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Exploring Computer Science Student Perceptions on Service Learning: Online and On-Campus Modality Comparative Study

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ABSTRACT

This study examines computer science students' perceptions of their service learning experiences, comparing fully online and on-campus modalities. Service learning is a teaching approach that integrates community engagement with academic learning, offering students opportunities to apply technical knowledge in real-world settings while addressing community needs. An electronic mixed methods survey was developed, tested for validity and reliability, and distributed to 110 college students enrolled in both modalities of our 400-level Race, Gender, and Class in the Digital World course. About 57% of students responded to the survey: 50 on campus and 13 fully online. Using survey data, this research evaluates students' views on skill development, career preparation, and their ability to apply computer science concepts to practical challenges. Additionally, qualitative analysis of open-ended responses reveals insights into students' reflections on social responsibility, professional growth, and challenges faced during their service learning. The findings indicate minimal differences between the two modalities, suggesting that service learning offers consistent benefits regardless of how it is delivered. However, unique challenges were highlighted, including managing expectations in virtual collaborations and navigating non-technical client relationships. Implications for curriculum design, strategies to foster deeper community impact, and directions for future research are discussed, emphasizing the value of service learning in computer science education.

Keywords: Service Learning, Undergraduate CS Students, Computer Science Service Learners, Service Learning Modalities, CS Service Learners.

1. INTRODUCTION

Service learning integrates community engagement with academic coursework, providing students with opportunities to apply their knowledge in real-world settings while addressing community needs. According to Bringle and Hatcher (1996), service learning involves "a course-based, credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility."

In the field of computer science, service learning is particularly valuable for enhancing technical and interpersonal skills, fostering career readiness, and promoting ethical awareness.

This study focuses on understanding computer science students' perceptions of their service learning experiences, specifically comparing the experiences of fully online students with those of on-campus students. Additionally, open-ended survey responses were analyzed to provide deeper insights into students' reflections on social responsibility, professional development, and the challenges faced during their service learning.

The study aims to address the following research questions:

1. Are there differences in perceived knowledge acquisition, skill development, practical application, and satisfaction between students in on-campus and fully online service learning courses?
2. Are there potential issues or challenges that students face in both on-campus and online service learning modalities?
3. What are student perceptions of the effectiveness of the Service Learning class within the computer science undergraduate programs?

To answer these questions, we analyzed quantitative survey responses and qualitatively examined open-ended feedback to gain deeper insights into students' reflections on their service learning experiences.

2. LITERATURE REVIEW

2.1 Service Learning Policy and Practice

In the early 1990's the United States of America's federal government committed to reinvesting in technology for education and training. Funding the following philosophy, "high quality education and training pay off for the individual whose skills are upgraded, for the companies seeking a competitive edge, and for the nation in achieving overall productivity and competitiveness" (Schmidt, 1994). Furthering this federal initiative, California's Senate mandated the California high school service learning requirement through Assembly Bill (AB) 189. Outlining the Edward M. Kennedy Serve America Act of 2009 to define service learning, AB189 requires students experientially learn, serving their communities in preparation for their roles and responsibilities as active and informed citizens of our state.

Mandating service learning seeks to address digital skill shortages by enhancing students' competencies in information communication technology, which can positively impact both economic and social outcomes. Service learning bolsters student's digital skills through experiential learning opportunities, employing California's service learning alumni, reduces the digital skills gap, caused by the lack of digitally skilled workers entering the workplace (Taylor-Smith et al., 2019, p.126). Undergraduate computer science service learners utilize information communication technology to drive economic development and social change through service to not-for-profit service learning partners. Reducing the digital skills gap by employing service learner alumni competent in information communication technology (ICT) contributes to global economic and social development (Kozma, 2005, p.117).

2.2 Service Learning in Higher Education

Service learning has emerged as a transformative pedagogical approach that integrates academic learning with meaningful community engagement. This educational method fosters civic responsibility enhances professional competencies, and enriches students' understanding of real-world challenges. For undergraduate students, service learning provides opportunities to apply theoretical knowledge in practical settings while simultaneously benefiting the communities they serve (Eyler & Giles, 1999).

Service learning has been widely adopted in higher education as a pedagogical strategy that bridges academic knowledge and practical application. Additionally, service learning fosters critical thinking and problem-solving skills by exposing students to real-world challenges that require innovative solutions (Jacoby, 2015). Beyond academic benefits, service learning enhances professional and personal development. Studies indicate that students involved in service learning report improved communication, teamwork, and leadership skills—essential competencies for career readiness (Astin et al., 2000). Furthermore, service learning fosters civic engagement and ethical awareness by prompting students to reflect on social issues and their role in addressing them (Saltmarsh, 2005).

In computer science, service learning projects often involve solving technical challenges for nonprofit organizations or developing software to address community needs. These projects provide students with hands-on experience in applying technical skills while working collaboratively in diverse teams.

Prior studies highlight several key benefits of service learning: Improved communication and teamwork skills, enhanced understanding of professional ethics, greater awareness of societal challenges and how technology can address them (Salam et al., 2019). The Asia Pacific Education systematic review details 133 existing service learning articles to find service learning is most frequently used in health sciences, business and economics, computer and information sciences and social sciences respectively. Building upon traditional service learning, online service learning leverages modern ICT tools to create the virtual collaboration environment, allowing for acceptance of service learning pedagogy across modalities (Salam et al., 2019).

Expanding the service learning offerings to multiple modalities reduces barriers, equitably engaging students in the pursuit of life-long learning. Education is an interactive and developmental process. Students participating in service learning during their junior or senior years report an enhanced perception of their academic experience (Burke & Bush, 2013). Service learning changes perspectives, identified in recurring student evaluations throughout the service learning course (Stevenson & Peterson 2015).

2.3 Service Learning and Experiential Learning Theory

Kolb's Experiential Learning Cycle (1984) provides a valuable framework for understanding how service learning fosters skill development. According to Kolb, learning occurs through a cyclical process involving four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation.

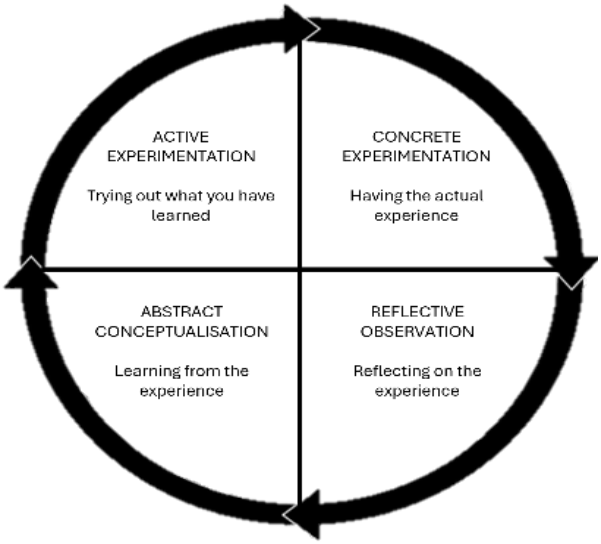

Figure 1. Kolb's Learning Styles and Experiential Learning Cycle (Mcleod, 2024)

Service learning aligns well with this model, as students engage in hands-on projects (concrete experience), reflect on their work and its' impact (reflective observation), connect their experiences to academic theories (abstract conceptualization), and apply lessons learned to improve their performance or approach (active experimentation). This iterative process ensures that students develop both technical and interpersonal skills in meaningful ways. By engaging in service projects, students experience real-world applications of their academic knowledge, reflect on their experiences, conceptualize broader implications, and apply their learning in new contexts (Furco, 1996).

3. METHODOLOGY

3.1 Participants

The study involved 110 computer science students enrolled in two service learning courses, with 30 fully online students and 80 on-campus students. Among them, 63 students responded to the survey: 50 on-campus students and 13 fully online students, resulting in a 57% response rate.

Regarding gender distribution, 64% of participants identified as male, 32% as female, and 4% as non-binary. Most participants (72%) were between 18 and 25 years old, while 4% were aged 26–30, 13% were 31–35, and 6% were 36–40. In terms of enrollment status and employment, 58% were full-time students without professional employment, while 34% were full-time students with professional jobs. Additionally, 4% were part-time students without professional employment, and another 4% were part-time students working in professional roles.

Regarding prior computer science experience, 55% had no professional experience, 15% had 1–2 years of experience, 13% had 3–4 years, and 17% had over five years of experience.

All students have just completed the required 25 hours of service learning as part of a 400-level course "Race, Gender, and Class in the Digital World". On-campus, service learners complete the course over the 16-week term period, while fully online complete the course over an 8-week term period. All students in the fully online program completed their service learning remotely whereas 29 on-campus students (58%) completed their service learning remotely and the 21 remaining on-campus students completed their service learning in person.

All service-learning sites had been pre-selected by the course instructor, ensuring they aligned with the learning objectives of the class. Students were provided with a curated list of available sites, each accompanied by a detailed description of the activities and responsibilities involved. To accommodate individual preferences, students were asked to submit their top three choices. Based on these preferences, the instructor carefully assigned students to a site, making every effort to match them with one of their preferred options while also considering logistical constraints and the needs of the partnering organizations.

3.2 Data Collection and Analysis

A survey instrument was developed and used to gather data on students' perceptions of their service learning experience in four constructs: Communication and Critical Thinking Skills, Career Preparation and Marketability, Ethical Awareness, and Technical and Professional Skills. The survey included 17 five-point Likert-scale items (1=Strongly Agree to 5=Strongly Disagree), 7 open-ended questions, and 5 demographic-related questions.

The open-ended questions asked students to describe their tasks, challenges, and how their service learning experience contributed to social responsibility and systemic change. Some Likert-scale survey items were adapted from Drewery and Lollar's (2024) study on undergraduate service learning perceptions to align with the research focus on computer science students. The survey was administered via Qualtrics, and all students received an email invitation at the end of the course to participate. Responses were anonymous, and no compensation or extra points were provided for participation.

The quantitative data were analyzed using descriptive statistics and independent t-tests to compare the perceptions of fully online and on-campus students. Homogeneity of variances was tested, and Welch's t-test was applied. Open-ended responses were analyzed qualitatively using thematic analysis to identify recurring patterns and insights.

4. RESULTS

The following tables include the means and standard deviations for the items in each of the four constructs.

4.1 Communication and Critical Thinking Skills

	Fully Online		On-Campus	
	Mean	SD	Mean	SD
My service learning experience enhanced my ability to communicate in a "real-world" setting.	3.69	1.11	3.74	1.08
I shared new ideas in my service learning role.	3.46	0.97	3.30	1.18
Service learning empowered me to make decisions	3.62	1.19	3.54	1.11
Service learning strengthened my critical and abstract thinking skills	3.31	1.25	3.46	1.13

The calculated Cronbach's alpha for the four items in this construct is 0.89, indicating a high level of internal consistency and reliability for these items. No statistically significant differences ($p > 0.05$) were identified in any of the four items.

4.2 Career Development and Marketability

	Fully Online		On-Campus	
	Mean	SD	Mean	SD
Service learning helped me clarify which career path I would like to pursue or continue	3.31	1.18	3.04	1.16
Service learning made me more marketable in my chosen profession	3.46	1.39	3.26	1.12
Application of service learning experience will enhance CS course performance	3.69	1.11	3.02	1.29

Cronbach's alpha for the above three items is 0.84, indicating good internal consistency and reliability. While the fully online students' ratings for all items in this construct were slightly higher than on-campus students, the difference was not statistically significant ($p > 0.05$).

4.3 Ethical Awareness

	Fully Online		On-Campus	
	Mean	SD	Mean	SD
My service learning skills allowed me to take critical equitable action through the use of technology	3.69	1.32	3.68	1.08
My service learning helped me to become more aware of professional ethics	3.54	1.20	3.66	1.02
My service learning facilitated engagement in responsive and reciprocal service	3.69	0.95	3.54	1.05
My service learning helped to become more aware of ethical issues in my discipline	3.46	1.33	3.36	1.19

As the first construct, Cronbach's alpha for the four items in this construct is also 0.89. No statistically significant differences were identified ($p > 0.05$).

4.4 Technical and Professional Skills

	Fully Online		On-Campus	
	Mean	SD	Mean	SD
Service learning experience improved my abilities as a CS student	3.77	1.30	3.08	1.12
Service learning projects required management skills	4.0	0.82	3.90	1.13
I believe service learning improved my leadership skills	3.62	1.12	3.26	1.26
Service learning skills are transferable to CS required skills	3.69	1.11	3.52	1.11
CS skills are transferable to service learning required skills	3.69	1.18	3.70	1.09
Service learning connects computer science concepts to	3.85	1.21	3.76	1.08

real-world scenarios				

The calculated Cronbach's alpha for the above six items is 0.92, indicating excellent internal consistency and reliability. This suggests that these items are highly coherent in measuring the construct related to technical and professional skills in computer science through service learning. While the fully online students' ratings were slightly higher in five out of the six items in this construct, the difference was not statistically significant ($p > 0.05$).

5. DISCUSSION

This study aimed to explore computer science students' perceptions of service learning, comparing experiences between fully online and on-campus modalities. The findings suggest that service learning provides consistent educational benefits across both modalities, with students reporting enhancements in problem-solving, career preparedness, ethical awareness, communication, and technical skills. However, students also highlighted challenges unique to each modality, particularly in virtual collaboration and balancing logistical constraints in on-site placements.

To better understand these results, this section addresses the study's three research questions by interpreting the quantitative and qualitative findings in depth. The implications of these findings for curriculum design, instructional strategies, and future research are also discussed.

*5.*1 Research Question 1: Are there differences in perceived knowledge acquisition, skill development, practical application, and satisfaction between students in the on-campus and fully online service learning courses?

The independent t-tests revealed no statistically significant differences ($p > 0.05$) in perceived knowledge acquisition, skill development, and satisfaction between on-campus and fully online students. Across all constructs—Communication and Critical Thinking Skills, Career Preparation and Marketability, Ethical Awareness, and Technical and Professional Skills—students in both modalities reported similar levels of perceived benefits. The independent t-tests revealed no statistically significant differences between the two groups in any of the measured categories, suggesting that service learning effectively fosters comparable learning outcomes regardless of delivery modality.

Notably, both fully online and on-campus students acknowledged the value of service learning in enhancing their critical thinking, decision-making, and ability to communicate in real-world scenarios. Furthermore, students across both modalities agreed that service learning strengthened their ethical awareness and ability to apply computer science concepts to practical challenges. These findings suggest that service learning can be equally effective in both face-to-face and virtual learning environments when properly structured.

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5.2 Research Question 2: Are there potential issues or challenges that students face in both on-campus and online service learning modalities?

The qualitative responses revealed distinct challenges experienced by students based on their service learning modality.

Challenges Faced by On-Campus Students

Among students in the on-campus program the most commonly reported challenges included:

- Communication difficulties: A few students mentioned that more communication was needed between them, their peers, and their service learning organizations to ensure clarity in expectations and responsibilities.
- Alignment with their field of study: Approximately 5% of students struggled to see the direct relevance of their service learning tasks to their computer science coursework. These students felt that their assigned tasks did not align closely with their technical skill set, indicating a need for better integration of computer science skills into service learning projects.
- Engagement and task variety: A few students found that their tasks were repetitive or administrative in nature, which limited their engagement and learning opportunities.

These responses suggest that on-campus students could benefit from structured guidance and better-defined project expectations to ensure their service learning experiences are both meaningful and technically relevant.

Challenges Faced by Fully Online Students

Fully Online students, on the other hand, reported challenges primarily related to independent learning and technical skill application. Common difficulties included:

- Collaboration and engagement: Since virtual service learners relied on digital communication tools, some students found it difficult to engage meaningfully with their teams or service organizations, leading to feelings of isolation.
- Lack of familiarity with required technologies: One student mentioned that the programming language they were expected to use was unfamiliar, making it difficult to contribute effectively. This suggests that online students may require additional training or preparatory resources before starting their service learning projects.

- Lack of direct mentorship: All fully online students performed their service learning remotely and often worked independently, which made it harder to receive immediate feedback or guidance from their service learning partners.

Despite these challenges, students in both modalities recognized the value of their service learning experience in terms of skill development and professional growth. The findings suggest that clearer communication channels, better-defined roles, and stronger faculty or mentor involvement could improve the service learning experience across both face-to-face and virtual modalities.
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5.3 Research Question 3: What are student perceptions of the effectiveness of the Service Learning class within the computer science undergraduate program?

The qualitative responses indicate that students from both Fully Online and On-Campus programs found service learning to be a meaningful experience, enhancing their sense of social responsibility, professional growth, and technical application. However, differences emerged in how each group related their service learning experience to coursework and the specific challenges they faced.

Perceptions of Social Responsibility and Systemic Change Both groups recognized the value of service learning in contributing to community development. On-campus students highlighted their participation in community-based events and the direct impact of their technical work on nonprofit organizations. One student noted that they attended an event that promoted service learning initiatives, reinforcing their commitment to community engagement.

Fully Online students, on the other hand, emphasized the importance of providing digital support to organizations. One student mentioned that their service learning role allowed them to provide support to an established digital literacy initiative, demonstrating how technology-focused projects can foster social responsibility. These responses suggest that service learning is effective in fostering civic engagement across modalities, though the nature of engagement varies depending on delivery format.

Strengths Developed During Service Learning When reflecting on their personal growth and skill development, students from both groups identified key strengths that they demonstrated during their service learning projects:

- On-Campus Students: Frequently mentioned collaboration, creativity, and critical thinking as strengths developed through their experiences.
- Fully Online Students: Highlighted strengths such as patience, resolve, open-mindedness, and leadership, which were necessary to navigate remote teamwork and asynchronous communication.

This distinction suggests that in-person service learning fosters interpersonal collaboration, while remote service learning challenges students to develop adaptability and independence.

5.4 Limitations and Future Research

While this study provides valuable insights into computer science students' perceptions of service learning, several limitations should be acknowledged. These limitations highlight areas for future research to deepen our understanding of the impact of service learning across different modalities.

Limitations Limited Sample Size – The study was conducted with a relatively small sample of on-campus and fully online students. While the findings suggest consistent learning outcomes across modalities, a larger and more diverse sample across multiple institutions would enhance the generalizability of the results.

Self-Reported Data – The study relies primarily on student self-reports through surveys, which may introduce response bias. Students may overestimate or underestimate their learning experiences, engagement, or skill development. Future research could incorporate objective performance assessments or faculty evaluations of student progress.

Lack of Longitudinal Data – This study captures students' perceptions at the end of their service learning experience but does not assess the long-term impact on their academic or professional growth. A longitudinal study tracking students before, during, and after service learning could provide deeper insights into its lasting effects on career readiness, technical proficiency, and civic engagement.

Variability in Service Learning Experiences – The nature of service learning projects varied significantly across students, which may have influenced their perceptions. Some students engaged in technically intensive projects, while others performed more administrative or organizational tasks. Future research could explore how different types of service learning projects impact student learning outcomes in computer science education.

Future Research Directions To build upon these findings, future research should consider the following directions:

1. Comparative Studies Across Institutions – Expanding the study to include multiple universities and diverse student populations would help determine whether findings are consistent across different educational settings.
2. Impact on Career and Professional Development – Future research could assess whether service learning participation leads to improved job placement, internships, or professional networking opportunities in computer science fields..

3. Faculty and Community Partner Perspectives – Investigating faculty and service learning partner experiences could provide a more comprehensive view of the effectiveness of service learning programs and reveal strategies to enhance collaboration between academia and the community.
4. Longitudinal Tracking of Student Growth – A multi-year study tracking students from their initial service learning experience through graduation and into their professional careers could offer stronger evidence on the long-term benefits of service learning in computer science education.

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6. CONCLUSION

This study examined computer science students' perceptions of service learning, comparing experiences between fully online and on-campus modalities and incorporating qualitative insights from open-ended responses. The findings indicate that service learning is an effective pedagogical strategy that fosters skill development, career readiness, and the practical application of computer science concepts in real-world contexts.

Thematic analysis revealed the importance of social responsibility, professional growth, and overcoming unique challenges faced in service learning environments. While both fully online and on-campus students reported similar benefits, differences emerged in technical skill application, communication dynamics, and engagement strategies, highlighting areas for program improvement.

These findings underscore the value of integrating service learning into computer science curricula to ensure students develop both technical competencies and civic awareness. Moving forward, continued research should focus on enhancing course alignment, improving mentorship opportunities, and exploring innovative strategies for virtual service learning to ensure inclusive and impactful educational experiences for diverse learners.

While these findings contribute to the understanding of service learning in computer science education, the study is limited by its sample size and reliance on self-reported data. Future research should explore long-term impacts and expand the participant pool across multiple institutions.

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