low SES, [or] HS counselor recommendation" [1]. We quickly discovered that the structure of the course was not resulting in equitable learning outcomes for ASP students. For example, over the four academic years leading up to our work on this project (AY15/16 - AY18/19), the average grade for ASP students was 2.6 (B-) vs. an average of 3.4 (B+) for non-ASP students. Furthermore, the DFW (D, F, or Withdrawal) rate was 29% for ASP students and 8% for non-ASP students.

Further, Figures 1-3 indicate that, compared to the non-ASP student population in this course, the ASP student population includes a higher percentage of first-generation college students, students who attended lower-resourced high schools, and minoritized students. Specifically, 42% of ASP students are first-generation students, compared to 6% of non-ASP students. The distribution of median income for the zip code of the high school that students attended skews substantially lower for ASP students than that of their peers. In addition, 27% of ASP students are Black compared to 1% of non-ASP students, and 16% of ASP students are Hispanic compared to 4% of non-ASP students.

Given the grade differential between ASP and non-ASP sections, these data indicate that first-generation students, students who attended lower-resourced high schools, and minoritized students are experiencing inequitable outcomes in this course. [1] We thus identified the need to

[1]Please note that the demographic data discussed here are a snapshot of this particular course. These data are reasonably consistent with patterns in this particular course in prior years, although the small N for some identities

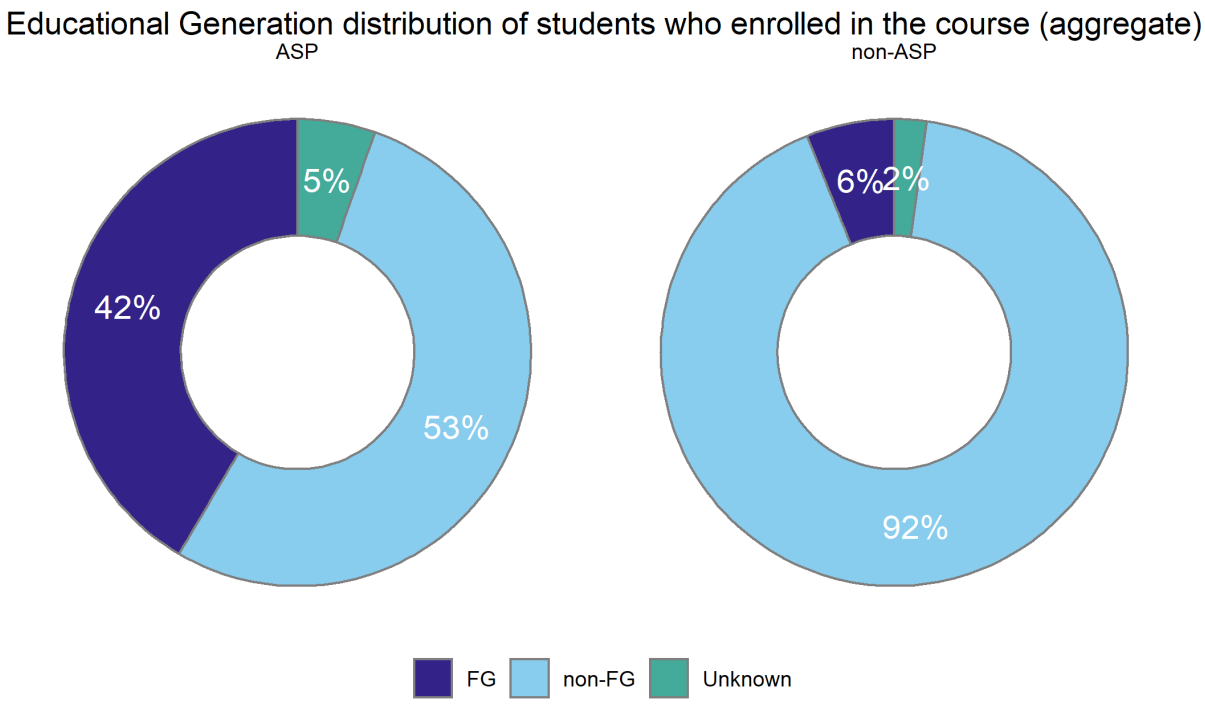

Figure 1

revise the course to disrupt, rather than exacerbate, patterns of educational disenfranchisement experienced by these student populations. [2]

To begin creating a more equitable course, we met with ASP leaders, advisors, instructors, and students to learn about student experiences. We learned that a sense of anonymity and disconnection with other students and with instructors was a common barrier ASP students experienced in CS1. This barrier may reflect educational inequities that students experience as members of minoritized social identity groups. It also reflects the structural limitations of a large course format, in which opportunities for students to develop a sense of community with other students and instructors are often limited.

Student-student and student-instructor interactions are central components of the learning process [2]. However, the sense of isolation experienced by ASP students in CS1 suggests a lack of opportunities to engage in these interactions, which in turn may create barriers to learning and contribute to the grade differential discussed above. As a first step towards creating a more equitable course, we focused on addressing this sense of disconnection.

Specifically, this paper describes in detail the design and implementation of two new lab sections, reserved primarily for ASP students.[3] We hypothesized that creating multiple, structured

lead to natural fluctuations in this distribution. However, these data are specific to this course and cannot speak to whether these demographic patterns are seen in other courses or in the ASP program more generally.

[2]This decision to prioritize equity in course design decisions is informed by our institution's teaching center's definition of Equity-focused Teaching.

[3]This approach of designing ASP sections is consistent with the ASP model implemented by other large-enrollment introductory courses at our institution, which includes creating ASP lecture, lab, and/or discussion sections within large

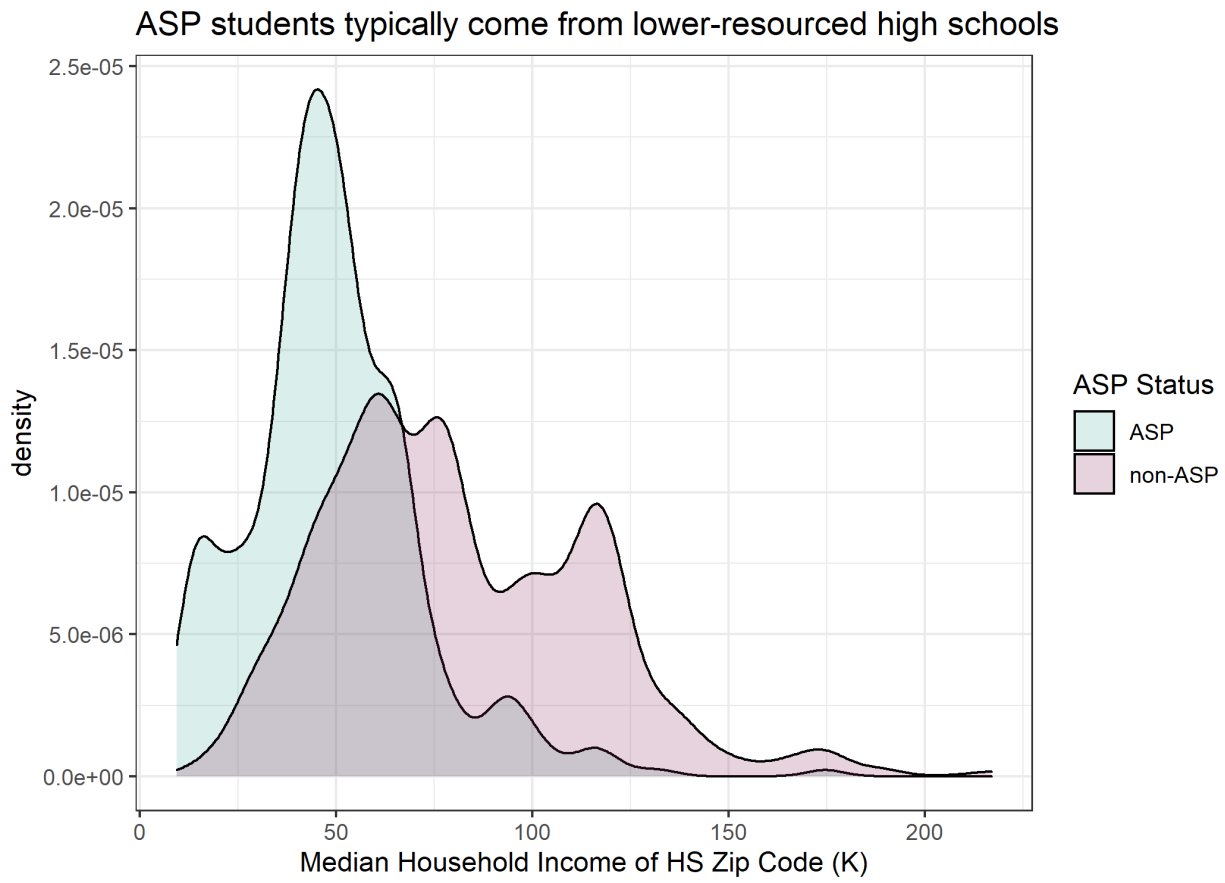

Figure 2: Kernel Density Estimate (KDE) plot showing the distribution of median income for the zip code of the high school that students attended. The distribution for ASP students skews substantially lower than that of their peers.

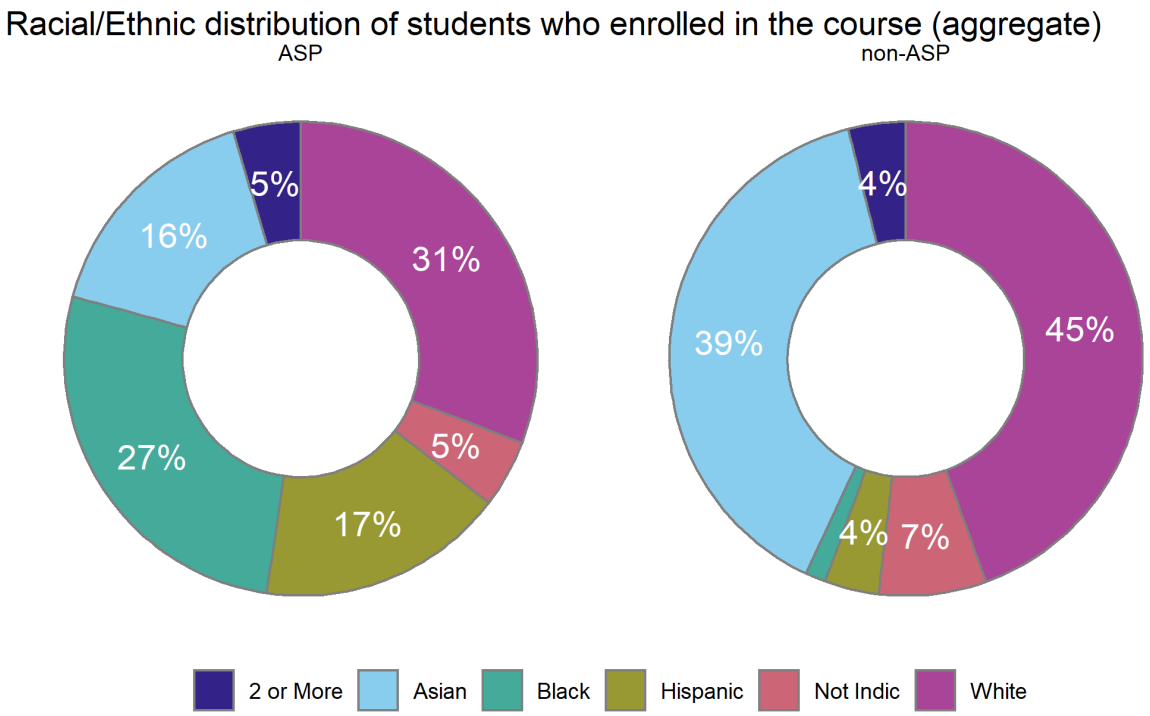

Figure 3

opportunities to foster student-student and student-instructor interactions within these lab sections would reduce the sense of isolation that may create barriers to learning in the course. Pre-survey data (Figure 4) supported the idea that being part of a classroom community is valued by most ASP students.

This paper proceeds as follows. First, we discuss how the practices used by ASP at our institution and the research literature informed our approach to designing the new ASP lab sections. Then, we discuss the design and implementation of these lab sections. Next, we examine the success of these lab sections in fostering a sense of connectivity among ASP students through student pre/post survey data. Finally, we reflect on strengths and areas for improvement and discuss next steps to continue creating a more equitable course.

Background

Our CS1 course enrolls 600-1,200 students per semester. While the course is targeted toward students with no prior programming experience, our students come from a wide range of computer programming backgrounds. The size of the course requires students to engage in self-directed learning, with the majority of effort focused on four programming projects. Project work is supported by office hours led by graduate and undergraduate teaching assistants. There are two exams involving writing code based on concepts covered in lectures. Teaching assistants typically run optional 32-person lab sections with lecture review and a weekly programming assignment. Many students have thrived in this structure, with 65% of students earning an A- or

courses.

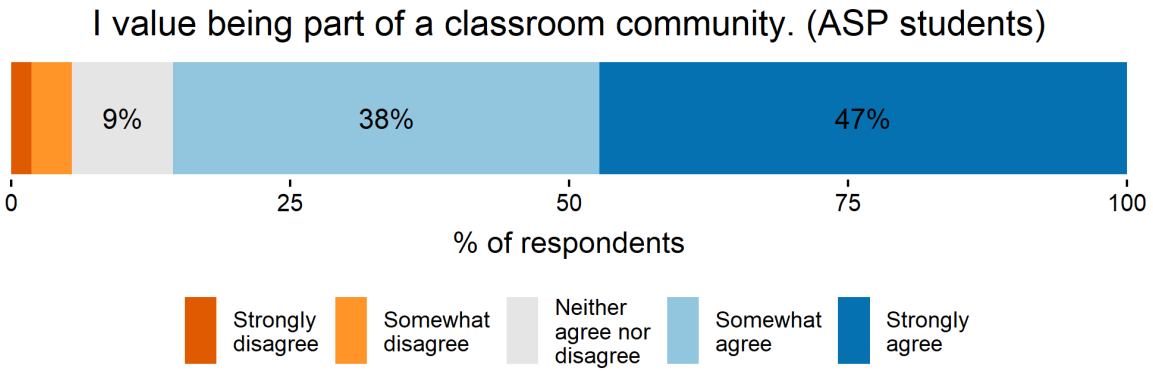

Figure 4: Survey Results for ASP Students for winter 2021.

higher, and under 3% DFW (D, F, or withdraw) rate in aggregate over the 5 years prior to COVID-19. While this format works for most students, as discussed above, conversations with ASP leaders, advisors, instructors, and students indicated that ASP students enrolled in CS1 experienced a sense of disconnection, which may be correlated with the observed lower grade outcomes.

To begin developing our new lab sections, we drew on ASP's approach to creating classroom environments that promote community. ASP provides dedicated ASP instructors in many courses. ASP instructors implement a wide range of instructional practices to foster community within their classes. Further, ASP sections are typically smaller and meet for longer periods of time compared to non-ASP sections. We met with ASP advisors and instructors to learn what made these practices effective for ASP students and brainstorm how these practices would translate to computer science.

In addition to learning from ASP's practices, we drew on research-based interventions designed to mitigate barriers to learning caused by systemic inequities. This research is relevant to our course design; the demographic data discussed above suggests that a high percentage of ASP students are likely to experience barriers to learning due to patterns of educational disenfranchisement that stem from income inequality, systemic racism, and other systemic inequities.[4]

Our approach to designing the learning environment in our new lab sections was motivated by seminal research which indicates that fostering a sense of belonging in school can support student success, particularly among minoritized students who, due to negative stereotypes and marginalization, "may be relatively more uncertain about their social belonging in mainstream institutions like school and work" [3] (p. 1447). Further, we drew on research which shows that inviting students in a STEM course to reflect on their personal values supports learning, particularly among women, by inviting them to "affirm their core values in a threatening environment" and thereby helping to mitigate the effects of stereotype threat [4] (p. 1235). This

[4]This framework for understanding and disrupting patterns of inequity in education draws on the Equity-focused Teaching approach at our institution's teaching and learning center.

research suggests that inviting students to consider themselves as whole people rather than more narrowly as students in a course supports student learning. In addition, we designed interactions to provide opportunities for all students to participate meaningfully as part of our effort to create a climate where all students feel valued [5].

Research in the field of engineering education indicates that strategies such as promoting a sense of belonging and fostering a growth mindset can support and enhance student learning, particularly among minoritized populations. For example, Rhee et al. find that strategies such as "fostering a growth mindset and/or feelings of belonging," may be effective in "impacting retention and graduation rates of engineering and technology majors at a large comprehensive public university with a significant minority population" [6]. Their study revealed that there may have been an effect "based on the evidence that academic performance, measured by course grade, was improved in the group receiving the belonging intervention."

The COVID-19 pandemic hit as we were developing a structure to test our hypothesis, and the course design team pivoted to a completely virtual learning environment. Research literature on online learning suggested that creating a community in the classroom through student-student and student-instructor interactions would be as important, if not more so, in a virtual learning environment compared to in-person. Such interactions can foster student engagement by "stimulating students' interest in online learning environments" [7] (p. 569). Similarly, Nilson and Goodson [8] highlight the value of student interactions with "the instructor, the course content, classmates, and technology in online courses" (p. 131). They summarize the importance of interactions as such: "[w]hen these interactions develop instructor, cognitive, and social presence, they help students feel part of a community, which sustains their persistence in online courses" (p. 132).

This research on in-person and virtual learning informed our central hypothesis: effective student-student and student-instructor interactions would promote a sense of community in CS1.

Interventions

Aligned with this hypothesis, the course design team developed new lab sections specifically for ASP students that were designed to foster a classroom community in which students had multiple opportunities to build connections with their peers and instructors. These interventions focused on two primary areas: supporting student-student and student-instructor interactions, as described in detail below.

In order to foster these interactions, we made several structural changes to create a smaller class community with ample opportunities for interaction. First, we decreased the enrollment cap to 20 (compared to 32 in non-ASP sections) and restricted enrollment to ASP students for the initial enrollment window. Second, we increased the number of section instructors from 1 to 2, with instructors specifically recruited based on experience and demonstrated commitment to inclusive teaching. These changes ensured that eligible students who felt they would thrive in this environment had the opportunity to enroll, would receive abundant instructional support due to the smaller instructor:student ratio, and be able to better connect with their peers than in a larger classroom environment.

Student-to-Student Community

The design team sought to create multiple opportunities for student-student interaction to help build more community among students. To support student-student interactions, we focused on three types of interventions: growth activities, consistent interactions, and creating a welcoming environment.

Growth Activities

Growth activities consisted of ten-minute lessons or interactive activities that focused on growth outside of the technical material. These activities provided a chance for students to share personal experiences with the instructor and each other to form deeper and stronger connections, and to counter stereotype threat students might have experienced. We hoped that this would help improve the student-to-student community. We implemented three growth activities, two of which supported student-student interactions: values affirmation reflection and addressing imposter syndrome.

For the values affirmation reflection we adapted resources from previous work [4]. In one week of lab, students individually completed a worksheet about 1 to 2 values they connected with and reflected on how those values shaped their everyday lives. The following week, students shared the values and reflections with their peers in a Zoom breakout room, guided by questions like "Which value did you pick and why?", and "What value is behind your decision to go to college?"

In a second example of a growth activity, the lab addressed impostor syndrome with a presentation followed by a group discussion. It included information about what imposter syndrome is and provided time for reflection and sharing. The instructor started the conversation by sharing their own experiences with imposter syndrome and then invited students to share if they wished. The exercise ended on a positive note with the instructor inviting all students to post in the Zoom chat something they are proud of accomplishing. The hope was to help students connect over shared struggles and accomplishments to create community while also helping to address a common issue faced by many students in computer science.

Consistent Interactions

Historically in our CS1, lab activities were completed individually and attendance was optional. To create more opportunities for student-student interactions, we required students to attend lab for class credit, placed students in assigned groups for lab work, and took into consideration student feedback about their assigned groups.

Requiring lab attendance achieved a number of objectives. First, it emphasized to students that we felt lab was an integral part of their class experience and learning process. Second, it helped create consistent student-student interactions because the students could rely on their classmates being present every week.

To further encourage consistent student-student interactions, the instructors placed students into small, stable groups of 3-4 people. These groups met each week in breakout rooms for one of the

two hours of lab. The students were encouraged to work on the weekly lab assignment together with the instructor popping in to answer questions.

To optimize student experience in breakout rooms, the instructors surveyed the students halfway through the term and asked about their preferences such as whether they would like to stay in their current group, be moved to a more interactive/talkative group, or be moved to a more individual work focused group. By taking into account students preferences to slightly reorganize breakout groups we were able to better address each student's unique learning needs.

Creating a Welcoming Environment

In addition to building community through formal components of lab section such as the growth activities, we also incorporated multiple small-scale interventions throughout each component of the lab section. We created opportunities for students to connect with one another, and created an environment where questions were welcomed.

We provided several mechanisms for students to interact and potentially form connections. We opened up the Zoom room for lab 10 minutes early and encouraged students to come early and chat with each other and the instructors if they were able. This was designed to replicate the casual interactions that would happen in person before class. In another intervention, we held pre-exam meetups in which students could join a Zoom meeting and converse with each other for 15 minutes prior to the exam in order to alleviate stress and help them feel less isolated. Students responded to this opportunity, with 10-15 in attendance for each meetup. As another intervention, instructors created 3 minute breakout rooms at the start of class and assigned 3-4 students to each room randomly. The instructor provided the students with an icebreaker question beforehand, such as "What is one thing that has gone well this week?"

Questions in lab were encouraged and normalized so students would feel comfortable speaking out if they needed clarification. To provide multiple avenues for asking questions, the instructor encouraged unmuting and asking directly, using the Zoom chat feature, and using the Zoom private messaging feature to ask questions to the instructors. To normalize having questions the instructor made a point to say they were expecting questions and to remind students that this material is challenging and confusing. If any student asked a question the instructor made sure to encourage them and affirm that it was a good question that many other students had as well. The goal was to create an environment where students felt comfortable not knowing something or being confused around their peers.

Student-Instructor Community

Our goal was to create multiple avenues for student-instructor interactions that aides in community-building. We focused on making one-on-one interactions readily available, and showing students they are valued members of their community.

One-On-One Interactions

One of the most important ways for students to build connections with instructors is through on-on-one interactions. This was accomplished through meeting with students through mandatory

and optional office hours and through personalized emails.

Office hours have always been a valuable part of CS1 at our institution. They are often the best place to receive clarification and/or guidance on a project or concept. To emphasize the importance of office hours, we required the ASP lab students to come to a 15-minute office hours slot once at the beginning of the semester and once after the first exam. This helped demonstrate the utility of office hours, and provided a mechanism for students to get to know the instructors and inform them of any concerns or issues. By creating space for students to feel as though they are being heard, understood, and acknowledged by their instructors, this approach was intended to help students feel that they were valued members of the classroom community and foster productive student-instructor relationships.

To create a learning environment that acknowledges student effort, instructors reached out directly to students after major grading events, such as score releases for projects and/or exams. Instructors sent emails to offer praise to students who did exceptionally well, acknowledging their great efforts and encouraging them to keep up the momentum by continuing to work hard. For students who may not have done as well as they would have liked, the instructors emailed them with encouragement, suggesting that they not give up, and reminding them that they are always more than welcome to set up a time to meet one-on-one to discuss how they can improve things for themselves moving forward.

Valued Members of the Community

To incorporate students into the classroom community, the instructor administered weekly lab surveys to ask about opinions on class material, studying techniques, and personal preferences. The survey questions provided space to reflect on the upcoming (or prior) week, and steps students could take moving forward. For example, the weekly lab survey following Exam 1 included questions that prompted students to engage in metacognitive reflection designed to help them examine their own study behaviors and identify study strategies to prepare for Exam 2 [9, 10].

These interventions connect the bridge between student and instructor, and are designed to demonstrate to the student that the instructor truly cares about how they are performing and wants to support them in taking steps to help them make progress in the course.

Results and Analysis

To learn about overall student experience as well as assess the impact of interventions in the ASP lab, we administered a survey to all students in the CS1 course.

Methods

All CS1 students were sent a survey link, and were awarded course credit for completing it. In this analysis, students were divided into 3 groups: non-ASP (students who are not part of the ASP and therefore not in this new lab section), ASP-general (students who are enrolled in the ASP and eligible for but not enrolled in the new lab section), and ASP-lab (students who are enrolled in the new lab sections affiliated with this program). This survey design allows us to examine

differences in experiences between these groups of students, with ASP students in the general sections acting as a control for the ASP lab sections. Table 1 describes the post-survey response rates for these groups based on the end of term course roster.

Table 1: Response Rates by Cohort - WN 21

Cohort	N (responded)	N (total)	Response Rate
ASP-Lab	11	27	41%
ASP-General	13	20	65%
non-ASP	380	556	68%

The surveys were designed to learn about student experiences in the course, rather than to assess each intervention individually, as intervention-agnostic questions enabled a direct comparison of student experience feedback between ASP lab students and both ASP and non-ASP students in the general sections.

In the analysis that follows, we do not claim to establish a causal relationship between the interventions and student experiences, as the research design does not allow for causal inference. However, this analysis does provide insight into how students experienced lab, and in turn, whether the new lab sections successfully cultivated community through student-student and student-instructor interactions relative to the prevailing model.

The primary threats to validity in our data are:

- ASP students self-selected into the regular lab or ASP-lab, so there may be differences in the populations. In particular, the ASP-lab students were more likely than ASP students as a whole to report on surveys that they value community.
- Because there are relatively few ASP students in the course, the number of respondents to our survey was low. Bias may have also been introduced through self-selection of survey responses. Students are more likely to respond to surveys when they are either very happy or very unhappy.
- The semester we studied was online, which meant that students in general felt more disconnected from each other and from instructors. It is not clear whether this made our interventions more or less effective than they would have been for in-person semesters.

Results: Student-Student Community

Figure 5 summarizes student responses to survey items that provide insight into how effectively the ASP lab sections cultivated a student-student community. Recall that instructors provided multiple opportunities for students to connect with one another through growth activities, consistent interactions, and creating a welcoming environment.

Students in the ASP lab sections were more likely to report having peers they felt comfortable working/studying with than students in the general section. 72% of ASP-lab students reported comfort with working with their peers, while this sentiment was shared by only 38% of ASP-general students and 61% of non-ASP students.

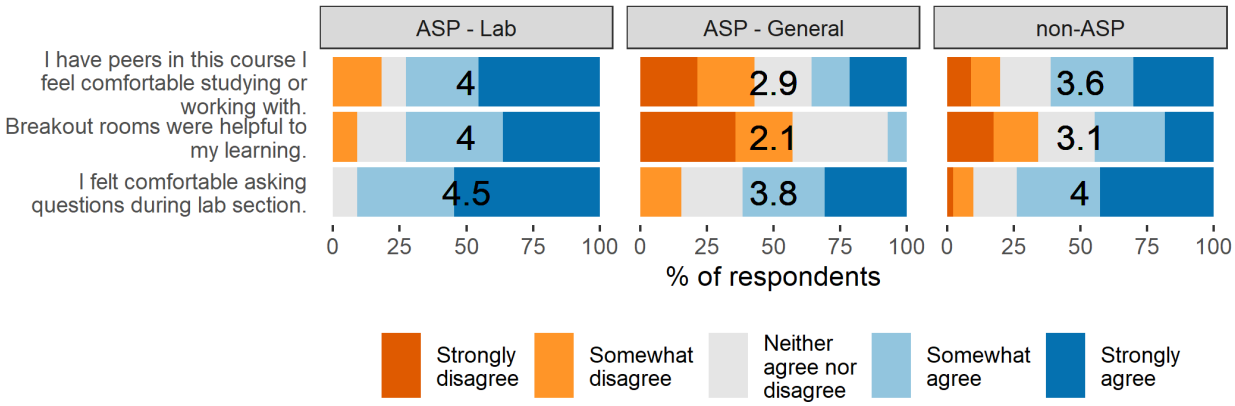

Figure 5: Survey results showing student-student community.

The main space for students to interact with each other was in breakout rooms. As such, the second question of Figure 5 "Breakout rooms were helpful to my learning" provides additional insight into the success of the student-student interventions. 73% of ASP-lab students reported that breakout rooms were helpful to their learning while only 8% of ASP-general students and 44% of non-ASP students reported similarly.

Another metric to evaluate this set of interventions was "I felt comfortable asking questions during lab section." Being comfortable asking questions in class reflects an environment of "learning together" rather than judging each other or competing against one another. 91% of ASP-lab students responded that they agree with that statement. This in contrast to only 63% of ASP-general students and 73% of non-ASP students reporting agreeing with the same statement.

Qualitatively there were also insightful responses from specific students in the course about the student-student community. One student said, "I really liked that it was a smaller community of students that are mostly all new to coding. It became a safe environment to ask questions and get any help." Another student reflected on the growth activities, "I liked being able to talk with my leaders and classmates in the growth activities because it made me feel valued and not just like another student that had to try to learn". These student experiences illustrate the general sentiment students felt about the ASP lab section and the success the interventions had.

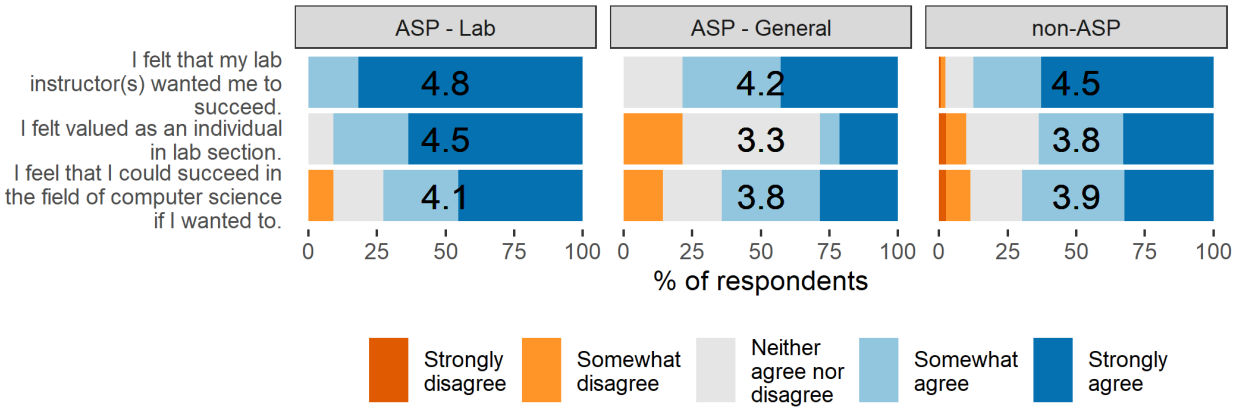

Figure 6: Survey results showing student-instructor community.

Results: Student-Instructor Community

Now, we examine how successful the ASP lab sections were at cultivating student-instructor relationships through the interventions described above. We focused on showing students they are valued members of their community, and making one-on-one interactions readily available. Figure 6 summarizes student responses to relevant survey items with respect to student-instructor interactions in the course.

Students across all sections on average agreed with the statement, "I felt that my lab instructor(s) wanted me to succeed." In the ASP lab section, all respondents (100%) agreed with this statement, compared with 76% of ASP-General students and 87% of non-ASP students. This suggests that while the course instructors have been effective across the board in communicating their support of students, this was particularly true in the ASP lab.

In addition, students in the ASP lab sections were more likely to agree with the statement "I felt valued as an individual in lab section," with 91% agreeing with this statement, compared with only 31% of ASP-General students and 63% among non-ASP students. This comparison further suggests that multiple types of one-on-one student-instructor interactions in the ASP lab sections helped students feel valued within the classroom community.

Figure 6 also indicates that on average students in the ASP-lab were slightly more likely to agree with the statement "I feel that I could succeed in the field of computer science if I wanted to" in comparison to their peers in other sections. ASP section instructors may have supported students' belief in themselves by communicating their confidence in students through the multiple, reinforcing student-instructor interactions described above.

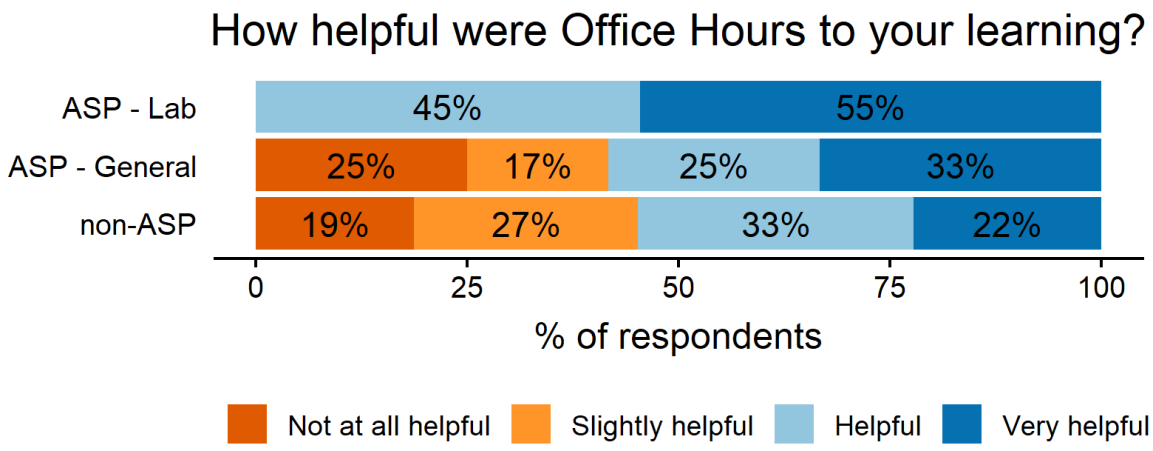

Figure 7: Survey results showing student's experience in office hours.

Qualitatively there were also insightful responses from specific students in the course about the student-instructor community. One student commented that, "The GSI and IA [ASP class instructors] really made a big difference [in] this class I feel. They were passionate and I felt they conveyed the material very well." Another student commented on the outreach the instructors did, "I also appreciated the staff reaching out to check in or congratulate me when I was struggling or making good progress it definitely kept my spirits up in rough patches during the semester." Both of these quotes highlight the success of the interventions in creating a student-instructor community.

Office hours in particular may have provided an avenue for productive student-instructor interactions. As Figure 7 shows, ASP-lab students were more likely than their peers to indicate that office hours were helpful to their learning. ASP-lab students were also more likely than their peers to attend office hours regularly. When asked to indicate "How frequently did you attend office hours?" (with options ranging from Never to Multiple times/week), 73% of ASP-lab students reported going at least every other week, with 55% attending multiple/week. This is high attendance compared with ASP-general (50% at least every other week, 3% multiple) and non-ASP (34% at least every other week, 8% multiple). ASP lab instructors focused on modeling a growth mindset [11] and communicating interest in students' futures, which may have enhanced the perceived value of office hours among ASP-lab students.

Results: Overall Course Experience

Responses to the question in Figure 8, "I felt a sense of community in lab section" illustrates the success the ASP lab sections had in creating community. 100% of ASP-lab respondents agreed that they felt a sense of community. This is in contrast to only 16% of ASP-general respondents and 48% of non-ASP respondents saying they agreed with the same statement. This is evidence that our student-student and student-instructor interventions made a difference for students feeling a sense of community.

A student also reported specifically being happy with the course and lab community, "CS1 and

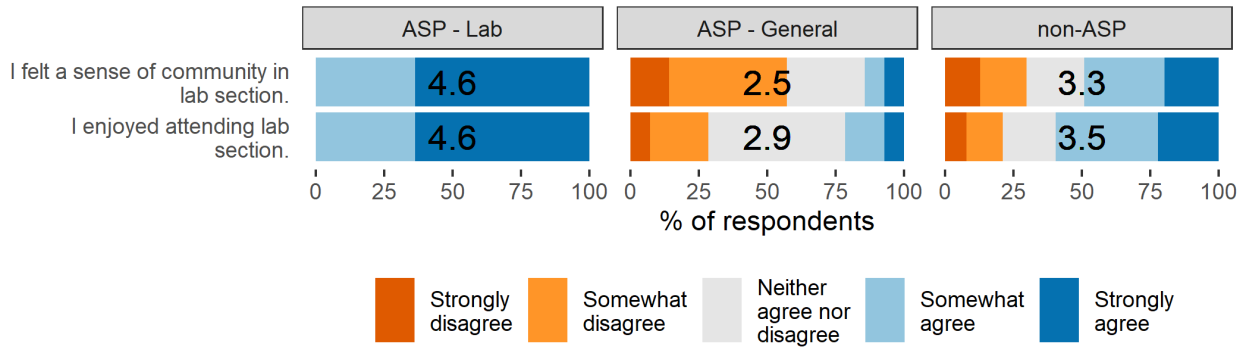

Figure 8: Survey results showing overall course experience.

the Lab are really comfortable places to learn not just coding but other things as well. I liked that it didn't feel too competitive and felt really welcomed as someone with no coding experience, but most importantly the staff is really helpful and they want the students to succeed. Most importantly, they were aware of how the present circumstances affected our learning and were very understanding."

Students in the ASP lab sections were also more likely than their peers to agree with the statement "I enjoyed attending lab section." 100% of ASP-lab respondents agreed that they enjoyed attending lab section. This feedback is in contrast to only 23% of ASP-general respondents and 58% of non-ASP respondents saying they agreed with the same statement.

Grade outcomes did not show an improvement compared to the baseline data discussed above. While the average grade of non-ASP students remained consistent at 3.3 (B+), ASP Lab students received a mean grade of 2.3 (C+), while ASP students who were not in the lab section received a mean grade of 2.2 (C/C+). While we had hoped for a shift in this disparity during our pilot year, it is clear that there is more room for growth with respect to improving this model in subsequent iterations.

Ultimately, these results suggest that interventions in the ASP lab sections designed to support effective student-student and student-instructor interactions fostered a community among students in the CS1 class. These results support our hypothesis. While this analysis does not establish a causal relationship, it does indicate that deliberately cultivating positive student-student and student-instructor interactions may be an effective mechanism to support community-building particularly in large courses.

Reflections, Lessons Learned, and Future Plans

Throughout this work, we appreciated the value of collaboration across various areas of our institution, particularly with ASP leadership, advisors, instructors, and students. We plan to

continue this collaboration with ASP for other core courses in the CS curriculum and believe this process would be fruitful for other institutions similar to ours.

Holistically, the approach we took of focusing on community and student well-being through the interventions we placed seemed to have worked well, as previously discussed. As one of the ASP instructors mentions, “Being able to see the same students during lab and office hours helped me feel a stronger connection and awareness of what the students were going through. This helped me better help students address any issues that came up.” In future iterations of these ASP lab sections, we plan to continue incorporating the interventions discussed in this paper to create a community.

At the same time, there were several drawbacks to some of our approaches that we plan to address to improve students’ experiences in the future.

First, we did not see much change in student performance on exams and overall in their final course grade. We held extra exam study sessions hosted by instructors, but they were not utilized as much as we hoped due to timing constraints. To combat this, we plan on focusing more on exam preparation during lab section. For example, in the current semester, the ASP lab section instructors have added a group work component to the practice exam question portion of lab. In the current iteration, students work individually to solve a practice exam question, followed by working in groups to discuss their solutions together. Previously students only worked individually on solving practice exam questions during lab section. Pre/post survey data as well as analysis of student grades will help determine whether this approach was beneficial.

The instructors also found it difficult to create open spaces for community building with the shift to online learning due to the COVID-19 pandemic. To create more opportunities for organic community-building, in the current semester, the instructors have created in-person office hours opportunities where students can congregate in one physical location to ask questions to instructors and to work together. Pre/post survey data will help assess the efficacy of providing such spaces for students to informally work together.

When it came to lab interventions, the instructors found it difficult to balance lab time between course material and incorporating growth activities. The plan was to have a growth activity done in every lab, but due to timing constraints, we were only able to accommodate 3 activities throughout the semester. In the upcoming semester, the ASP lab sections will pilot a longer lab section, extending the lab from 2 to 2.5 hours. The goal is to provide additional time to accomplish the multiple goals of lab, including reviewing lecture material and engaging students in practice problems, answering practice exam questions, growth activities, and working individually or in small groups on the weekly lab assignment. Student pre/post survey data and analysis of student grades will help determine the efficacy of this change.

Our approach of creating a separate lab section for ASP students required a significant investment of staff resources. Given the resources currently available, we are unable to scale this model to create enough ASP-designated sections for all ASP students enrolled in the course. As the data above suggest, ASP students who did not enroll in ASP sections encountered challenges in the course compared to other students. Thus, this approach is limited in its ability to reach all students who may potentially benefit from it.

Conclusion

For many students, community with peers and instructors is an important aspect of their learning experience in computer science. We created a lab section that focused on community to improve the learning experience for students in our school's academic success program. Overall, building a sense of community and belonging proved to be beneficial. With tweaking to certain interventions, we hope to see better results in exam scores, final course grades in the future, overall satisfaction with the course, and better retention rates of minoritized students in computer science.

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