

The Development and Delivery of a Diabetes Service-Learning Course for Community-Based Self-Management Education

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Abstract

Service-learning programs for health profession students both engage students and promote health literacy in the community. This paper describes the development and delivery of a service-learning course designed to enhance diabetes literacy and improve outcomes among a medically underserved population. The didactic component of the course introduced students to topics such as health literacy, health education techniques, and diabetes pathophysiology, prevention, and treatment. Subsequently, students designed and delivered community diabetes education classes at a free clinic. Both diabetes knowledge and self-efficacy scores improved for community members and student educators. A subset of community members also showed a reduced body mass index at a 6-month follow-up. Due to the COVID-19 pandemic, the course transitioned to an online format in its final semester, allowing a comparison between students who taught in-person classes versus those who conducted classes virtually. Only those students who provided in-person education demonstrated significant improvements in self-efficacy, highlighting the value of direct community engagement. This course model demonstrates that student-led education at rural clinics can serve as a cost-effective and sustainable strategy to enhance rural health literacy while offering meaningful experiential learning opportunities.

Diabetes impacts about 11.6% of the U.S. population (Centers for Disease Control and Prevention [CDC], 2024a), with most cases classified as type 2 diabetes (CDC, 2024b). Diabetes self-management education (DSME) can be an effective way to control type 2 diabetes (Chrvala et al., 2016) and reduce risk of mortality (He et al., 2017), yet over 40% of people with diabetes never attend DSME (Li et al., 2014). Barriers to participating in DSME include literacy issues, lack of transportation, and the financial cost of services (Balamurugan et al., 2005). Therefore, reaching those who have not obtained DSME may require novel strategies. *Standards of Medical Care in Diabetes* reported some promise in DSME strategies that use community health workers, peers, and lay leaders as providers of continuing support (American Diabetes Association, 2017). Free clinics are essential access points for individuals who do not have health insurance or consistent medical care (Hall & Weiner, 2019). Student-delivered interventions in such environments can effectively improve diabetes outcomes (Nickelson et al., 2022) and provide service-learning opportunities for students. Service-learning enables students to engage with underserved populations through hands-on, community-based experiences (Stevens,

2008). Moreover, service-learning is considered a high-impact pedagogical practice (American Association of Colleges & Universities, n.d.), has been described as an integral part of undergraduate public health (Cashman & Seifer, 2008), and has been associated with favorable student learning outcomes (Kilgo et al., 2015).

This article describes the development and implementation of an interdisciplinary, community-engaged service-learning course (SLC) focused on diabetes health literacy at a free clinic. The course resulted from a 3-year community-based participatory research project (the “Health Lab”) that identified a need for diabetes education for local adults with limited resources. Grounded in the principles of mutual benefit and collaborative engagement, the course was codesigned with clinic staff to enhance patient education and support improved health outcomes. In addition to evaluating health-related outcomes for participating patients, the study also examined the impact of the initiative on student learning and community capacity building. Lessons learned from this partnership underscore the value of authentic community-academic collaboration in addressing diabetes health literacy.

Service-Learning Course

Student Recruitment

The SLC was an elective course that could substitute for a required undergraduate public health culminating experience course. It also gave nursing students an opportunity to gain community clinical experience. The course was available to both undergraduate and graduate students, and students needed the instructor's permission to register. Faculty in nursing, nutrition, and public health programs were encouraged to distribute a recruiting flyer to their students. Faculty interviewed interested students to assess their eligibility for the course, of which the most important criterion was student enthusiasm for engaging with community members.

Didactic Student Experience

Course instructors were faculty members in the University of Alabama's Public Health Program in the Department of Health Science and the Capstone College of Nursing program. One faculty member, Dr. Nickelson, was a registered dietitian, and the others were registered nurses, Drs. Johnson and Montgomery. The SLC was divided into didactic and community experience components. The didactic, in-classroom component prepared students to conduct meaningful community diabetes education classes. Weekly sessions introduced students to service-learning, health literacy and health education principles, health behavior theory, and strategies for health behavior change. Sessions also included a comprehensive review of the pathophysiology, prevention, and treatment of type 2 diabetes (Table 1). Students also learned about ethical research conduct and data collection, as they were expected to consent participants and gather data on program outcomes as part of their work in the field.

The didactic portion of the course spanned the first 6 weeks of the semester. The class format included readings, brief content lectures, discussions, and interactive activities, such as mock health coaching sessions. Diabetes-specific material reflected the content that community members would receive. This content was informed by the Association of Diabetes Care & Education Specialists' 7 self-care behaviors (ADCES7; Cornell et al., 2017), as well as by introductory (Bensley & Brookins-Fisher, 2019) and clinical nutrition (Doak et al., 1996) textbooks and other resources (Gilbert et al., 2015). Health education textbooks guided instruction in health literacy and health education methods (Mahan & Raymond,

2022; Whitney & Rolfes, 2016; Wolff et al., 2016). Students were required to complete the midterm exam with a minimum grade of B before moving on to the community engagement portion of the course.

Student Engagement Experience

Students completed the community engagement experience component of the course at a local free clinic that provided primary health care to uninsured individuals of all ages, races, and genders. Clinic staff had expressed a need to offer diabetes education classes, and students were assigned to teach these classes weekly. Students were responsible for recruiting potential participants through phone calls, recruitment flyers, and their presence at the clinic. Each student was assigned a specific class to teach, either individually or as part of a team. Class development, practice, and revision took place over 2 to 3 weeks before the community engagement experience began.

After recruiting a small group of clinic patients for the class, students created a weekly schedule. Weekly afternoon diabetes education sessions took place for 5 to 6 weeks, depending on the semester schedule. Each session lasted about 2 hours, totaling 8 to 10 hours of teaching time per semester.

Diabetes education classes were held on the same day and time each week. Students arrived early to set up the room and organize materials for the session. They provided both group sessions and individualized, personalized DSME supervised by faculty. Patients who needed additional assistance with diabetes management were scheduled for an appointment with a clinic provider.

After each session, and once the patients had left, students participated in debriefing and reflection sessions. During this time, they addressed problems and received immediate feedback for improvement ahead of the following week's sessions. These sessions proved to be significant time for students, allowing them to discuss what they did well and what they wanted to improve before the next class.

The program was conducted over four semesters from Fall 2018 to Spring 2020. The program's community engagement portion concluded prematurely due to COVID-19, having lasted for three semesters (Fall 2018 to Fall 2019). In Spring 2020, students created video-recorded PowerPoint presentations on their assigned topics instead of visiting the clinic in person.

Table 1. Sample Syllabus

Week 1	Introduction to course, service-learning, research
MODULE 1: HEALTH LITERACY AND HEALTH EDUCATION	
Week 2	Health literacy Working with people with low health literacy
Week 3	Health behavior theory Educational principles of health behavior The learning environment
MODULE 2: DIABETES—PATHOPHYSIOLOGY, PREVENTION, AND TREATMENT	
Week 4	Diabetes basics, understanding risks Glucose monitoring and taking medications Diabetes pathophysiology, prevention, and treatment
Week 5	Healthy eating for diabetes Intro to nutrition, macronutrients, carbohydrates Energy metabolism and body composition
Week 6	Being active in diabetes Problem solving and healthy coping
Week 7	Mid-term exam
MODULE 3: PREPARING FOR COMMUNITY OUTREACH AND HEALTH EDUCATION	
Week 8	Recruiting for group classes HIPAA training at community clinic
Week 9	Individual meetings to review health education sessions
Week 10	Practice health education sessions
MODULE 4: DELIVERING HEALTH EDUCATION IN THE COMMUNITY	
Week 11	Week 1: Intro to class, understanding risks, diabetes basics
Week 12	Week 2: Glucose monitoring, taking medications
Week 13	Week 3: Healthy eating, meal planning, eating out, etc.
Week 14	Week 4: Being active and health coping strategies
Week 15	Week 5: Summarize and receive certificate of completion
Week 16	Finals Week: "Week in the Life" assignment and Final Reflection due

Student Assessment

In addition to the midterm exam administered after the course's didactic component, various assignments throughout the semester aimed to assess student learning. Students completed the Collaborative Institutional Training Initiative (CITI) training for protecting human subjects in research, recruiting community members to participate in sessions, and creating a lesson plan. Students were also evaluated by the instructor and community members after each community education session. The final "week-in-the-life" assignment had students practice recommended diabetes lifestyle guidance for 1 week, which included creating hypothetical plans for one episode each of hypoglycemia and hyperglycemia. Additionally, students completed weekly reflection journal entries after each community education session and following the week-in-the-life

assignment. Reflection is an essential component of SLCs (Stevens, 2008).

Outcomes

Community Member Outcomes

The University of Alabama's Institutional Review Board approved the program with Protocol ID 18-05-1189. With faculty's assistance, students collected data to evaluate program outcomes. In line with DSME Outcome Standards (American Association of Diabetes Educators, 2003), three outcome categories were monitored over time:

1. learning,
2. behavior change, and
3. clinical improvement.

Specifically, data were collected to assess community members' diabetes knowledge, diabetes self-efficacy, global health literacy, diet, exercise, glucose self-monitoring, foot care,

body mass index (BMI), systolic blood pressure, diastolic blood pressure, and HgbA1c (a long-term indicator of glycemic control). Patient satisfaction was also evaluated. The initial plan called for data collection at three time points: the initial meeting (Time Point 1), the program's conclusion (Time Point 2; approximately 6 weeks later), and a 6-month follow-up (Time Point 3). However, due to COVID-19, Time Point 3 data was collected only from individuals who participated in the program's first two semesters. Students received training to gather data, including clinical data, and assessed patients' learning outcomes, behavioral outcomes, and satisfaction outcomes using modifications of existing surveys (Bradley, 1999; Chew et al., 2004; Rothman et al., 2005; Schmitt et al., 2013; Yamashita & Kart, 2011). Statistical significance was set a priori at $\alpha = .10$, given the small sample size.

Baseline (Time Point 1) data were gathered from 11 participants, Time Point 2 data from nine participants, and Time Point 3 data from six participants. The average age of the participants was 62.3 years (range, 46–76 years); the majority of participants ($n = 9$) were female, and their reported race was either African American ($n = 6$) or White ($n = 4$). Most participants ($n = 7$) had completed at least some college education.

Outcomes data are presented in Table 2. Since we did not collect Time Point 3 data from participants in Semester 3, data are reported

separately for the entire sample compared to the smaller group for whom Time Point 3 data were available. Diabetes knowledge and self-efficacy were significantly higher for the larger group at the end of the program. BMI was significantly lower after a 6-month follow-up with the smaller sample. No significant changes were observed in any other outcome measures (Table 2).

The satisfaction survey was completed by two community participants who were very satisfied with the program and reported that their understanding of diabetes improved significantly as a result of their participation. Both were very likely to recommend the program to others. One participant suggested that the program could be enhanced by continuing the classes; this same participant also expressed a desire to learn how to manage meals more effectively. What participants liked most about the program were: "All the information was beneficial," and "People, students, nice, pleasant, and welcoming. Very informative."

Student Outcomes

Students' diabetes-specific knowledge and self-efficacy were assessed at three time points: the beginning (Time Point A), the end of the didactic portion (Time Point B), and the end of the semester (Time Point C). Students' perceptions of service-learning benefits (program satisfaction) were assessed at Time Point A and Time Point C. Two program satisfaction scales were created:

Table 2. Community Participant Outcomes Following Student-Led Diabetes Classes

	Data from Semester 1, 2, and 3 Participants			Data from Semester 1 and 2 Participants			
	<i>n</i>	Baseline Mean (<i>SD</i>)	End of Program Mean (<i>SD</i>)	<i>n</i>	Baseline Mean (<i>SD</i>)	End of Program Mean (<i>SD</i>)	6-month Follow-Up Mean (<i>SD</i>)
Diabetes knowledge	9	8.6 (1.9)	9.9 (1.7)*	6	9.0 (2.1)	9.8 (1.3)	9.3 (1.2)
Diabetes self-efficacy	8	33.8 (4.1)	36.4 (2.7)**	5	34.4 (5.0)	37.4 (2.6)	35.4 (4.8)
Global health literacy	9	4.9 (2.2)	4.1 (1.1)	6	4.8 (2.2)	3.8 (0.8)	3.8 (0.8)
Diet	9	16.0 (6.3)	14.8 (4.5)	6	15.8 (6.4)	15.3 (5.3)	15.8 (3.5)
Exercise	9	6.2 (4.8)	7.3 (3.7)	6	5.8 (4.4)	5.5 (2.6)	6.7 (3.8)
Glucose self-monitoring	9	5.4 (6.1)	6.8 (6.1)	6	4.2 (5.7)	6.5 (6.4)	3.3 (5.5)
Foot care	9	7.4 (5.0)	8.2 (3.0)	6	7.8 (4.7)	8.5 (3.7)	9.5 (2.4)
BMI	8	30.6 (6.8)	31.6 (5.3)	5	31.1 (6.4)	30.9 (6.2)	29.8 (6.5)* **
Systolic BP	8	126.4 (16.2)	131.6 (10.6)	5	119.6 (11.8)	124.8 (5.5)	128.2 (15.9)
Diastolic BP	8	74.9 (5.7)	77.1 (2.9)	5	74.4 (5.6)	76.4 (2.3)	79.6 (5.3)
Hgb A1C	10	8.5 (3.0)	n/a	5	7.6 (3.1)		7.7 (3.4)

Note. Boldface indicates statistical significance; *significantly higher than baseline ($p = .042$); **significantly higher than baseline ($p = .069$); ***significantly lower than baseline ($p = .089$) and end of program ($p = .046$)

1. the importance of service-learning to the educational experience and
2. how much university coursework prepared the student for the real world.

Student outcomes were also assessed using modifications to existing surveys (Rothman et al., 2005; Yamashita & Kart, 2011) and the Service-Learning Benefit (SELEB) scale (Toncar et al., 2006). Comments from university end-of-semester course evaluations were also reviewed. Student data were collected over four semesters from Fall 2018 to Spring 2020. Statistical significance was set a priori at $\alpha = .05$.

Baseline knowledge and self-efficacy data were collected from 23 students; however, later surveys could match data to only 19 of them. The mean diabetes knowledge and self-efficacy scores for Time Points 1, 2, and 3 are shown in Figures 1 and 2. Diabetes knowledge and self-efficacy scores did not differ among cohorts at any of the three time points. Nonetheless, since students participating in Spring 2020 were unable to deliver community education in person, data were analyzed separately for those involved in the first three semesters of the course. For the entire sample, both knowledge and self-efficacy scores were significantly higher at Time Points 2 and 3 than at Time Point 1. Scores at Time Point 3 were higher, although not significantly so, compared to those at Time Point 2. For students who delivered community education in person, self-efficacy scores (but not knowledge scores) were significantly higher at Time Point 3 than at Time Point 2 (Figure 1 and Figure 2).

Baseline program satisfaction data were collected from 21 students, although end-of-semester data could be matched to only 19. Satisfaction scores did not differ among cohorts at baseline or the end of the course; however, data were analyzed separately for those who could deliver in-person community education. The *importance of service-learning to the educational experience* score and *how much university coursework prepared the student for the real world* score were both significantly ($p < .001$; data not shown) higher at the semester's end than at the beginning for both the whole sample and for those students who delivered community education in person. Students expressed high levels of course satisfaction in end-of-semester course evaluations. For example, one student wrote:

I think I got a lot more out of this class than just a resume booster. This class taught me compassion, respect for others,

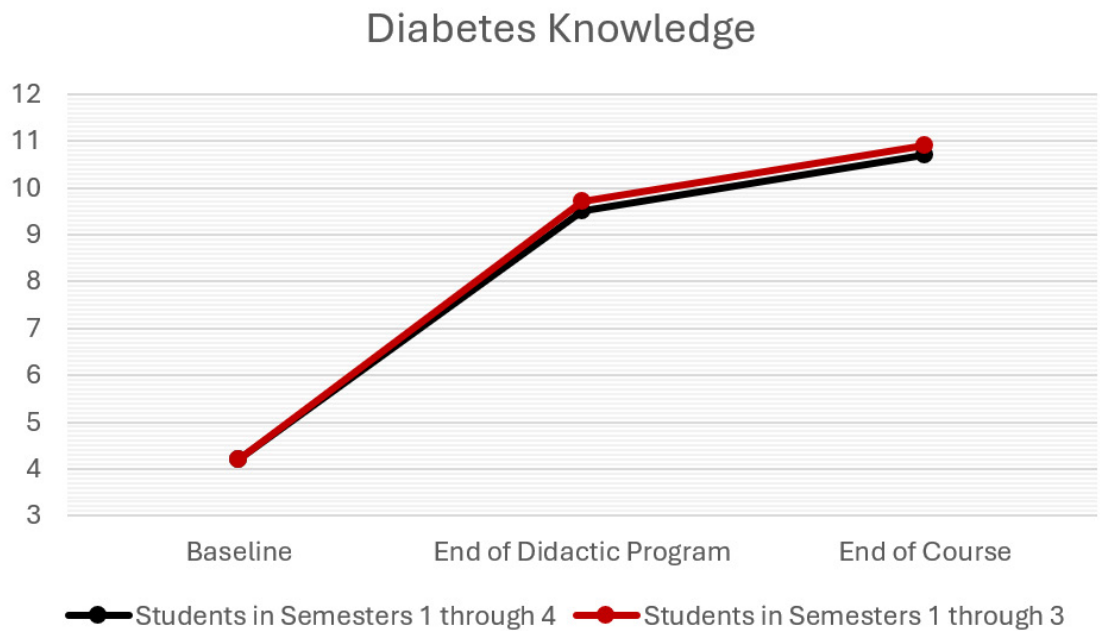
and valuable communication skills. Out of all the experiences that I have had in my college career, I think this has been one of the most valuable for my personal and professional development.

Discussion and Lessons Learned

This experience contributes to the growing body of literature demonstrating the benefits of service-learning, particularly for diabetes management (Nickelson et al., 2022). For the larger sample of community members for whom we had end-of-program data, diabetes knowledge and self-efficacy scores were significantly higher at the end of the program compared to baseline. Among community members for whom we had 6-month follow-up data, BMI was significantly lower at the follow-up. Despite the small sample size, the significant changes observed are noteworthy. With a larger sample size, we might have identified improvements in additional measures. In particular, improvement in glycemic control (as measured by HbA1c) is desired. In a systematic review of student-led diabetes interventions (Nickelson et al., 2022), those with the smallest sample sizes also did not see improvements in HbA1c (Gorrindo et al., 2014; Matvienko & Hoehns, 2009). Studies that demonstrated improvements in HbA1c (Baldwin, 2015; Krok-Schoen et al., 2017; Nuffer et al., 2012; Smith et al., 2014) were conducted in various settings by students from different disciplines, with patients seen over periods ranging from 12 weeks to over 2 years. A minimum of 10 contact hours is considered necessary to improve HbA1c (Chrvala et al., 2016). Although we provided approximately 8 to 10 hours of education, these hours were not customized to individual needs. More education hours tailored to each individual's learning needs may have led to better outcomes.

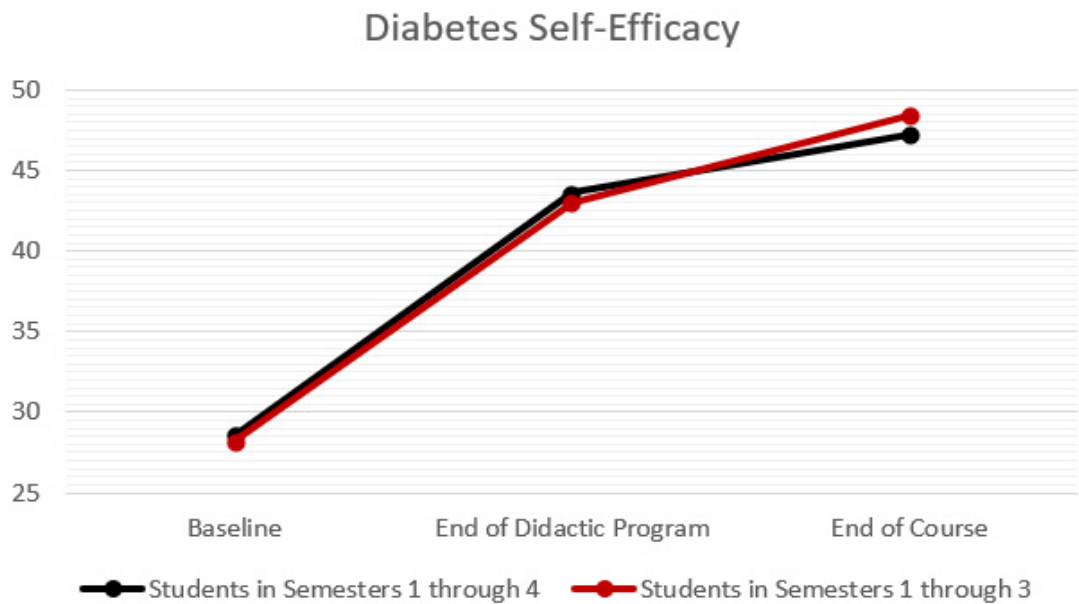
Students also significantly improved their diabetes knowledge and self-efficacy after the didactic course component and at the semester's end compared to baseline. Since people tend to learn better by doing (Main, 2023), and self-efficacy improves with successful behavioral performance ("mastery experience"; Bandura, 1982), we anticipated that these scores would be even higher after students taught diabetes classes independently. COVID-19 allowed us to examine the impact of providing classes in-person versus online. Our findings show that self-efficacy at the semester's end was significantly higher than after the didactic component of the course among

Figure 1. Changes in Student Diabetes Knowledge Scores Over Time



Note. Scores were significantly different from baseline at the end of the didactic program ($p < .001$) and end of the course ($p < .001$) for all students in the course (Semesters 1–4) and for those who delivered the in-person community education (Semesters 1–3). Scores were not significantly different at the end of the course compared to at the end of the didactic program.

Figure 2. Changes in Student Diabetes Self-Efficacy Over Time



Note. Scores were significantly different from baseline at the end of the didactic program ($p < .001$) and end of the course ($p < .001$) for all students in the course (Semesters 1–4) and for those who delivered the in-person community education (Semesters 1–3). Scores were also significantly different at the end of the course compared to at the end of the didactic program ($p < .001$), but only for the students who took part in the in-person community education (students in semesters 1–3).

those students who taught in-person community classes, further justifying the benefits of SLCs and emphasizing opportunities for students to practice what they are learning in the classroom.

Moreover, students who took this course appreciated and valued the experience, as shown by satisfaction scale scores and comments in the university's end-of-course evaluation. These findings are not surprising, as public health students have been found to value service-learning experiences (Mason & Dunens, 2019), and service-learning is generally believed to enhance student learning outcomes (American Association of Colleges & Universities, n.d.). For faculty, offering the course as an elective ensured that we attracted students who genuinely wanted and valued this experiential learning opportunity.

Although this paper's main purpose is to describe the development and delivery of the SLC, it's important to acknowledge limitations in the program evaluation design. Besides the small sample size, this study was constrained by self-reported behavioral outcome data, which can be biased. Additionally, the study design could have been improved by incorporating community and student comparison groups. Nevertheless, the thoroughness of the outcomes assessed and the objective measures of community member and student learning enhanced this evaluation design.

As we would with any new program or class, we faced challenges and learned valuable lessons. A significant challenge was finding a class schedule that worked for both community members and students. Initially, we intended to hold community classes at times convenient for community members—after work or on weekends. However, student commitments outside of class varied. Since we could not rely on students to be available beyond class time, we needed to schedule community classes during our class periods. Although we sought to attract students from various disciplines, we struggled to find a class time that suited everyone, and most students who enrolled were public health majors. While we appreciate the importance of an interdisciplinary approach, it's crucial to recognize that time commitments differ significantly from one college to another. The more intentional that course faculty can be in establishing class times and community engagement, while communicating those expectations to students well in advance, the better informed students will be about the time commitment required. Additionally, buy-in at the departmental and programmatic levels is necessary to ensure that

the SLC can be integrated into the overall course curriculum and can substitute for other required courses without disrupting students' schedules.

Having an existing relationship with the community clinic through nursing faculty who volunteered there was essential for our ability to recruit community participants. The clinic needed diabetes education for its patients and was willing to make accommodations to help meet that need. Without the university's established relationship with the clinic, we might not have been able to offer the SLC. The lesson here is that a strong commitment to community-based partnerships is crucial, and nurturing those partnerships demands persistence and patience. Even though we provided a much-needed service in this free clinic, we were also guests. Often, facility staff had to take on additional workloads to assist with recruitment efforts, space arrangements, and various other aspects of a successful engagement experience. We have found that key characteristics of effective partnerships between community organizations and students include building on each other's complementary strengths, recognizing our shared mission, maintaining an equitable workload, developing and sustaining trust, accepting each partner as they are, forgiving mistakes, ensuring effective communication, and exhibiting unselfishness (Naher et al., 2023), aligning with the *Power of 2* framework (Wagner & Mueller, 2009). Collaboration and often accommodation are necessary from all parties involved. Supporting each other and maintaining a patient-focused perspective is an effective strategy for sustaining a strong relationship. Also, the university faculty continues to work in various capacities with the community partners to date. As this project was built on a long-standing partnership, it was vital to ensure that we shared our results to support the clinic's goals, strengthen grant competitiveness for both the community partners and the university, and promote long-term sustainability of the partnership.

Finally, during the last semester this course was offered, the university shut down due to the COVID-19 pandemic and transitioned all classes to an online format. To complete diabetes education sessions with community members who signed up that semester, we asked students to create video PowerPoint presentations that could be delivered online. Unfortunately, due to the age of community participants and their lack of access to smartphones or computers, many were unable to complete online sessions. However, now that people are more accustomed to navigating life

in an online environment, online sessions may prove to be more effective. Nonetheless, at least for students' self-efficacy, the in-person sessions had a greater impact than the online sessions. Some evidence suggests that students prefer in-person service-learning opportunities over virtual ones, while acknowledging that sometimes virtual service-learning may be necessary (Bartlett & Scholl, 2024). When SLCs must be delivered online, careful design is essential and can lead to beneficial outcomes (Faulconer, 2021).

Future Directions

This study, and the overall experience for students and community members, highlights a promising avenue to replicate this work under present-day conditions. Now that both students and community members are more accustomed to online platforms post COVID-19, a well-constructed virtual SLC might achieve comparable results or even superior outcomes. Future research could replicate this work and design a virtual service-learning intervention. In addition, future studies can also investigate different time doses of education beyond the 8–10 hours of education provided. Educational interventions of 10, 15 and 20 hours can be compared to individual versus standardized curricula to see the outcomes on HbA1c and other metabolic outcomes.

Conclusions

In conclusion, the findings of this project suggest that student-led diabetes classes may improve diabetes health literacy and BMI among community members. Additionally, the findings indicate that an SLC can serve as an effective pedagogical strategy for enhancing student diabetes knowledge and self-efficacy, even though the program evaluation was limited by a nonexperimental design. Theoretically, allowing students to apply what they learn in the classroom to real-world settings should bolster their self-efficacy, a notion supported by this project.

Regarding improving health literacy, this project highlights the dual impact for community members and students. The classes provided plain-language, culturally appropriate, and action-oriented information that supported comprehension and self-management of diabetes. For the students, teaching these concepts required them to translate complex evidence into easy-to-understand messages, a critical skill for improving health outcomes. By simultaneously elevating community members' diabetes literacy

and students' ability to communicate health information, health literacy is impacted.

Ultimately, student-led community classes can be a financially sustainable approach to low-cost health education that benefits both community members and students while directly advancing health literacy at multiple levels.

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