Developing Post-pandemic Learning Community on an Urban Commuter Campus

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Abstract

This ***evidence-based practice*** paper presents our multiple-pronged approach to develop a post-pandemic learning community in the Department of Computer Science and Information Technology on an urban commuter campus. College students' sense of community has been directly linked to their persistence, satisfaction with the university, motivation, and perception of course value. Building learning communities face special challenges on commuter campuses in the era of post-pandemic hybrid learning. Based on the social learning theory of community of practice, we connected a first-year programming course, a student service-learning program, and two student organizations and developed a unique community-building approach. Our expected outcome is a stronger sense of community among the students and faculty in the department.

Introduction

Learning is a socially situated process optimized when students construct their knowledge together [1], [2], [3]. As communities of practice, college learning communities facilitate the development of collaborative and academic support relationships through ongoing peer interaction [1]. College students' sense of community has been directly linked to their persistence [4], satisfaction with the university, motivation, and perception of course value [5]. Literature also shows that first-year college students with positive changes in university belonging have corresponding positive changes in self-perceptions (e.g., academic competence, self-worth) [6].

Sense of community is defined as "the perception of similarity to others, an acknowledged interdependence with others, a willingness to maintain this interdependence by giving to or doing for others what one expects from them, and the feeling that one is part of a larger dependable and stable structure [7]." It is comprised of the following sub-factors [8], [9], [10]:

1. Membership: feeling that one has invested part of oneself.
2. Influence: sense of opportunity to affect outcomes.
3. Needs fulfillment: both individual and community needs are met reciprocally.
4. Emotional connection: shared history, personal investment, and quality interaction.

Commuter students face additional challenges in integrating into learning communities. Many of them work full-time or part-time [11] and carry responsibilities in addition to the ones of a traditional student. Fostering a sense of community in commuter students has been further challenged by the pandemic since learning communities were forced to transform during social distancing. Increased options in various learning modalities, i.e., virtual, face-to-face, or hybrid, means college commuter students can now choose what suits their individual learning needs and easily switch between classes, work, and family obligations. However, it also means fewer opportunities to "bump" into other students who have chosen a different learning modality. Urban institutions with commuter students must develop new strategies to build learning communities. Students, staff, and faculty have found their new comfort zone, style of working

with others, and ways to manage their other components of life, whether in-person or virtual. Insisting on homogeneous virtual or in-person community participation would diminish participation and, thus, the sense of community. We must cater to virtual and in-person preferences and be flexible enough for students to participate in a community.

There is an urgent need to investigate methods and activities that build communities on post-pandemic urban commuter campuses. However, there is limited literature on post-pandemic community building, particularly on urban commuter campuses of minority-serving institutions.

In this work, we try to solve the problem of developing a post-pandemic learning community in the Department of Computer Science on an urban commuter campus. Aimed at increasing the sense of community for underrepresented minority students, we designed and implemented a multiple-pronged approach based on the social learning theory of community of practice. It includes three aspects:1) Connect a first-year programming course with a student service-learning program; 2) Connect a first-year programming course with student organizations; and 3) form a Department Community Center. Through this approach, we intentionally built community and social capital for our students, especially students underrepresented in the computer science discipline.

Our work addressed the urban commuter community-building challenges by 1) creating multiple entry points to a departmental community; 2) providing easy access and mode choices to reduce the commute time and the financial cost of engaging in a community. Our work also provides a timely study of the methods and activities that can be used to build post-pandemic communities on an urban commuter campus of a minority-serving institution.

In the next section, we explain the details of our approach. We then discuss our results and draw conclusions. We conclude the paper with our future plan.

Approach

Our approach includes the following three components:

1. **Connect a first-year programming course with a student service-learning program:** We connected Computer Science I (CS I) with ExCITE (Excellence in Computing and Information Technology Education), a student service-learning program. CS I students were regularly invited as participants in ExCITE workshops, where upper-level classmen conduct fun hands-on outreach workshops, such as robotics. ExCITE presenters also demonstrated applications of CS I concepts during the CS I lab sessions of the course. We then recruited ExCITE volunteers from these participants and engaged them in outreach activities.

2. **Connect a first-year programming course with student organizations:** We also connected the CS I class with two chartered clubs, the Association of Computing Machinery (ACM) and ACM-Women. CS I students were invited to participate in club meetings, and we arranged some club events immediately after the CS I class to maximize CS I student participation. We allocated a work-study student to devote five to

ten hours per week to planning, coordinating, hosting hybrid club meetings and events (both in-person and online) and increasing students' access and engagement.

3. **Form a Department Community Center with both in-person and virtual spaces:** We established a pilot Department Community Center for students to get together, interact with and support each other. The Center was previously a research-only lab and is currently located in Room C03A. We extended its function to host the ExCITE program, the ACM club, and the ACM-W club. We complement this Center with a virtual one on Discord, where ACM, ACM-W, ExCITE, and CS I have their respective channels and share channels of scholarships, learning resources, internship, etc.

Research Context

We implemented and tested our approach in one of the Department's first-year programming classes, Computer Science I (CS I), in Fall 2022. At the beginning of the semester, twelve students were enrolled in the class – the CS I enrollment has significantly decreased since the pandemic. 80% of the students are Black; 10% are Hispanic or Latino. One student withdrew from the class after the mid-term, and eleven remained for the rest of the semester.

1. **Connect CS I with a student service-learning program.** In Fall 2022, ExCITE students presented "AI and Dance," an interactive virtual seminar, demoed Edison robots [12] and a project developed from a Lingo kit [13] to the CS I students during the CS I lab time. These seminars and demonstrations aimed to 1) inspire curiosity about programming applications; 2) illustrate programming concepts such as loops and branches; and 3) initiate interactions between the ExCITE students and the CS I students, as well as among the CS I students. One of the ExCITE student presenters had just taken the CS I class one semester earlier and the other two semesters ago. Thus, they could easily relate to the current CS I students.

   We explain each one of the activities below.

   - ***AI and Dance.*** We chose an off-the-shelf AI4All Open Learning Curriculum [14] because it is interactive and can create a "wow" effect to spark students' curiosity. This curriculum introduced how Artificial Intelligence (AI), state-of-the-art computing was applied to dancing. During the seminar, students experimented with software that could detect, through a camera, their body movement and generate visual effects accordingly. The workshop, including hands-on activities, discussions, questions, and answers, took about 45 minutes.

   - ***Edison robot demo.*** Edison robots are off-the-shelf robots requiring no assembly and can be programmed with a drag-and-drop interface similar to Scratch [15]. We arranged for an ExCITE student to demonstrate how a robot follows the torchlight of a cellphone. The demonstration illustrates how loops and branches in programming can be used to make robot movement decisions. The demo, including code explanation, discussions, questions, and answers, took about 20 minutes.

- ***Lingo project demo.*** We invited an ExCITE student to present to the CS I students a project he did with a Lingo kit [13], which included a microcontroller board and electronics components, such as LED lights, wires, sensors, a breadboard, etc. The student demonstrated how their program allowed the microcontroller to detect objects with an ultrasonic sensor, turn on a light, and send off an alarm, similar to how an auto-driving car avoids obstacles. The demo took about 20 minutes, including explaining the code and hardware connections, discussions, questions, and answers.

We chose the above topics for the seminar and demos because they were directly related to the computing discipline and exposed students to real-life programming applications. The lights, sounds, and movements of objects and people in these activities made the sessions interactive and engaging, a desired social atmosphere for students to bond with each other.

2. **Connect CS I with student organizations.** CS I students were invited to participate in two in-person club events: a computer take-apart event and a robotics programming workshop. Both events were outside class time, and participation was voluntary. Both were held in the space that serves as our pilot Department Community Center immediately after a CS I class. About half of the CS I class participated in each of the two events.

    - ***Computer take-apart event.*** Six CS I students participated, including a new ExCITE volunteer. Besides the CS I students, three ACM members (one freshman, one upperclassman, and a graduate student) joined this event. Students took apart two used computers with the tools provided during the event. They worked together to figure out how to dissemble the computers and identify the parts. The ExCITE student volunteer facilitated the event by giving brief instructions, technical support, and encouragement.

    - ***GiggleBot programming workshop*.** One ExCITE student volunteer demonstrated three GiggleBots [16] to the CS I students. Three CS I students and five ACM/ACM-W members participated. Among these five students, two were freshmen, and three were upperclassmen. The presenter demonstrated how to drive a GiggleBot with a pre-programmed Microbit [17] and then let the participants do the same. The students also plugged markers into the GiggleBots, to let the robots draw lines on the papers on the floor by moving. Then the students were divided into groups to write programs for the robots on the computers in the lab and then download their code to the robots to test it.

3. **Form a Department Community Center with both in-person and virtual spaces.** The in-person space for the Department Community Center in Room C03A is equipped with a projector, a whiteboard, five desktop computers, and miscellaneous computing equipment and supplies such as various robots and electronics parts. The two work-study students on the ExCITE team were assigned lab hours to keep it open. Access to the lab was also given to the ACM and ACM-W club officers. The ExCITE program, the ACM club, and the ACM-W club host meetings and events in the room. One of the work-study

students, also an ACM-W club officer, was responsible for coordinating events in the Center and sending out announcements as part of their work.

The Discord server, created by the faculty of the ExCITE team, hosts the following text channels: ACM, ACM-W, ExCITE, CS I, scholarships, conferences, internships, learning resources, competitions, pictures, mentoring, etc. The CSI students and the new students to the clubs and ExCITE were invited to join the virtual space by shared link. A faculty member is the server owner. Two student leaders are assigned officers of the server and can create new channels. Faculty and students on the Discord server can all post.

Evaluation Methods

We used an adapted College Sense of Community Scale survey [18] and a survey of reflection questions to collect data for our project.

1. **Adapted CSOC Survey.** We adapted the College Sense of Community Scale survey [18] to measure our participants' sense of belonging to the departmental learning community. The 14-item survey was derived from a 26-item instrument that was factor-analyzed with a sample of 198 undergraduate students. The factor analysis yielded one large first-order factor (the only one with an eigenvalue greater than one) of 14 items [18]. Cronbach's alphas for the 14-item scale were 0.88 and 0.90 for two different samples of 98 undergraduate students [18]. When the 14-item survey was later given to a sample of 761 college students in another study, the reliability score was consistently high ($\alpha = 0.92$) [19].

   We kept all the survey items except for one but modified the questions to fit the departmental learning community instead of the entire campus. Before administering the survey, the research team, which consists of two computer science experts and one educational researcher, confirmed the face validity of the instrument. One item was considered irrelevant to the current study and, therefore, was removed from the instrument. Five-point Likert-style scale was used with choices ranging from 'strongly disagree' to 'strongly agree.' The 13 items were summed to generate a single CSOC score ranging from 13 to 65.

   Survey Directions: Using the scale below, please circle the number that best describes how you feel about the community of the Computer Science and Information Technology Department. 1: corresponds to Do Not Agree; 5: corresponds to Strongly Agree.

   - I really feel like I belong here.
   - There's a sociable atmosphere in the department.
   - I wish I had gone to another department instead of this one.
   - I feel I can get help if I am in trouble.
   - I would recommend this department to students in my high school.
   - There is a strong feeling of togetherness in the department.
   - I someday plan to give alumni contributions to this department.

- I really enjoy being in this department.
- Students here really care about that happens to this department.
- I feel very attached to this department.
- Campus life offered by the department is very stimulating.
- If I am/were going to college next year, I would continue with this department.
- There's a real sense of community here.

2. **Reflection Survey.** Besides the above survey, we also created another open-ended anonymous survey with the following reflection questions to gain deeper insight into students' experiences in the departmental learning community.

    - Do you find the presentations/workshops conducted by the ExCITE Program students helpful? Why or why not? If helpful, in what ways? If not, please explain why.
    - How did participating (or not participating) in the ACM and ACM-W club meetings/activities (including the take-apart event and the robotics workshop) impact your integration into the department community?
    - How did use (or not use) the Discord server (where the ACM, ACM-W, and CSI channels) impact your integration into the department community?
    - Did you use the C03A Lab? Why or why not? If you used the C03A Lab, did you find it helpful or not? If helpful, in what ways? If not, please explain why.

We created both the adapted CSOC Survey and the reflection survey on Qualtrics and administered them virtually to CS I students. The adapted SCOC survey was administered at the beginning of the semester before implementing our approach and then again at the end of the semester after implementation. The reflection survey was only administered after implementation.

Data Analysis

We collected both quantitative and qualitative data. Descriptive statistics and percentage increases were used to analyze the quantitative data. Thematic analysis [20] was used to make sense of the qualitative feedback. The qualitative data provides a sense of theoretical validation on the descriptive quantitative survey items, as it corroborated numeric results. Our project is designed as action research [21]; therefore, the result is not intended to generalize or be predictive. Additionally, our sample size is limited by the number of students enrolled in the CS I class, which was eleven by the end of Fall 2022. While the quantitative data indicates the effectiveness of our approach, inferential statistics were deemed inappropriate due to the small sample size. Our results are summarized below.

1. **Quantitative Results.** The sense of belonging in students that participated in departmental community learning activities is presented in Table 1. Twelve students were enrolled at the time of the baseline survey, and the response rate was 66.7%. Eleven students remained registered when the end-of-semester survey was conducted, and the response rate was 81.8%.

Table 1. Results of Adapted Collegiate Sense of Community

(R) indicates reversed scoring.

#	Field	Baseline Mean (8 entries)	Baseline Standard Deviation	End-of-semester Mean (9 entries)	End of semester Standard Deviation	End-of -semester Mean change	End-of-Semester Mean change percentage
1	I really feel like I belong here	3.88	1.27	4.56	0.50	0.68	17.5%
2	There's a sociable atmosphere in the department	3.63	1.11	4.67	0.67	1.04	28.7%
3	I wish I had gone to another department instead of this one (R)	3.37	0.86	3.44	1.07	0.07	2.1%
4	I feel I can get help if I am in trouble	3.63	1.22	4.44	0.68	0.81	22.3%
5	I would recommend this department to students in my high school	4.25	0.66	4.56	0.50	0.31	7.3%
6	There is a strong feeling of togethernes s in the department	3.63	1.65	4.56	0.68	0.93	25.6%
7	I someday plan to give alumni contributio ns to this department	3.75	1.20	3.89	0.87	0.14	3.7%

8	I really enjoy being in this department	4.00	0.71	4.22	0.79	0.22	5.5%
9	Students here really care about that happens to this department	3.38	1.22	4.22	0.63	0.84	24.9%
10	I feel very attached to this department	3.50	1.58	4.00	0.67	0.50	14.3%
11	Campus life offered by the department is very stimulating	2.75	1.20	3.67	0.82	0.92	33.5%
12	If I am/were going to college next year, I would continue with this department	4.00	0.71	4.22	0.92	0.22	5.5%
13	There's a real sense of community here	3.75	1.30	4.00	0.94	0.25	6.7%
Total adapted CSOC		47.53	11.54	54.45	7.67	6.92	14.6%

Table 1 shows that, at the beginning of the semester, the averages of all the items were above the mean of the scale (3.0), except for only one, i.e., "campus life offered by the department is very stimulating." This finding indicates that the students overall had a high sense of belonging. After our community-building activities, the total score of sense of community increased from 47.53 to 54.45, a 14.6% increase. The averages of all questions increased during the study. The most significant positive changes on average were for a) "Campus life offered by the department is very stimulating," b) "There's a

sociable atmosphere in the department," and c) "There is a strong feeling of togetherness in the department." Figure 1 visualizes the end-of-semester means versus the baseline means of Table 1.

At the end of the semester, "There's a sociable atmosphere in the department" had the highest average (4.67). "I wish I had gone to another department instead of this one" has the lowest (Reversed, 3.44). Other results indicated that students were finding belongingness. For example, one CS I student became an ExCITE volunteer early in the semester and another four students applied at the end of the semester. Three of the CS I students became ACM club officers during the semester.

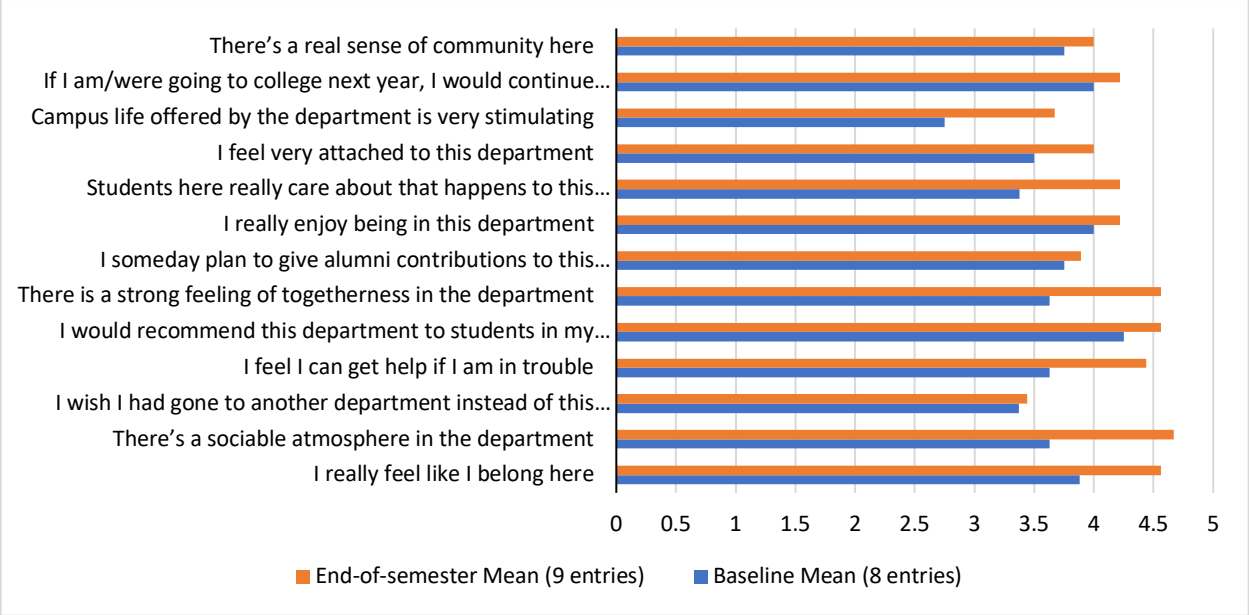

Figure 1. Changes in the Adapted Collegiate Sense of Community

2. **Qualitative Results.** We received eleven entries for the end-of-semester reflection from the students enrolled in CS I. The overall response rate was 100%. The responses to each reflection prompt were summarized below.

1) Do you find the presentations/workshops conducted by the ExCITE Program students helpful? Why or why not? If helpful, in what ways? If not, please explain why.

Of all the eleven students who responded to this question, one did not participate in any of these workshops, while four students found the workshops "helpful" and six "very helpful." Three major themes emerged from the data analysis. First, several students found the workshops helped them see new applications of computer science, for example, "aligned with the course of study" yet "showed different aspects of computer science and coding" or "something I haven't seen before." One student wrote, "It opens my eyes…helps me to realize how the codes we learn in class are applied in real life."

Another noted the presentations "allow me to see where the skills I learn in this class can take me." Second, several students also mentioned the visual and interactive nature of the workshops, e.g., "They (the workshops) are very interactive, and they give me a hands-on experience with different aspects of computer science and coding in general." Third, a couple of students also shared how the workshops were "motivating" or "sparked interest." Overall, these responses indicate increased interest, understanding, motivation, or appreciation of computing.

2) How did participating (or not participating) in the ACM and ACM-W club meetings/activities (including the take-apart event and the robotics workshop) impact your integration into the department community?

Two major themes emerged from the data analysis for this question. First, the workshops cultivated a sense of belonging among the students. For example, one student wrote, "It made me feel like I was part of a community and helped me understand." Another wrote, "It helped…to meet other people and learn…from others." Similar comments included "feel welcomed," "feel like I belong," and "feel accepted and welcomed." One student mentioned that the teamwork in the computer-take-apart activity made them feel like being part of the department. Second, five entries used the word "helped" to describe the impact of the workshops on their understanding of the course materials. For example, students appreciated that the activities improved their understanding of class materials, hands-on experience, and a peek into a future career. One student wrote the activities "really help me to even like the department more and more." It should be noted that out of the three students who responded with "did not participate," one wished they had participated. Another indicated a desire to participate in the future.

3) How did using (or not using) the Discord server (where the ACM, ACM-W, and CSI channels are) impact your integration into the department community?

Two themes similar to the ones we found for Question 2 also emerged from the data analysis for Question 3. First, students found that the Discord server helped them build a learning community. For example, four of the eleven students wrote that the Discord server enabled them to connect, communicate, and be involved with others. One student said the Discord server "made integrating into the class community a bit easier." Second, some students appreciated that the server provided resources and opportunities for them. One student indicated that they wished other classes had also used Discord servers. Ten out of the eleven students thought the server was either helpful, really helpful, or positively impacted their integration into the department community.

4) Did you use the C03A Lab? Why or why not? If you used the C03A Lab, did you find it helpful or not? If helpful, in what ways? If not, please explain why.

Only four out of the eleven students used the lab. The responses were grouped into two themes. First, students found the lab environment appealing to them. For example, they appreciated the various aspects of the lab environment, including quietness and being in a safe space. Second, being able to connect with others and seek help and collaboration was another common reason among the four students who reported having used the lab.

Finally, three out of the seven students who did not use the lab wished to use it in the future. Two of these three indicated that meeting and interacting with other students was part of why they would like to use the space.

The above qualitative data corroborated the positive changes in the quantitative survey results. In conclusion, our community-building activities increased the students' sense of belonging.

It should be noted that our research findings were based on a small sample size due to the low enrollment of the CS I class. Low enrollment in this class is a post-pandemic challenge that this work aims to solve on an urban minority-serving commuter campus. Therefore, we do not expect our findings to be generalizable to other college students in the United States. However, we believe that our findings may be extended to similar minority-serving commuter campuses and will provide valuable insights for similar campuses.

Discussion and Conclusions

As more students today attend colleges and universities through remote learning and more students are over the age of 25, the traditional model of community building may not be able to meet the diverse needs of today's college students, especially commuter students. In this study, we designed, implemented, and assessed an innovative approach to build a post-pandemic learning community for commuter students.

Overall, our quantitative assessment data suggests that the students, in general, reported a greater sense of community after participating in the community learning activities. The students' qualitative feedback indicates that the increase in the sense of community may be associated with the following:

1) Allowing CS I students to interact with the service-learning students and the student clubs through workshops and demos and

2) Having a Departmental Community Center and a Discord server for first-year students to meet with other students and share resources.

These results support the effectiveness of our creative and flexible community-building approach in meeting the learning needs of commuter students.

Our work shows that the most critical elements of creating community are hosting events, leveraging organizations, and providing spaces for students to interact and develop relationships. Events create entry points to a community, while organizations and spaces allow continuous interactions and sustain relationships. Connecting CS I with student organizations had the most significant impact per hour of effort.

Future Work

In our future work, we will extend the study to additional first-year courses, such as Introduction to Programming and Computing Foundations, to investigate our approach further with more

students. We also plan to evaluate if an increased sense of belonging and community increases student retention. Furthermore, we plan on including high-school students to gauge whether a strong sense of community is associated with motivation to pursue a computing major at our institution.

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