Experience of Women Undergraduates Attending a Trip to a Regional Women in Computing Celebration

Dr. Mary V Villani, Farmingdale State College, SUNY, New York

Mary V. Villani is an Associate Professor at Farmingdale State College (FSC) in the Computer Systems Department. She holds a doctoral degree from Pace University, the Ivan G. Seidenberg School of Computer Science and Information Systems. Her dissertation topic was Keystroke Biometric Identification on Long-Text Input. Publications in this area include peer-reviewed journal articles, and a co-authored book chapter, in Behavioral Biometrics for Human Identification: Intelligent Applications. Dr. Villani has been actively seeking funding internally and externally to address gender disparity and broaden participation in the Computing Programs at FSC. The money raised through campus grants and other funding sources was used to provide Women Student Orientation programs, and to take students to women in computing events. Dr. Villani has been active publishing and presenting these experiences in an effort to share within the research community and to ultimately broaden participation. Dr. Villani is the co-advisor of the Supporting Women in Computing Club where she has mentored many women students in the program. Dr. Villani is the recipient of the Chancellor's Award for Teaching Excellence, 2012. Prior to joining FSC, Dr. Villani had a 15 year computer consulting career in the Risk Management and Insurance Industry.

Dr. Ilknur Aydin, Farmingdale State College, SUNY, New York

Ilknur Aydin is an Associate Professor of Computer Systems at Farmingdale State College, SUNY, New York. Dr. Aydin's research is in the general area of wireless and mobile networks with a focus on transport layer issues including multihoming, SCTP, congestion control, and network coding. Dr. Aydin has mentored undergraduate and high school students on research projects that involve the use of Arduino boxes and Raspberry Pi's in the context of Internet of Things, and the use of public testbeds such as CloudLab and FABRIC for WiFi and cellular networking research. Dr. Aydin has been a vivid supporter of women in computing and increasing diversity in computing. She has been the co-faculty advisor for Women in Computing club at Farmingdale, contributed in Grace Hopper Celebration as a technical committee member and reviewer. Dr. Aydin has published and presented in peer reviewed venues about women in computing and broadening the participation over a decade. Dr. Aydin is the 2023 recipient of the Farmingdale Foundation Excellence Award for faculty service.

Dr. Lisa Cullington, Sacred Heart University

Lisa Cullington, Ph.D. is an educational researcher with expertise in academic program development, learning outcomes, and educational assessment best practices. She focuses on building and evaluating academic programs that promote inclusive excellence for all learners. Currently, Dr. Cullington serves as the Associate Provost of Academic Programs at Sacred Heart University. Previously, she was the Founding Co-Chair of the Honors Program at SUNY Farmingdale and Associate Director of the Research Aligned Mentorship (RAM) Program where she designed, implemented, and evaluated academic programs to engage students from historically minoritized communities in undergraduate research opportunities. She has served as a principal investigator and educational researcher on number grant initiatives, including grants from the National Science Foundation and the United States Department of Education.

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Mary Villani
Computer Systems
Farmingdale State College
Farmingdale, NY USA
villanmv@farmingdale.edu

Ilknur Aydin
Computer Systems
Farmingdale State College
Farmingdale, NY USA
aydini@farmingdale.edu

Lisa M. Cullington
Provost's Office
Sacred Heart University
Fairfield, CT USA
cullingtonl@sacredheart.edu

ABSTRACT

Institutions, nationally and internationally, experience a persistent gender imbalance in computing programs enrollment. Despite recent initiatives to increase the number of women in computing degree programs, this disparity continues at Farmingdale State College. It has been demonstrated that increasing students' sense of belonging (SoB) and academic self-concept (ASC) have positive impacts on academic outcomes, particularly for students underrepresented in STEM education. This study investigated how attending a women focused computing conference can impact student attendees' SoB and ASC in short- and long-term. Students' perception of their experiences and measures of SoB and ASC are obtained through a series of surveys. This study found that attending a women focused computing conference positively impacted women students' SoB and ASC.

1. Introduction and Background

Gender imbalance in computing programs is a persisting issue not only at Farmingdale State College (FSC), but also at the national and international level. The authors have taken a multi-faceted approach to balance the gender gap by running multiple support programs at FSC more consistently since fall 2019 [1]. This paper focuses on the intervention of providing women students with an opportunity to attend an overnight, women in computing conference. Preliminary results from the first in-person overnight mixed-gender field trip in spring 2022 were positive [2]. This paper evaluates the impact of the second in-person overnight trip, that was limited to women only in spring 2023.

Enrollment in FSC computing programs has doubled since 2010 to over 750 at its peak; however, the percentage of women enrollment in computing programs has remained relatively flat between 8-16% (Fig. 1). While the Computer Programming and Information Systems (CPIS) program has been offered for over 20 years, the Computer Science (CS) program was launched in fall 2021. FSC is one of the 64 campuses in a large state college system and a diverse space where about 90% of its ~10,000 students are commuters, 82% work full or part-time while attending college, 57% are from minority populations, 62% receive financial aid, 30% are first-generation college students, and 42% are women. Coupled with the high cost of living in the area, these factors result in a school community in which the students work and live in their childhood homes. In addition, opportunities for students and faculty to attend professional events are limited with funding. All

these factors make it challenging to build student camaraderie and engagement unlike in a traditional residential college.

Researchers posit that providing students with an opportunity to have an overnight stay away with classmates, while being immersed in a conference with women in the computing industry and academia, will have positive immediate and longer-term impacts. Research questions investigated are as follows.

RQ1) Does attending a women in computing conference impact students' sense of belonging (SoB) in the short- and long-term?

RQ2) Does attending a women in computing conference impact students' academic self-concept (ASC) in the short- and long-term?

The rest of the paper presents the related work and conceptual framework in Section 2, the trip planning and logistics in Section 3, the data collection in Section 4, results and analysis in Section 5, discussion and limitations in Section 6, and conclusions and future work in Section 7.

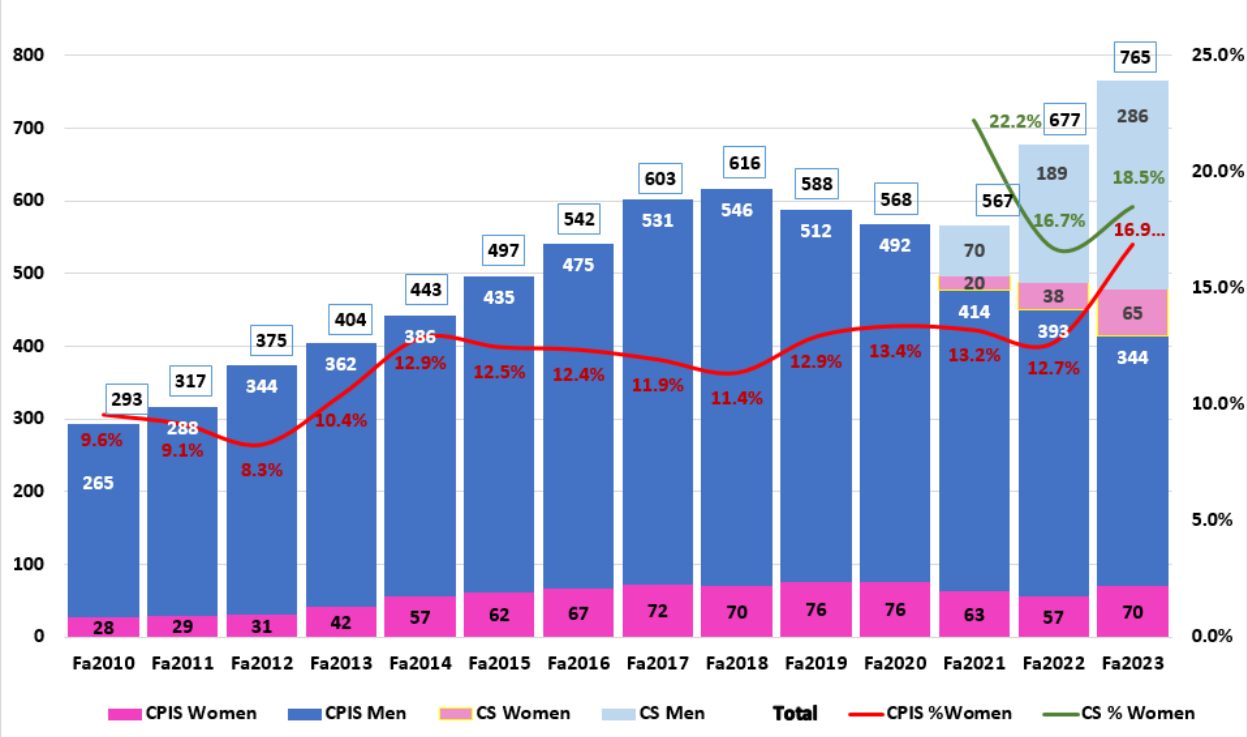

Figure 1: Computing Degree Enrollment at FSC by Gender

2. Related Work

Sense of belonging (SoB) [3] is identified as one of the five levels of human need and shaped decades of extensive research focused on the cultivation of SoB among college students. SoB refers to one's feeling that they are connected and belong. In higher education, Strayhorn [4]

defines it as "students' perceived social support on campus, a feeling or sensation of connectedness, and the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the campus community or others on campus such as faculty, staff, and peers". Feeling a sense of personal and academic acceptance from both faculty and peers influences academic self-help seeking behaviors, personal motivation, and perceptions of their faculty members [5]. Previous research has demonstrated the complexities of cultivating SoB among underrepresented racial and ethnic communities [6], women in the STEM disciplines [7], and first-generation college students [8, 9]. Furthermore, scholars have identified the positive impacts of cultivating a SoB on student retention, persistence, and graduation through both academic and social integration [10, 11]. This integration may include faculty mentorship [12, 13] and peer interaction [7, 10, 14, 15].

Educational psychologists have long sought to understand the motivations of students' Academic self-concept (ASC) in higher education. Self-concept influences what students think about themselves, how they feel about their capabilities, and the actions they take in face of challenges [16, 17, 18]. Using both cognitive and affective judgements, ASC is a useful predictor of students' anxiety, satisfaction, and self-esteem in academic situations and overall college retention [16, 17, 18]. ASC intersects with race, gender, social, and first-generation college student status to inform understandings of college retention, particularly in the STEM fields, by predicting non-cognitive dimensions of student success [16]. [20] identifies research that has demonstrated that ASC may be a more accurate predictor of GPA than standardized test scores for students from low-income communities and students from historically marginalized racial and ethnic groups. [18] found that a lower social economic status combined with lower levels of parental education correlate with lower levels of ASC for students. Within the STEM fields, ASC is higher for women in biology and medicine, whereas men's ASC is higher within engineering, math, and physics fields [21]. Given the significant gender disparity in computer science, future research needs to identify the role ASC plays for women [19].

Undergraduate student attendance at discipline specific and technical conferences provides several benefits for students. Specifically, conferences aimed at supporting underrepresented student populations can be particularly effective. Started in 1994, the Grace Hopper Celebration of Women in Computing Conference (https://ghc.anitab.org) is an international conference that brings women together from across the computing field and serves as a networking opportunity for students, faculty, and industry professionals. Conference participation has been demonstrated to increase students' awareness of accomplished women in the CS field, students' self-confidence to success in the computing field, and students' motivation to remain in the CS field [22]. Regional conferences also provide similar positive impacts for undergraduate students. [23] measured the impact of attending regional celebrating women in computing conferences. They found that student participation strengthened their commitment to their peers, decreased feelings of isolation and increased a sense of community. Conference attendance, whether national or regional conferences, is not to be reserved for students in their final year of undergraduate study. [24] found that conference attendance among first- and second-year students can increase students' sense of belonging and self-confidence and these increases maintain higher than non-participants over time.

As such, conference attendance in the early years of undergraduate education may assist student retention in computing majors.

However, conference attendance requires additional pre-conference and during-conference support by faculty members. [25] found that supplementing student attendance with a course designed specifically to students attending the Grace Hopper Celebration for Women in Computing (GHC) or the CMD-IT/ACM Richard Tapia Celebration of Diversity in Computing Conference (https://tapiaconference.cmd-it.org) was helpful for students and faculty alike. This course prepared students for the experience, engaged students in diversity, equity, and inclusion related conversations, and empowered self-exploration among the students participating. Student attendance at conferences requires substantial faculty support in and outside of the classroom.

3. Trip Logistics and Planning

The NY Celebration of Women in Computing (NYCWiC) conference (https://nycwic.org) is one of the most established ACM-W regional celebrations in its 10th year. It has been organized as a two-day event requiring an overnight stay where the student registration covers food, conference attendance, and lodging as a nominal fee. As such, it was selected as the spring 2023 field trip location (as it was in spring 2022 field trip) at FSC.

FSC provided an academic sponsorship to the conference in 2023 which covered eight student and two faculty registrations. The remainder of the funding for the transportation (the largest expense) and remaining student registration came from the student government funding via the Supporting Women in Computing (SWiC) club, a registered student organization and ACM-W Student Chapter at FSC.

All women students enrolled in four computing majors including CPIS, CS, and Computer Security Technology (CST) and Security Systems Technology (SST) were invited to attend to the 2023 field trip by the two women SWiC faculty advisors (authors). This invitee list totaled 125 women students (21 CST, 16 SST, 52 CPIS and 36 CS). Invitation and notification of the trip were sent via email and paper mail to student homes. Additionally, two hybrid information sessions were held during the SWiC meetings to help students with the RSVP process. The notification and recruitment process lasted 2.5 months from early January until March (the conference was scheduled for mid-April). Student attendees were *not* required to pay to attend the trip, but many had to take time off from work and obtain "permission" from families. Initially 54 students registered their interest, but at the end 35 women students (accompanied by two SWiC faculty advisors/authors) attended the trip with significant student cancellation in the week prior to the conference. Reasons for the increase in student cancellation right before the conference are explored in the discussion in Section 6.

FSC required waiver and emergency contact forms to be completed by the trip attendees. Faculty advisors gained experience on this challenging process from the 2022 trip but collecting missing information from registration documents, following up with students via email and text messages, and ensuring the completion of the travel package for approximately 50 students in the middle of

a semester was a time-consuming process. There was no administrative support for the two faculty in completing these tasks.

In addition, the participants were also required to complete the registration process of the conference in coordination with faculty advisors and the conference leadership. Instructions were provided to student attendees via email and a hybrid SWiC meeting was held to help students with the conference registration. However, one-on-one support was still required for some students which resulted in considerable time commitments among the faculty advisors, conference organizers, and students. Additional support was required for issues such as student errors in online registration and payment processes, hotel room assignment disagreements, collecting t-shirt sizes, and parking overnight on campus as most students were commuter students and did not have prior authority to park overnight. Furthermore, a considerable number of students were observing Ramadan that required the coordination of meal accommodation from the conference leadership. Lastly, a bus was hired for transportation to and from the conference, which required coordination from the faculty advisors.

Student attendees were required to attend a mandatory pre-trip meeting that was held in a hybrid format. Students who could not attend the meeting were required to individually meet with one of the advisors. The pre-trip meeting was an opportunity for the advisors and student to meet one another prior to the trip and inform the students first-hand about the trip logistics such as departure and return times, overnight parking on campus, review of the conference program, and expectations from students during the conference.

A Discord server was setup and utilized as a communication channel throughout and after the conference among students and faculty advisors and provided a convenient way to distribute messages and share pictures and videos. The discord server was created and maintained by one of the SWiC officers who added a countdown and helpful information in the weeks leading up to the trip. An anonymous voting feature in Discord was deployed to gain participant information. For example, during the ride back home, participants were polled if they wanted to stop or drive straight through to arrive home sooner. The Discord server feature provided the ability to canvass the attendees to get majority vote eliminating peer pressure to vote publicly. All this helped to increase the bonding among the participants.

FSC group boarded the bus on campus on Friday early morning to return Saturday early eve. During the conference, faculty advisors monitored and encouraged FSC students to engage and network with others while also acting as moderators for sessions. SWiC club officers presented a poster about the club, while one FSC student presented a workshop about her undergraduate research experiences. The conference included opportunities for engagement in discipline specific technical sessions and network opportunities. There was a range of formats for the sessions that included workshops, panels, lectures and career and graduate school fairs. Several methods were employed to extrinsically motivate students to engage with others at the conference such as raffle tickets for asking interesting questions in sessions and prizes for students who made the most connections at the conference.

4. Data Collection

The pre-trip and post-trip surveys were administered using Qualtrics software to measure the student perceptions of the conference and the immediate impact on their SoB and ASC. Students were provided QR codes to enable them to take the surveys utilizing their mobile device on the bus ride to and from the conference. Participating in the survey was voluntary. As a result, the data collection procedure did not have a 100% response rate. To explore the long-term impact of attending the conference and other initiatives at FSC, women students enrolled in CS and CPIS programs were also invited to participate in an end of semester (EoS) surveys starting in fall 2021. This research has been approved by the institution's IRB for 5 years since 2020. Fig. 2 shows a timeline of a subset of surveys where the red font indicates what is reported in this paper, which includes EoS May '22, post-trip '23, and EoS May '23 survey results. This paper's focus is on the impact of the spring (April) '23 trip and its comparison with the previous spring (April) '22 trip so while May '22 and May '23 EoS surveys look at the immediate and 1-year impact of the spring '22 trip, respectively, post-trip '23 survey looks at the immediate impact of the spring '23 trip.

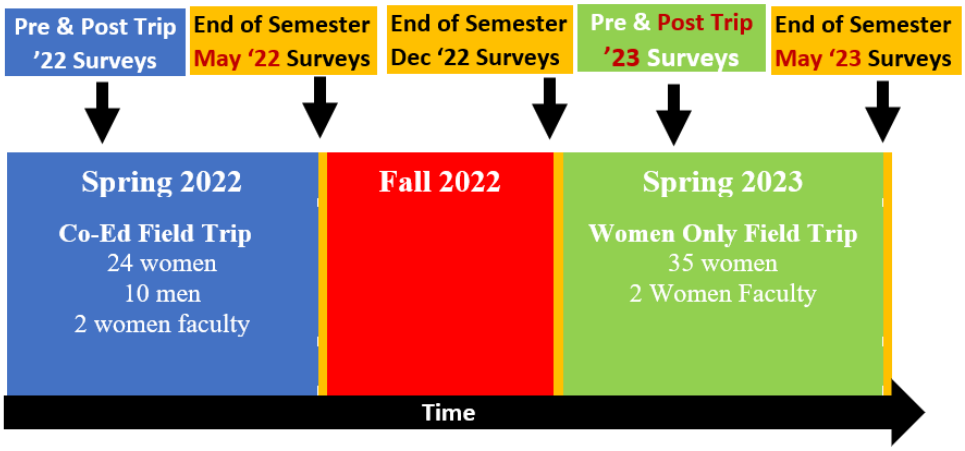

Figure 2: Timeline of Survey Data Collection

5. Results and Analysis

The demographics included 35 women students attended the spring 2023 conference, 26 took the pre-trip survey and 30 the post-trip. The post-trip respondents were 10 from CPIS, 8 CS, 5 CST and 6 SST and 1 other major. More than half were upper-class women. 29 respondents identified as woman and one as transgender. Fig. 3 demonstrates the diversity of the respondents. In EoS May '22, 4 of the 22 total responses were from field trip attendees (FTA) and in EoS May '23, 12 of the 35 total responses were from field trip attendees.

Student experience and perceptions are included in Table 1. The responses are summarized from the post-trip survey where attendees report what they gained from the trip experience. Students were also prompted with free form questions at the post-trip survey to provide a summary of their experience attending the conference. Fig. 4 and 5 contain the positive and negative comments respectively. The takeaway from the free form responses is that the trip was a positive experience for most and the goal of creating camaraderie and bonding was largely accomplished.

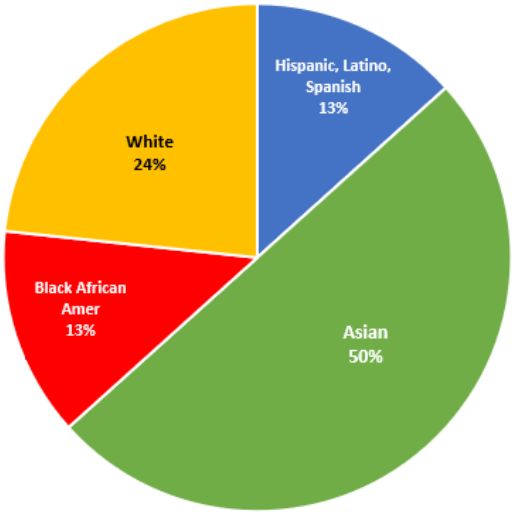

Figure 3: Race/Ethnicity of Post Survey Respondents (N=29)

	SA	Agree	Neutral	SD	Disagree	N/A
Learned from industry leaders about tech topics	64%	32%	4%	0%	0%	0%
Gained technical skills from workshops	36%	32%	12%	0%	12%	8%
Gained soft skills from workshops	40%	44%	8%	0%	4%	4%
Learned about grad. school paths	36%	32%	4%	0%	4%	24%
Learned about job opportunities	48%	36%	4%	0%	4%	8%
Networked w/ leaders and peers in field	60%	32%	4%	0%	4%	0%

Table 1 : Student Perception on Gains (Post Survey N=29)

I enjoyed the workshops and other breakdown sessions they had. However, the biggest drawback was the fact that faculty was easier to talk to then my peers, at FSC or not. There were a lot of cliques, so I did my best to branch out anyway.

I liked attending the different events and networking. I also really enjoyed learning about masters and PHD programs. However, I didn't like how packed the first day was. The highlight of the conference was attending the career fair and winning something from the raffle.

I didn't really like this year's keynote speakers. Some of them felt irrelevant to me. But overall, I had a good experience and felt like I learned a lot.

Figure 4: Negative Comments (Post-Trip Survey)

This was my first time attending one of these conferences, so I didn't really know what to expect at first. Being there and learning about what some people are studying/what jobs people was so interesting and showed me that there are so many paths I can take in this field. I really enjoyed the first panel where they talked about how cool their jobs were!

The most important concept that I was looking for was the ability to network. My goal was met. I also was able to get closer to my peers from XYZ. Plus, it did not hurt that I had a room alone. I do wish that there was more assortment of food.

The conference overall was such an amazing experience. I not only had a lot of fun, but I learned a lot. It made me feel more motivated and opened my eyes to new opportunities and how to be successful within this field. The workshops really helped me gain insight. The Taylor Swift birds of a feather event and the trivia were such fun events where I really got to bond with and have fun with my peers from FSC.

I really enjoyed that we got to meet with succeeding women in such a male dominated field. It motivated me to keep working at my goals. I was so excited to meet the national president of Esports especially because I am always gaming with my friends. I was also inspired to see educators turn to computing and combining both worlds.

I really enjoyed attending the conference where I made new connections, learned to interview skills, and graduate school paths. Although I may not receive any jobs or internships from this conference, I feel way more connected to the SWiC in FSC!

Figure 5: Positive Comments Post-Trip Survey

In the rest of this section, the results for RQ1 (about SoB) and RQ2 (about ASC) are examined for both the short term and long-term impact on trip attendees.

The short-term impact on SoB is seen in Table 2 that includes post-survey responses related to SoB. 84% of respondents both strongly agree and agree that they felt they bonded with classmates and peers at FSC because of attending the trip. 88% strongly agree and agree that they will have better peer support in classes upon return from the trip. The last two categories of how attendees feel about expanding their network beyond FSC and feeling more connected to others in the field also received very positive percentages on strongly agree and agree; however, it is not a direct measure of SoB at FSC because of attending the trip, but a more tangential measure of SoB in the industry at large.

The longer-term impact on SoB is observed in Fig. 8 that reports EoS results. The results show both May '22 and May '23 responses of attendees where in '22 100% strongly agreed and agreed that they bonded with classmates and peers as a result of attending conference and in '23, 75% strongly agreed and agreed where 25 % were neutral. In '22, 75% strongly agreed and agreed they improved peer support in their classes where 100% strongly agreed and agreed in '23. Expanding

the network beyond FSC is not as direct a measure of SoB at FSC, but in the industry and in ‘22 only 50% strongly agreed they expanded their network where in ‘23 83% strongly agreed and agreed they expanded their network. Another measure of long-term impact can be gleaned from Fig. 6 and 7 that report EoS results about experience in computing programs at FSC. A general question about the social experience at FSC is asked of all respondents in EoS, Fig. 6 and 7 show ‘22 and ‘23 results of All respondents and FTAs (field trip attendees). In ‘22, 20% of respondents report a poor social experience whereas FTAs report 50% excellent and good and 50% acceptable and not poor. In ‘23, a similar result where All respondents have reported poor social experience where FTAs have not poor and quite strong on excellent and good. In summary, the data supports the research question that the field trip positively impacted the attendees short-term and long-term SoB because of attending the trip.

The short-term impact on ASC is seen in Table 3 that includes post-survey responses related to ASC. 88% of attendees reported they strongly agreed and agreed that they felt more confident to succeed in their computing classes upon return from the trip and 16% were neutral. 84% strongly agreed and agreed that they were more motivated to complete their degree than prior to attending the conference. 8% were neutral and 8 disagreed.

The longer-term impact on ASC is in Fig. 9 that reports EoS results. In ‘22, only 50% strongly agreed and agreed that they felt more confident to succeed in classes upon return of the trip and 50% were neutral whereby in ‘23, 75% strongly agreed and agreed that they felt more confident to succeed in computing classes and 16.7% were neutral and 8.3% disagreed. In ‘22, 75% strongly agreed and agreed that they were more motivated to complete a degree than prior to attending conference and in ‘23, 91% strongly agreed and agreed which is showing the motivation very positive feeling months after attending the conference. An additional question was posed in ‘23, and not in ‘22, that inquired if attendees felt empowered from the knowledge gained from the conference and a resounding 91.7% reported they strongly agreed and agreed that they felt empowered which contributes to the long-term ASC. Another measure of long-term impact can be gleaned from Fig. 6 and 7 that report EoS results about experience in computing programs at FSC. When comparing All respondent responses to FTAs, in ‘22, 80% of All respondents report Excellent and Good Academic Experience which is slightly higher than 75% that attended field trips. However, neither report poor academic experience. In ‘23, All respondents report 87% excellent and good academic experiences whereas FTAs report 100% academic experience. In summary, the data supports the research question that attending the field trip has a positive impact in both the short term and the long-term measures of ASC.

I feel I…	SA	Agree	Neutral	SD	Disagree
Bonded with classmates and peers at FSC	48%	36%	8%	0%	8%
Will have a better peer support in my classes at FSC	44%	44%	4%	0%	8%
Expanded my network with people beyond FSC	40%	48%	8%	0%	4%
Am more connected with people in my field	48%	32%	16%	0%	4%

Table 2: Immediate Impact on SoB (Post Survey N=29)

I feel more…	SA	Agree	Neutral	SD	Disagree
Confident to succeed in my computing classes	40%	44%	16%	0%	0%
Motivated to complete my computing degree more than prior to attending the conference	48%	36%	8%	0%	8%

Table 3: Immediate Impact on ASC (Post Survey N=29)

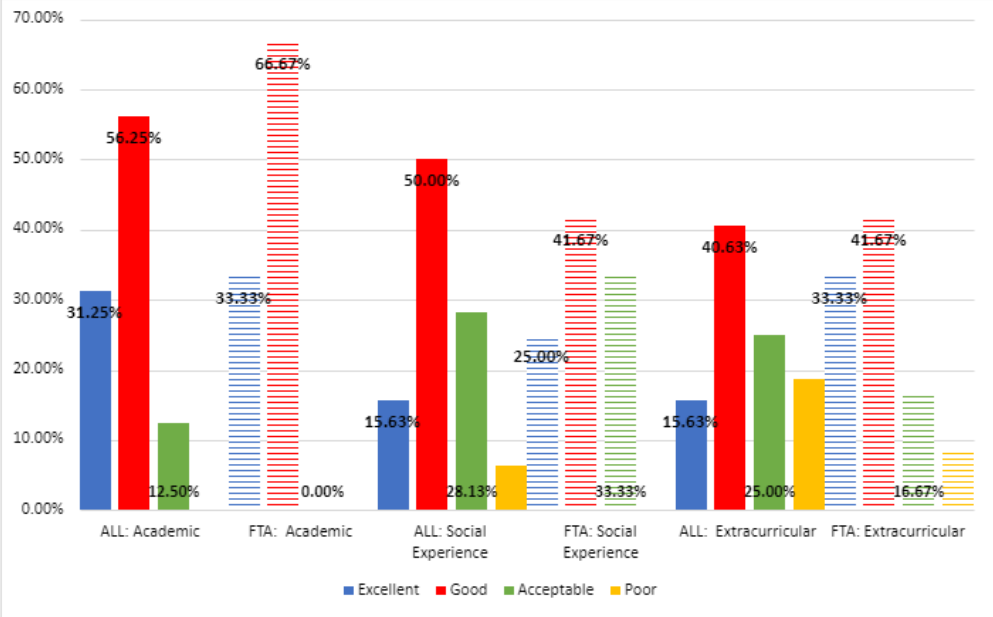

Figure 6: Experience Perception Women Students EoS 2023 Survey

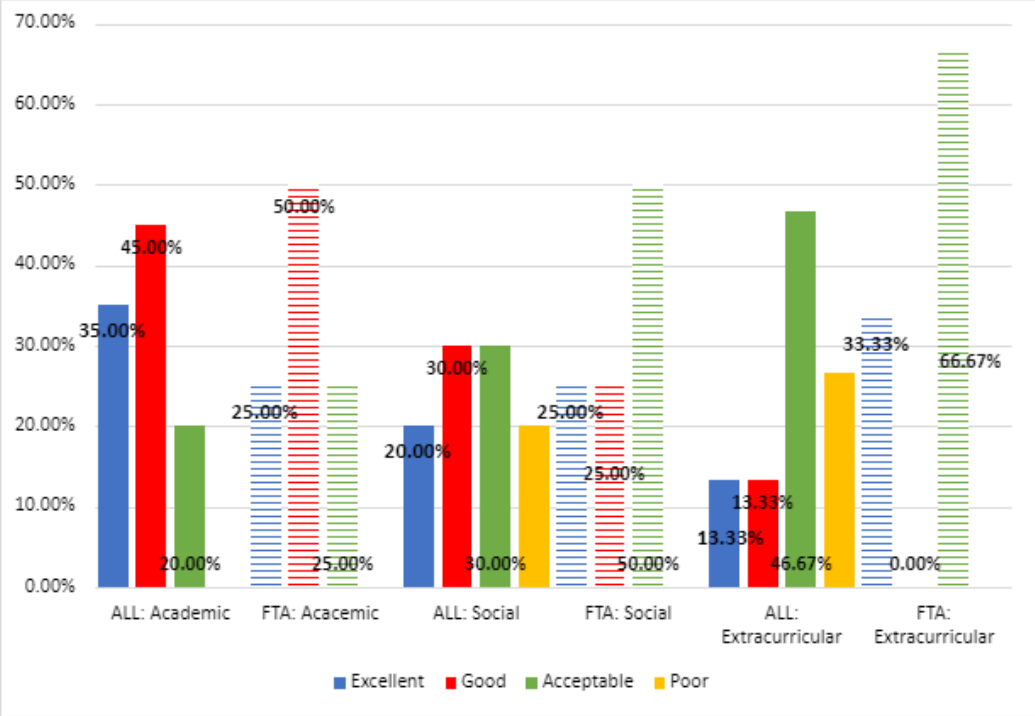

Figure 7: Experience Perception Women Students EoS 2022 Survey

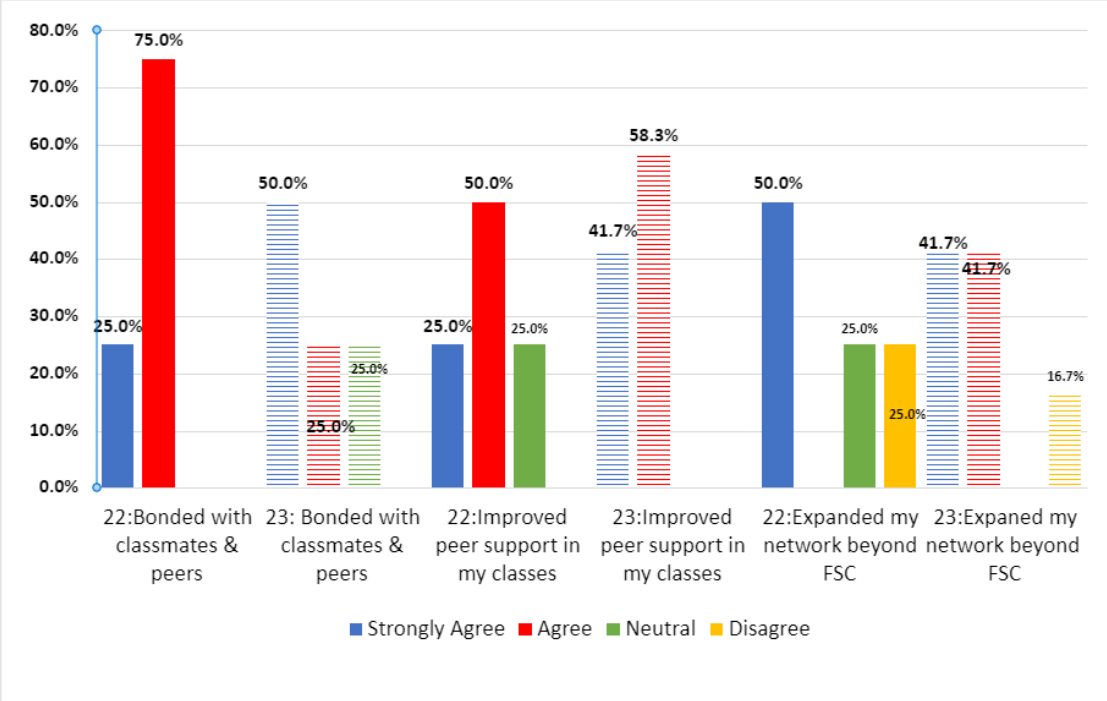

Figure 8: Sense of Belonging (EoS '22 & '23 EoS)

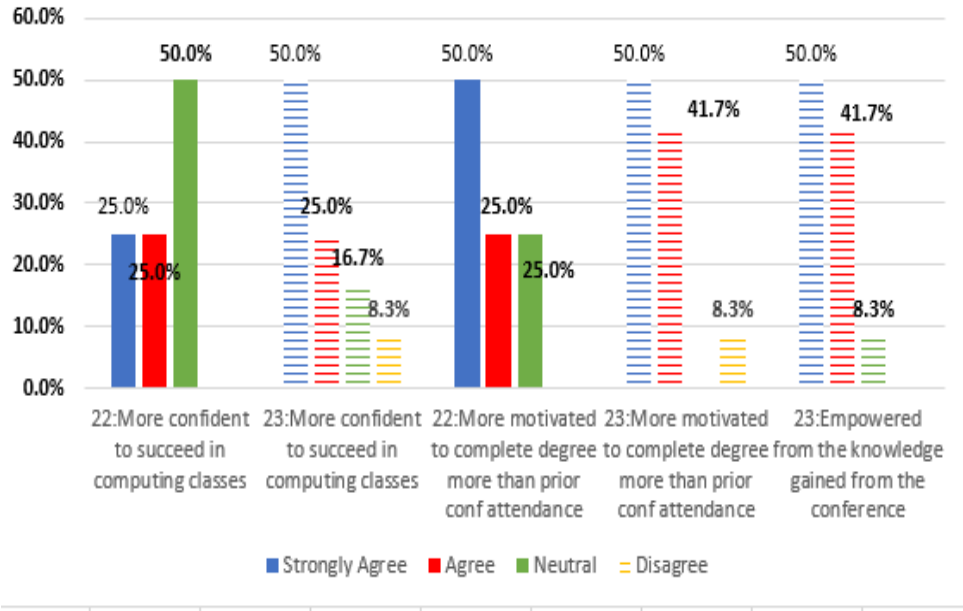

Figure 9: Academic Self-Concept (May '23 & '23 EoS)

6. Discussion and Limitations

Overall results presented in Tables 2-3 and Fig. 6-9 support that attending a conference positively impacted student experience, bonding, SoB, and ASC. However, authors acknowledge the small number of responses in the surveys and plan to conduct qualitative data collection and analysis using interviews. Attending the field trip positively impacted students' peer interaction and support, specifically. Peer acceptance is one area of SoB. Future research is needed to investigate the impact on *academic* acceptance and connection with the faculty members and/or the academic department at FSC. Students also reported positive impacts of their ASC. While students felt more confident in their classes, the study did not ascertain if students felt their capabilities were enhanced by this experience.

There seemed to be last-minute hesitation about attending among some students. Their reasons included being responsible for younger siblings at home, not being able to take time off from work, and not feeling well. For example, one student communicated to the advisors via Discord at 1 a.m. the morning of the trip, *"I want to go, but I just get nervous being away from home. I don't know if I will attend but I apologize."* Most students notified one or both advisors; however, some elected to notify SWiC officers only. The morning of the trip, several students informed the advisors that their friend (who had previously registered for the conference) would not be attending. In preparation for the trip, faculty advisors offered to speak with several students' families who expressed concerns that their parents would not allow them to stay overnight on a school trip. For some of the attendees, families had strong emotional reactions at drop off and pick up.

While the reasons for these hesitations are complex, Kegan's Adult Constructive Development Theory (ACDT) [26,27] might shed light on the students' experience. Kegan explains that the theory focuses on individuals building a self through constructing meaning from experiences and that this self develops over a lifespan. The theory posits that people can move through five

developmental stages (order of mind). Each order does not involve knowing more, but rather a new way of constructing that knowledge [27]. These five stages include (1) the impulsive mind, (2) the imperial mind, (3) the socialized mind, (4) the self-authoring mind, and (5) the self-transforming mind. In the third order, students have internalized systems of meaning. As such, they might feel tension when they are negotiating two systems of meaning (family versus college/school in this study). Theoretically, it would be more difficult to strengthen a SoB and ASC with students who perceive their internalized system of meaning as at odds with higher education and their academic discipline.

Most of the women registrants from FSC college are commuter students who reside in their childhood homes. Unlike students from residential colleges, this was many of the registrants' first time spending a night away from home. While religion is not a focus of this study, a large group of students observed Ramadan which coincided with the conference. This also may have led to feelings of tension between remaining at home versus attending the conference (despite accommodations for students observing Ramadan). Future research could investigate how Kegan's ACDT might relate to students' SoB and ASC.

7. Conclusions and Future Work

This paper presents how attending a woman focused computing conference positively impacts SoB and ASC for women computing degree majors. However, due to the large number of last-minute cancellations, authors call for future work to consider how ACDT might be useful in understanding the students who registered but did not attend. The authors posit that tension between home responsibilities and attending the conference could have impacted the study participants. Authors theorize from this study that it may be more difficult to cultivate a SoB and ASC for students who felt that tension. While this work fills a gap in the literature and shows that conference attendance has a positive impact on SoB required to make more definitive and broader conclusions.

REFERENCES

[1] I. Aydin, M. Villani, L. Cullington, "Measuring the Impact of Budding Support Programs for Women Undergraduates in Computing Degrees," *ASEE Annual Conference & Exposition*, Baltimore, MD, June 2023.

[2] M. Villani, I. Aydin, L. Cullington, "Analyzing the Impact of Attending a Women in Computing Conference on Undergraduate Computing Students," *ASEE Annual Conference & Exposition*, Baltimore, MD, June 2023.

[3] A.H. Maslow, *Toward a Psychology of Being*, New York, NY: Harper & Row Publishers, 1962.

[4] T.L. Strayhorn, *College Students' Sense of Belonging: A Key to Educational Success for All Students*, (2nd ed.) Routledge, 2018, p. 4.

[5] A. Zengilowski, J. Lee, R.E. Gaines, H. Park, E. Choi, D.L. Schallert, "The collective classroom "we": The role of students' sense of belonging on their affective, cognitive, and

discourse experiences of online and face-to-face discussions," *Linguistics and Education*, Feb 2023, 73, pp101-142.

[6] K. Rainey, M. Dancy, R. Mickelson, E. Stearns, & S. Moller, "Race and gender differences in how sense of belonging influences decisions to major in STEM," *International journal of STEM Education*, 2018, *5*, 1-14.

[7] S.L. Rodriguez, J.M. Blaney, "We're the unicorns in STEM": Understanding how academic and social experiences influence sense of belonging for Latina undergraduate students," *Journal of Diversity in Higher Education*, 2021, *14*(3).

[8] C. Gillen-O'Neel, "Sense of Belonging and Student Engagement: A Daily Study of First- and Continuing-Generation College Students," *Research in Higher Education*, 2021, *62*(1), 45-71.

[9] S.D. Museus, T.H. Chang, "The Impact of Campus Environments on Sense of Belonging for First-Generation College Students," *Journal of College Student Development*, 2021, *62*(3), 367-372.

[10] G.M. Davis, M.B. Hanzsek-Brill, M.C. Petzold, D.H. Robinson, "Students' sense of belonging: The development of a predictive retention model," *Journal of the Scholarship of Teaching and Learning*, 2019, *19*(1).

[11] V. Tinto, *Completing College: Rethinking Institutional Action*, University of Chicago Press 2012.

[12] A. Byars-Winston, J. Branchaw, C. Pfund, P. Leverett, J. Newton, "Culturally Diverse Undergraduate Researchers' Academic Outcomes and Perceptions of Their Research Mentoring Relationships," *International Journal of Science Education*, 2015, 37:15, 2533-2554.

[13] T. Tsang, "The role of faculty and peer interactions in supporting humanities students' persistence and post-graduation aspirations: A case study," *InterActions: UCLA Journal of Education and Information Studies*, 2018. 14(2).

[14] J.A. Crowe, "Creating a departmental climate that increases a student's sense of belonging, perceived faculty support, and satisfaction with the major," *Innovative Higher Education*, 2020, 46(1), 95–109.

[15] A. Tsang, "The value of a semi-formal peer mentorship program for first-year students' studies, socialization and adaptation," *Active Learning in Higher Education*, 2023. *24*(2),125–138.

[16] M. Bong, E.M. Skaalvik, "Academic Self-Concept and Self-Efficacy: How Different Are They Really?", *Educational Psychology Review*, 2003, *15*(1), 1–40.

[17] A. Haktanir, J.C. Watson, H. Ermis-Demirtas, M.A. Karaman, P.D. Freeman, A. Kumaran, A. Streeter, "Resilience, Academic Self-Concept, and College Adjustment Among First-Year Students," *Journal of College Student Retention: Research, Theory and Practice*, 2021, 23(1) pp. 161-178

[18] A. Sullivan, "Academic self-concept, gender and single-sex schooling," *British Educational Research Journal*, 2009, 35(2), 259–288.

[19] L.J. Sax, M.A. Kanny, T. A. Riggers-Piehl, H. Whang, L.N. Paulson, "But I'm Not Good at Math:" The Changing Salience of Mathematical Self-Concept in Shaping Women's and Men's STEM Aspirations," *Research in Higher Education, 2015*, Vol. 56, Issue 8, Springer Netherlands.

[20] K. Cokley, “An Investigation of Academic Self-Concept and its Relationship to Academic Achievement in African American College Students”, *Journal of Black Psychology*, 2000, 26(2), 148–164.

[21] M.E. Beier, A.D. Rittmayer, “Literature Overview: Motivational factors in STEM: Interest and Self- Concept,” *Assessing Women and Men in Engineering*, 2008, 1–10.

[22] J.M. Francioni, “A conference's impact on undergraduate female students,” *ACM SIGCSE Bulletin*, June 2002, *34*(2), 66-69.

[23] G.C. Townsend, K. Sloan, “An effective alternative to the Grace Hopper Celebration,” *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*, February 2015, (pp. 197-202).

[24] H.M. Wright, N.B. Tamer, “Can sending first and second year computing students to technical conferences help retention?” *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, February 2019 (pp. 56-62).

[25] M. Seyam, M. Abu-Elkheir, “Diversity-focused Course Design for Computer Science Students: Incorporating Diversity Conference Attendance into Course Design and Delivery,” *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education*, June 2023, *V. 1* (pp. 40-46).

[26] R. Kegan, *The evolving self: Problem and process in human development*, Cambridge, MA: Harvard University Press, 1982.

[27] R. Kegan, *In over our heads: The mental demands of modern life*, Cambridge, MA: Harvard University Press, 1994.