





informed that their lack of agreement to participate in the study would not have an impact on their course mark. Data was collected between October 2017 and January 2018 by a research assistant, who was not enrolled in the course. At the end of the semester (December 2017), the research assistant recruited participants for the focus group. Participants signed consent and confidentiality forms and agreed to an audio recording of the group interview.

## Outcome Measures

A mixed-methods study was conducted using surveys and semi-structured focus group interviews to seek an understanding of the impact of the CSL activity on students' self-efficacy and learning experience.

## Quantitative Measures

Pre- and post-surveys were administered to assess students self-efficacy related to various workshop tasks. The pre-survey was administered during week 4 (before students completed the workshop rehearsal and community workshop), and the post-survey was administered during week 12 (after all students completed the entire assignment). The pre- and post-surveys included the same questions. Students were asked to rank their level of self-efficacy (confidence) on a 10-point Likert scale (1= not very confident to 10 = very confident) related to various workshop activities (Table 2).

## Qualitative Measures

Students were invited to participate in the focus group to discuss their perceptions about the impact of the workshop CSL experience on their learning. Focus groups were conducted in December 2017 and January 2018, were 60 minutes in duration, and were led by a research assistant who moderated the discussion. A focus group guide, consisting of open-ended questions, was prepared *a priori* at the beginning of the study and used to facilitate the focus

groups. However, opinions and thoughts raised by the participants that were not in the focus group guide were also pursued (Gill, Stewart, Treasure, & Chadwick, 2008). The participants were encouraged to bring forward any relevant information, while the moderator ensured that all questions were adequately discussed. The focus group questions were:

1. What did this opportunity add to or take away from your learning experience?
2. How did this experience influence your impression of behaviour change and communicating nutrition-related information to the public?
3. How did this experience influence your personal growth?
4. How did this experience impact your self-efficacy for disseminating nutrition and health-related information to the public?
5. How do you feel this opportunity contributed to your future career plan?
6. What impact do you think the community engagement workshops had on community members?

The focus group audio recordings were transcribed using a thematic-framework analysis to identify key themes arising from the responses to the open-ended questions (Attride, 2001). Two research assistants independently reviewed and coded the transcripts to identified key themes using deductive and inductive reasoning. NVivo software was used to verify the key themes that emerged from the focus groups (Version 11, QRS International, Burlington, MA, USA).

## Additional Data Collection

For descriptive purposes, year of birth, gender and past enrollment in another course with a community-oriented project was collected by the research assistant. The topic and the location of each workshop were also recorded.

## Data Analysis

The mean (SD) and frequency (percent) were computed for continuous and categorical data, framework analysis was used for the responses to the open-ended questions (Attride, 2001). Quantitative analyses were performed with SPSS Version 25.0 (IBM Corporation, Chicago, IL). P-value  $\leq 0.05$  was considered significant.

## Results

A total of 34/36 (94%) students agreed to participate in the study and completed both pre and post-surveys. Table 1 presents the descriptive characteristics of the participants. All nine

respectively. The student's t-test was used to explore the difference between mean self-efficacy scores from the pre- and post-surveys. A thematic-

workshops occurred during November 2017 and were conducted at various sites in Hamilton, Ontario, Canada. On average, self-efficacy increased by an average of 1.4 points from the pre- to post-survey. There were significant improvements in self-efficacy for all questions related to the workshop tasks (Table 2). Out of the 34 students who participated, seven students had previously completed a course with a community-oriented project. A separate analysis of survey scores for these participants revealed that post-survey self-efficacy ratings were not significantly different from pre-survey scores for all 6 questions ( $p > 0.05$ ) (data not shown).

Table 1. *Descriptive characteristics of study participants (N=34)*

<ul style="list-style-type: none"> <li>• Age, years, mean (SD)</li> <li>• Female</li> <li>• Previously completed a course with a community-oriented project</li> </ul>	23 (1) 28 (82) 7 (21)
Workshop location: <ul style="list-style-type: none"> <li>• Sackville Hill Senior's Centre</li> <li>• Physical Activity Centre of Excellence (PACE)</li> <li>• Ancaster Senior Achievement Centre (ASAC)</li> <li>• Hamilton City Housing Residence</li> </ul>	1 (11) 3 (33) 1 (11) 4 (44)
Workshop topics: <ul style="list-style-type: none"> <li>• Sarcopenia</li> <li>• Osteoporosis</li> <li>• Osteoarthritis</li> <li>• Alzheimer's disease</li> <li>• Hypertension</li> <li>• Type 2 diabetes</li> <li>• Cholesterol</li> </ul>	2 (22) 1 (11) 1 (11) 1 (11) 1 (11) 2 (22) 1 (11)
Note: values are n (%) unless otherwise indicated.	

Table 2. Pre- and post-survey ratings of self-efficacy

Survey questions	Self-efficacy rating		P-value
	Pre-survey	Post-survey	
I can effectively explain evidence-based nutrition information to a lay population.	6.2 (1.9)	7.7 (2.3)	0.007*
I can explain the benefits and recommended guidelines for healthy eating to a lay population.	6.4 (1.8)	7.7 (2.2)	0.014*
I can explain how healthy eating can help manage health conditions prevalent in older adults.	6.9 (1.6)	8.0 (2.2)	0.029*
I can demonstrate strategies in eating healthy to a lay population.	6.7 (1.7)	7.8 (2.5)	0.033*
I can help a lay person compose goals related to healthy eating.	6.7 (1.5)	7.8 (2.5)	0.039*
Overall, I can facilitate workshops related to evidence-based nutrition and healthy eating to a lay population.	6.2 (2.2)	8.1 (2.1)	<0.001*
Note: *denotes a significant difference between pre- and post-survey mean			

### Qualitative Results

Two focus groups were conducted with three and four participants each during December 2017 and January 2018, respectively. Regarding the impact of the workshops on the students’ learning experience, there were three themes that emerged from the focus groups:

1. Self-efficacy for science communication;
2. Enhancing the connection to the community;
3. Preparation for future careers.

These themes and select representative quotes are displayed in Table 3.

Table 3. Impact of community service learning experience on student learning: key themes

Theme	Example quotations
<i>Theme #1: Self-efficacy for science communication</i>	
Improved communication to lay population and simplifying science	“I think it helped me because I never thought of myself as like, the source to teach other people, right? But doing the workshop, doing all the work, and seeing how engaged they were and they were looking to you for the knowledge and were interested in asking the questions, it kind of did make me feel a little bit better about my ability to do it, and teach, and be a reputable source to them.”

<p>Communication forced enhanced learning</p> <p>Public speaking decreased anxiety because of increased engagement and team work</p>	<p>“It’s kind of like you have to know the content, you have to be able to answer the questions, it kind of made me learn it more, and remember it better.”</p> <p>“In the actual workshop when people are giving you eye contact and really taking notes and really asking you questions that you’re talking about, you’re like ‘wow I’m actually impacting their lives and they’re really taking in the information that I’m saying and that I worked hard on research’, and yes it helps with your confidence because people are actually listening.”</p>
<p><i>Theme #2: Enhancing connection to the community</i></p>	
<p>Feeling of purpose</p> <p>Fostered action-oriented conversations</p>	<p>“I found that this workshop was interesting in the fact that we got to interact with the community, it was kind of nice to be able to take what we were learning and what we were studying and actually apply it and like be able to kind of give back to the community and just see what our knowledge can mean.”</p> <p>“I think the rationale for that was just because what we were thinking was there are parts of the Hamilton community that are disadvantaged socioeconomically and those might be the ones that need the most education.”</p>
<p><i>Theme #3: Preparation for future careers</i></p>	
<p>Decision to pursue careers in healthcare and higher education</p> <p>Development of soft skills</p>	<p>“It solidified the fact that I want to work with people and share health knowledge.”</p> <p>“I think it is more beneficial than your standard presentation, because you have to know the information better, and it improves your skills and all that, improves group work, all the things that have already been said, and also, you can put it on a resume, it is not just for marks, it’s more – just more, you’re getting more out of it.”</p>

## Discussion

This study demonstrated that a CSL activity, such as developing and delivering a nutrition workshop in the community, had a positive impact on students’ self-efficacy and enhanced the learning experience

for students by improving science communication skills, creating a connection to community and preparing students for future careers. Overall, students felt more confident in their ability to effectively communicate evidence-based nutrition information to a lay population after completing this workshop assignment. Some students in our sample

had participated in community-oriented projects in previous courses, and there was no significant impact of completing the current assignment on their levels of self-efficacy related to various workshop tasks. This indicates that for students who have had experience with CSL-type assignments, the assignment objectives, specific activities in the assignment, or target audience may need to be modified in order to make the assignment more novel and to elicit an impact in more advanced students. On the other hand, our study was not equipped to adequately explore this question in the small subset of participants who had prior CSL experience, and thus more quantitative and qualitative research is needed to clarify the relationship.

CSL activities are an important aspect of a student's undergraduate experience. They encourage communication of academic knowledge, translation of knowledge to a lay population resulting in social responsibility, and enhance personal and interpersonal development (Eyler, Giles, Stenson, & Gray, 2001). Similar to a large study of over 22,000 undergraduate students (Astin, Vogelgesang, Ikeda & Yee, 2000) and another meta-analysis involving over 11,000 students (Celio, Durlak & Dymnicki, 2011), our study showed that a CSL assignment significantly improved students' self-efficacy related to various workshop tasks. Self-efficacy is an important outcome in education because students with high self-efficacy are more likely to have better problem solving skills (Larson, Piersel, Imao, & Allen, 1990), persist in math and science academic disciplines, are more likely to graduate from a program (Larson et al., 2015), pursue math and science-related careers (Luzzo, Hasper, Albert, Bibby & Martinelli, 1999), and have better academic performance (Museus & Hendel, 2005). As self-efficacy can be influenced by four main factors—mastery experiences, vicarious experiences, social persuasions, and physiological and psychological states (Bandura, 1997)—it is likely that the in-class workshop rehearsal played a role in improving students' self-efficacy. During the rehearsal, students had the opportunity to practice

their workshops in front of peers and receive positive and constructive feedback on workshop content, activities and body language. As students had the opportunity to observe their peers practicing, this may have enhanced self-efficacy through vicarious experiences. The positive feedback that students received from the professor, teaching assistant, peers and group members may have contributed to social persuasion and positive reinforcement. In addition, by having the opportunity to practice the workshop, students may have benefited from mastery experience. This may have also reduced the feelings of anxiety when public speaking, improving the students' physiological and psychological states. Other studies have demonstrated that self-efficacy can be influenced by interventions or programs in the academic environment. For example, in a four week study, Luzzo, Hasper, Albert, Bibby & Martinelli (1999) showed that an intervention focused on vicarious and mastery experiences improved self-efficacy among undergraduate students compared to a control group who were not exposed to vicarious and mastery experiences. In another study, Wheeler & Wishusen (2014) showed that self-efficacy rating scores were higher for students who participated in a Biology Boot Camp with peer-to-peer interactions and learning communities (vicarious experiences), detailed feedback sessions (social persuasion) and review sessions (mastery experience). These findings support the notion that an improvement in self-efficacy in our study may be beneficial to the student, and may lead to more students pursuing careers in science, however, this should be explored in a longer-term study. In addition, it would be interesting to learn which aspect of the CSL assignment contributed most to self-efficacy improvement.

The focus group discussions revealed three key themes: self-efficacy for science communication, connection to the community and direction for future careers. Undergraduate students in science disciplines typically have few in-course opportunities to practice translating scientific information to a lay population, which is an essential skill for healthcare professionals (Woods, Pasold, Boateng, & Hense,

2014). This assignment gave students the opportunity to practice science simplification and communication skills, which in turn forced enhanced learning, as students were responsible for understanding the content in order to communicate it in lay terms (Tucker & McCarthy, 2001). Students reported an increase in engagement and teamwork skills, and a decrease in public speaking anxiety, which aligns with the improvement in communication skills with a CSL activity (Tucker & McCarthy, 2001). Students also reported a greater sense of purpose, as they were able to give back to the community and transfer their knowledge about nutrition for the management and prevention of chronic disease. Engagement and positive interactions builds authentic partnerships between the students and the community members, resulting in a desire to continue to share knowledge to facilitate action-oriented conversations (Cashman & Seifer, 2008). Action-oriented conversations are partnerships between the community and campus partners to provide services to communities in need (McMaster University, 2016). This project provided a stronger sense of community for students, which is important for fostering community-campus connections and future community engagement work (Eyler et al., 2001). Lastly, this CSL activity contributed to preparation for future careers. Students found that this experience solidified their decisions to pursue careers in healthcare and provided opportunities to develop soft skills, such as organization and teamwork. Given the positive impact on self-efficacy, it is not surprising that students gained understanding and clarity around career goals, as Lent and colleagues proposed that the Social Cognitive Career Theory links self-efficacy to the pursuit of programs and careers in the science, technology, engineering and mathematics (STEM) fields (Lent, Brown & Hackett, 1994). This is a benefit to students, but also to the community, as exposing undergraduate students to public health through this CSL activity may help to ensure that students are able to contribute to developing healthy communities (Cashman & Seifer, 2008).

The limitations of our study should be considered. The population studied was a small cohort of a larger Life Science program. The generalizability of this CSL assignment to larger classes and students enrolled in different levels remains to be determined. One of the challenges to scaling-up this assignment is that the sources of self-efficacy, such as mastery experience, vicarious experience and social persuasion, may be lost in a larger class. Another limitation is that we did not have the power to conduct a more detailed sub-group analysis investigating why students who previously participated in community-oriented courses did not experience a significant increase in self-efficacy. Furthermore, we were not able to investigate the specific details *such as* content, objectives, deliverables, and timeline of the previous community-oriented projects, which may be an important consideration. Finally, our study did not include a control group, which makes it challenging to compare the impact of this CSL assignment to another more traditional assignment in a small class.

## Conclusion

CSL activities enhance the undergraduate student learning experience and can positively impact self-efficacy, community values, and preparation for future careers. This pedagogical approach may be ideal for undergraduate science students aspiring to work in healthcare in the future, as this experience allowed students to practice teaching the lay public about nutrition and health and fostered a sense of responsibility towards helping others in the community.

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