

COMMUNITY ENGAGEMENT ACROSS DISCIPLINES: ENGINEERING WITHIN THE SERVICE LEARNING ENVIRONMENT

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Abstract

Working within an interdisciplinary service learning environment fosters information sharing; donning those “many hats” by incorporating contributions of all participating disciplines. The “Tiger Trails” project was designed to facilitate collaboration between faculty and students in different departments toward a common goal: to increase awareness of physical fitness within the Queensborough Community College campus. It commenced as a service-learning project featuring classes from two seemingly different fields: Engineering Technology, and Physical Fitness, expanding beyond traditional engineering through collaboration with non-engineering disciplines towards establishing a service learning opportunity within the community.

Queensborough has a unique campus configuration. Located in a small area with hilly topography, it was built on several levels, connected by stairways and walkways. With only one gymnasium and one small fitness center - for a population of 16,000, customary physical fitness opportunities are extremely limited. The Tiger Trails project set out to map various indoor/outdoor walking trails within and throughout the campus for use as physical activity outside of the gym.

Using Fitbits® and surveyor’s wheels, physical fitness students measured walking distances and caloric expenditures between the campus buildings, while engineering students using Surveying Equipment such as the Total Station, Auto Level, and Philadelphia Rod surveyed the campus hills. Fitness students then measured caloric expenditure up and down each measured hill. All in all, new learning and information was created between the parties involved through interaction and cooperation. Although it was not necessary for engineering students to

understand physical education and vice versa, it became evident that all participants acquired a new general understanding of physical activity throughout the campus.

Scores from student service-learning surveys demonstrated overwhelmingly positive attitudes toward the project as well as service in general. Students also reported that the project provided them with opportunities to strengthen their academic content knowledge beyond the classroom, theory, numbers, and drawings towards diverse real-world situations for everyone's benefit.

Introduction

An interest involving the noble notion of *service to the community* can be seen an attempt to improve the community and serve to benefit its' citizens. This may be possible through the efforts of individuals wearing "many hats" in order to shoulder several responsibilities. The Tiger Trails project is a working example of such collaboration. Tiger Trails was set up as an initiative to help inform the QCC community of the various health and fitness opportunities that exist within the campus. In this collaboration, an Engineering class joined forces with Health and Physical Education classes in measuring various campus walking trails, stairs, and hills in order to provide students with knowledge of physical activity and caloric expenditure while walking from class to class. On the surface, such interdisciplinary collaboration might not seem relevant to their respective fields, as engineering and physical activity may be seen as disparate subjects. However, this collaboration sought to contribute each subject's vital expertise toward a larger project serving the common need. Specifically, the following three objectives were targeted for the project:

1. To enhance student learning through work beyond the classroom in real-world situations through participation in a service-learning project.
2. To increase collaboration of engineering with other academic fields and disciplines.
3. To increase knowledge and awareness of physical activity and caloric expenditure within the QCC campus.

Addressing the need

Recent research demonstrates a nationwide decline in physical activity (CDC, 2015). College students in particular exhibit a prevalence of inactivity despite the fact that colleges may provide the ideal setting for the advancement of physical activity (Keating, et al., 2005; Huang, et al.,

2003). To this end, researchers have suggested a greater effort on the part of college faculty and administration to increase student awareness of the benefits of physical activity and offer more programs designed to get students active (Lowry, et al., 2000; Keating, et al., 2005; Kwan, et al., 2012).

Among the goals of the American College Health Association's Healthy Campus 2020 initiative is for colleges to "create social and physical environments that promote good health for all" (2010, p. 1). According to Dr. James Pivarnik of the American College of Sports Medicine, "The built environment, as we call it, has a lot to do with how active people are" (Internicola, 2012). The Tiger Trails project is an attempt to address this issue by creating knowledge and awareness of alternative campus health opportunities. Despite a student population of 16,000, the QCC campus has only one gymnasium and one fitness center available for students to exercise. The gym is occupied most days with physical education classes, athletic team practices and competitions, and recreation programs. The fitness center is small (76' x 30') and is equipped with weight machines, free weights, treadmills, exercise bicycles, and other cardio equipment. There is only room for 30 – 40 students to comfortably workout. Needless to say, customary physical fitness opportunities for QCC students are extremely limited.

Service-learning

Service Learning has been defined as, "an instructional method that combines community service with classroom instruction, focusing on critical reflective thinking as well as personal and civic responsibility" (Robinson, 1999, p. 1). Research demonstrates the numerous positive impacts of academic service-learning: improvement of academic achievement across disciplines including those of students who require remediation and those engaged in career and technical (CTE) majors; attainment of general education objectives and workplace skills such as critical thinking, teamwork, and problem solving; increased student retention; and cognitive and attitude development (Eyler & Giles, 1997; Astin et al., 2000; Duffy, 2000; Prentice and Robinson, 2007, 2010; Finley and McNair, 2013; Rochford, 2014; Ellerton et al., 2014). Such work may include projects involving students with different discipline backgrounds leading to newly acquired or discovered knowledge that could help to provide a "missing link" towards global understanding of real world applications of such knowledge.

Physical Features of QCC:

Queensborough Community College (QCC) home of “the Tigers” is one of 24 college education campuses of the City University of New York (CUNY) system. It is located in Bayside, Queens, New York. Bayside’s unique topography was formed during the Wisconsin Stage within the Pleistocene Epoch which saw two glaciers advancing and receding to form Long Island (Jean-Michel, 2014). Located in northeast Queens, Bayside is on the north flank of the Harbor Hill Moraine, hence its hilly topography. Originally a farming hamlet, Bayside grew at first as a summer escape from Manhattan to today’s bedroom community stemming from the Long Island Railroad expansion which included a station for Bayside.

By 1896, John Taylor owned the 180 acre former Frederick Newbold Lawrence estate which he organized and built the Oakland Golf Club (Pietri, 2008). The Oakland Golf Club ceased operations during the early 1950s where the land was sold to the City of New York; which built three public schools including Queensborough Community College in 1959 (Kadinsky, 2015).

The campus sits on 37 acres of land and includes 14 buildings bounded by 900 feet along Cloverdale Blvd, 1355 feet south along 56th Ave, 584 feet north along Kenilworth Ave, finally 1210 feet west and 1255 feet north bounding Oakland Lake Park. Topography shows this location within the higher elevation Oakland Gardens section of Bayside. The lower elevations of the campus are found at the northeast corner by Cloverdale Blvd and Kenilworth Ave, east along Cloverdale Blvd, and south along 56th Ave. Within the campus center, the topography rises to the highest knoll in front of the Oakland Gallery at 120 feet above sea level before sharply descending roughly 45 feet where the athletic fields are located. The significant buildings located within the higher elevations are the Oakland Gallery, Technology Building and Student Union. While at the lower elevations are the Humanities, Science, Medical Arts Buildings, the Library and the Administration Building. The hilly landscape of the campus provides potential opportunities for physical activity for students walking to and from classes.

Demographically, Queensborough Community College is one of the most diverse colleges in the world. Students hail from 139 countries and over 43 percent speak a language other than English at home. A majority of the QCC population is comprised of students of color; 30 percent are Hispanic, 26 percent are Black, 26 percent are Asian or Pacific Island and 18 percent are White (QCC, 2014-2015).

Participating Disciplines

Department of ET

The Department of Engineering and Technology (ET) provides academic programs for students interested in learning about Computer, Electronic, Mechanical, Architectural, and telecommunication technology as well as engineering science and new media technology. Three of the department's main objectives are to 1) Reason quantitatively and mathematically as required in their fields of interest and in everyday life, 2) Use information management and technology skills effectively for academic research and lifelong learning, and 3) Integrate knowledge and skills in their program of study (QCC, 2016).

ARCH -125: Surveying and Site Planning

ARCH 125 offers principles and practices of elementary surveying with applications of the fundamental techniques of site planning principles with the use of topographical maps and models. Emphasizing the importance of site development as it relates to architecture and sustainable site development. Field work in the practical application of surveying techniques includes measurements of distances, angles, and elevations that relate to computations and mapping of closed traverses (QCC 2016). In this class, students are introduced to basic land surveying as expected in the Architectural, Construction, Engineering or "ACE" field, Students learn measuring procedures for horizontal distance, elevation difference between two points; leveling, and the angle formed by the intersection of two lines or courses at a common point. The surveying instruments typical for the field are the Total Station, Auto Level, Philadelphia Rod, Prisms, etc. There are a series of points within the QCC campus where the students do their measuring work and recording these activities in a formal field book.

Department of HPED

Queensborough Community College's Health, Physical Education and Dance (HPED) Department provides academic programs for students interested in learning about health, nutrition, physical education, exercise science and personal training. Two of the department's main objectives are to 1) provide a program of instruction in the scientific bases of health and physical activity that will serve as a foundation for lifetime optimum fitness and wellness, as well as serve the needs of community, and 2) provide learning experiences designed to enable

students to develop analytical reasoning skills in order to make informed health decisions (QCC, 2016).

PE-540: Introduction to Physical Fitness

PE-540 offers a comprehensive approach to preparation of a physically active lifestyle. This course focuses on building sound exercise and activity habits that can carry on throughout one's lifetime and emphasizes an extensive review of physical fitness components, design and initiation of a personal fitness plan, and active engagement during fitness activities (QCC, 2016). In this course students are exposed to past and current theories of health and fitness with emphasis on how lifestyle, wellness, and personal fitness are affected by genetics, gender, and age. During the semester, each student assesses and designs improvement plans for their own cardiovascular capacity, muscular strength, muscular endurance, flexibility, body composition, and diet. Within the course is fitness lab work, where students work on their various improvement plans.

PE-545: Fitness Walking

This course is designed to give students a basic working knowledge of cardiovascular fitness using walking, the nation's most popular form of exercise. Other topics covered include proper form, flexibility, stress management, motivation, and current fitness topics. This class is tailored to meet the needs of students at all levels (QCC, 2016). This activity course provides students the opportunity to exercise outside of the traditional gymnasium/fitness center setting. Students track their walking activity and caloric expenditure on a daily basis and work on chronicling their progress and programming improvement of their pre-course fitness measurements.

Procedures

Pre-program orientation

Prior to the commencement of the service-learning project, instructors from both ET and HPED programs presented the Tiger Trails project to participating classes. This presentation included: a) a detailed description of the project; b) the scope and objectives of the project, c) general areas and specific responsibilities of each participating class; d) benefits for participation

in the project; and e) options for students who do not wish to participate (since Tiger Trails is a service-learning project, students have an option to opt-out of participating).

ARCH -125: Surveying and Site Planning

ARCH-125 participated in the Tiger Trails project over the course of three semesters. Each course averaged fifteen students for a total of 45 participants. For the Tiger Trails project ARCH-125 students utilized the leveling measuring discipline to establish elevation differences among those portions of the Tiger Trails network encountering the hills within the campus. The locations of these portions are as follows:

1. Along the Service Road between the Main Gate at 56th Ave and the Student Union nearest the highest point.
2. The “Spanish Stairs” located between the Administration Building and the Library.
3. Path and Stairway from the Athletic Field to the Student Union.

The Leveling Measuring work for these three portions consists of:

1. Establishing a 0.000 ft. base elevation at the start being the lowest point.
2. Establishing intermediate points where between each point this procedure was used:
 - a. Taking a backsight reading towards the point of known elevation.
 - b. Adding this value to the known elevation to obtain a height of instrument value.
 - c. Taking a foresight reading towards the point of unknown value then subtracting this to obtain the elevation of the unknown point.
 - d. This repeats to the final top elevation.
 - e. A map is drawn up indicating these elevation values between lowest and highest point for each of these three paths.

ARCH -125 Equipment Used:

- Automatic Level (Scope and Bubble Level), Tripod Mounted
- Philadelphia Rod – A surveying measuring tool for leveling that is given in decimal format with graduations to the thousandth position.
- Pegs to position the Philadelphia Rod over an established point to set accuracy.
- Pins to establish points between lowest and highest points for each path.

PE-540: Introduction to Physical Fitness

PE-540 participated in the For the Tiger Trails project for two semesters. A total of 40 students were involved in the project. PE-540 students set out to measure the QCC campus. Students alternated tasks between measuring the campus (usually in pairs) and working on their personal fitness programs. Explicit rules were put in place to ensure the safety of those involved as well as students and personnel on campus such as: walking, not running; use of sidewalks, not roads or parking lots; measuring during times of low student traffic; and keeping to student-accessible areas only. Students recorded their own fitness expenditures while measuring the campus. Primarily, PE-540 students set out to measure:

1. Door to door walking distances between buildings
2. Calculations of average calories expended for each walking distance
3. Tallying of all outside campus stairs with caloric expenditures up and down
4. All designated paths multiple times
5. Confirmation of results, including repeated calculations of questionable measurements

In addition, students were encouraged to track their own physical activity while participating in Tiger Trails. Tallies were given to the instructor after each outing. Some students volunteered to measure outside of class for extra credit or to make up missed work.

PE-545: Fitness Walking

PE-545 participated in the Tiger Trails project for one semester. A total of nineteen students participated in the project. Fitness Walking students participated in the Tiger Trails project mainly by combining various data points in creating a series of indoor/outdoor trail combinations throughout the campus (i.e. the 100 calorie “Inner Circle” trail). Using the assembled Tiger Trails data, students mapped out and performed various campus walks. Students were encouraged to explore multiple trail combinations and report their preferences. As with PE-540, all measurements took place when classes were in session as to avoid heavy walking traffic on campus.

Equipment Used (both classes):

- Surveyor's wheel – hand-held measuring device used to measure door-to-door distances between campus buildings.
- Fitbit® - a small wireless activity-tracking device containing sensors that track the user's three-dimensional motion and converts data into useful information such as: intensity and duration of activities, calories burned, steps taken, stairs climbed, and distance traveled.
- Clipboards and tally sheets - used to record all measurements

Results

Participation in a service-learning project

A total of 114 students participated in the Tiger Trails project over the course of three semesters. The QCC Office of Academic Service Learning (OASL) administered a post-course survey to participants at the end of each semester. The surveys were not course specific. Their main focus was to assess the service-learning experience of the participants. Ninety five percent of participants took the survey.

Students reported having a quality experience in the service-learning class and that the project provided opportunities to strengthen their academic content knowledge. Overall, students were satisfied with their experience in the service-learning class (73%). Students reported that they applied what they learned in the course during the service-learning project (73%) and that the experience helped them to learn academic content knowledge more effectively (72%). Students also reported a positive impact on their knowledge of societal problems. As a result of participating in service-learning projects, the majority of students felt that they understood the needs and problems facing society (63%). Students also agreed that service-learning gave them a good understanding of the community need addressed by their project (66%). In addition to reporting greater knowledge of the community issue, they agreed with that their projects had a positive impact on the community (67%).

Table 1: Survey questions about service-learning experience

Question Text	Responses	Percent Positive
I usually volunteer in my community.	97	32%
As a result of participating in this service-learning project, I will probably volunteer or do service in the community in the future.	104	60%
As a result of participating in this service-learning project, I have a good understanding of the needs and problems facing society.	108	63%
I have a good understanding of the community need my service-learning project addressed.	95	66%
As a result of participating in this service-learning project, I have a good understanding of the daily responsibilities involved in working with others.	108	76%
The service-learning project helped me learn material from my course more effectively.	105	72%
The service-learning project helped other people and/or the community partner.	105	67%
I applied what I learned in class during the service-learning experience.	106	73%
How would you rate the overall experience you had in the service-learning class?	104	73%

Participation in service-learning projects may have increased the likelihood of future community service by these students. While only thirty-two percent of students said that they usually volunteer in the community, sixty percent reported that they would volunteer in the community in the future.

Students tended to report increased confidence in certain skills after participating in service-learning. Students reported that their participation in service-learning positively impacted their ability to work with others, complete projects, and think critically. Service-learning positively impacted students' abilities to respect the opinions of others (86%), communicate with people of

different backgrounds (86%), and understand the values of people different from themselves (86%).

Table 2: Student reports in of confidence in academic and workplace skills

Question Text	Responses	Percent Positive
Work with others as a member of a team.	95	75%
Solve challenging problems.	93	73%
Express ideas, opinions and facts in writing.	95	77%
Express ideas, opinions and facts verbally.	94	74%
Follow directions completely.	91	85%
Ask questions in class.	93	79%
Respect the opinions of others who may disagree with you.	89	86%
Complete projects or assignments on time.	94	88%
Communicate with people of different backgrounds or cultures.	94	86%
Make a presentation in front of a class or speak in public.	93	59%
Understand values of people different than you.	95	86%
Analyze and critically evaluate ideas, arguments and points of view.	91	81%
Compare different approaches to solving a problem.	94	83%

After performing service-learning, students reported a positive increase in confidence with regards to more traditional academic skills. Students reported that more confidence in their ability to complete projects/assignments on time (88%) and follow directions completely (85%). Additionally, respondents said that service-learning had a positive impact on their ability compare different approaches to solving problems (83%) and analyze/evaluate arguments and points of view (81%).

Collaboration of engineering with other academic fields

The Tiger Trails project represented the first QCC collaboration between the ET and HPED departments. Although students from each program did not directly work together, information obtained from each program contributed to the project. A central feature of this collaboration is

the measurements of the QCC “Spanish Stairs,” centrally located between the school’s library and administration buildings. Eight asymmetrical stair runs totaling 46 risers make up the plaza-like ambience of this unique space. ARCH-125 students began their leveling work at the foot of the stairs, continuing to the top, finally ending at the Student Union Commons. PE-540 students measured caloric expenditures for the stairs and found that climbing up burns twelve calories, while descending down burns only eight. Thus all parties became aware of the discrepancy while noting that traversing the stairs up and down five times results in a 100-calorie workout.

Awareness of physical activity

All in all, over 500 measurements were gathered and analyzed. Information was shared with all participating students, as well as the OASL and department colleagues. The results of this project has also let to discussions of further Tiger Trails-related projects between departments, as well as with professors from mathematics, art and design and other interested departments.

In response to open-ended questions on the OASL survey, reflection questions, and comments on course evaluations, students noted how the project compelled them to be more responsible and accurate with their measurements, indicating that they understood the importance of the project for the entire campus. One student remarked, *“We are creating information the public didn’t have access to before.”* Students also noted the practical application of the project, *“I liked that we were able to see that we can even get a workout walking between the school buildings with the Tiger Trails project”* and *“It was very interesting to see how active one person can be throughout the campus.”* Another common theme was how the project encouraged problem solving. Through the experience, as a student observed *“...there is always an alternative route to reach your goals; you just have to find it.”*

Discussion

The purpose of the Tiger Trails project was to engage students in meaningful service to the college by increasing awareness of fitness opportunities outside of the QCC gym and fitness center. Students were successful in gathering information such as elevations of campus hills and stairways, distances between campus buildings, and calories burned. Specifically, the ARCH-125 measurement of elevations was augmented by the measurement of calories. Thus, participating

students were better able to grasp the notion that the calories burned walking from building A to building B are often different than walking from building B to building A, even though they are the same distance apart. Students were required to work within the parameters and specifications given to them by a client, in this case, the Tiger Trails project. Hence this project fulfilled the expectation of being service to a common need through collaboration of seemingly disparate fields, each contributing a part towards the whole. What each class could do on its own did not add up to the complexity of the present project. New learning was created between all parties involved through interaction and cooperation – a blend of expertise from two different fields. Although it was not necessary for physical fitness students to understand engineering and vice versa, it became evident that all participants acquired a new general understanding of physical activity on our campus.

While engineering students were accustomed to working with surveying equipment in the ARCH-125 course, participating in a service-learning project provided the students with a practical application with which to bridge class theory to real -world workforce activities. This supports the notion that “[t]he linking of service-learning and coursework provides the potential of engineering to help community needs” (Duffy, 2000, p. 92). Since the Tiger Trails represented a real-life service project, students were able to focus their work as it would be in a professional situation.

Implications for the Future

The successful collaboration of the Tiger Trails project could be seen as the beginning of a larger project involving more academic fields. Plans are being discussed to add additional service-learning projects to the mix. The ET department plans to work on developing a color-coded map of various Tiger Trails. In addition, ET is considering a project to create a Tiger Trails smart phone application. Interest throughout campus has led to inquiries in a possible feature article in the campus newspaper published by students in a Journalism class. Marking trails with informative signage could possibly involve the Art and Design department. Once established, Tiger Trails can be used for a variety of QCC promotional events such as QCC Athletic Team Warm-up/ rally, the QCC “Walk to Aspire” charitable event, and a possible QCC Iron competition.

While the benefits of service-learning for students have been well documented, additional research can shed light on how service-learning can play an important role in strengthening the collaborative process among faculty. At Queensborough, the Tiger Trails project may be just the program with which to build upon this process.

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