

Service Learning in Higher Education Exercise Science Programs

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Introduction: Service learning (SL) describes teaching methods that incorporate student service activities with specific learning objectives. SL has been applied to allied health higher education programs.

Purpose: To determine the applicability of SL to exercise science courses. SL data associated with an undergraduate course in exercise physiology serving a local fire department is examined.

Methods: Among 90 firefighters, resting heart rate, blood pressure, estimated relative VO_2 max, body composition, lower extremity power, upper body strength, flexibility, and perceived stress was assessed before and after an education and physical activity intervention consisting of exercise prescriptions, supervised exercise programming, and education for 60 minutes 1–3 times per week for 1 year. Learning outcomes among 34 participating students were assessed via a questionnaire assessing higher education SL. Secondary data was retrospectively examined for this study.

Results: An increase in estimated VO_2 max (+9%, $p = .04$) and upper body strength (+13%, $p = .03$) and a decrease in perceived stress (-34%, $p = .00$) were observed in the firefighters. Student SL data revealed that 90% of students found that the activities were aligned with the course, 75% found that the activities enhanced communication skills, and 80% found that the activities enhanced relationships with faculty.

Conclusions: Positive outcomes of SL were observed in the firefighters and undergraduate students, indicating that SL can be applied successfully to exercise science higher education courses.

Keywords: *exercise science, firefighters, health and fitness, service learning*

Introduction

Service learning (SL) describes student activities providing a specific service that meets the needs of the community while also meeting specific course or curriculum objectives. Applied service activities in coordination with an institution of higher education are integrated and incorporated into specific learning objectives and include a fostering of civic responsibility and reflection on the SL experience. Chief among the criteria for an SL activity is its relevance to the course or curriculum to which it is applied (Cashman & Seifer, 2008).

Though SL can be incorporated into almost any discipline, it is more commonly applied to the fields of public health, nursing, occupational therapy, pharmacy, and physical therapy (Brush, Marker, & Lazarus, 2006). Student outcomes include the development of health promotion and research skills (Reising et al., 2008), facilitation of social change (Cashman & Seifer, 2008), attainment of cultural competency, critical thinking, and civic engagement (Nokes, Nickatas, Keida, & Neville, 2005). Physical therapy (Hoppes, Bender, & DeGrace, 2005) and occupational therapy (Beling, 2003) skills

have been incorporated into SL activities including screening and assessment skills. In addition, SL has been associated with positive academic and professional outcomes (Brush, Marert, & Lazarus, 2006), such as attainment and improvement of clinical skills and job placements. Communities and groups served by students have included patients and communities at risk of or diagnosed with chronic disease, in addition to service personnel such as police officers (Juller, Alexander, & Hardeman, 2006).

Colleges and universities have increasingly incorporated SL into allied health and general curricula with an estimated \$9.1 billion worth of community services estimated in the year 2011. Over 300 million hours of SL represented about 6 hours per week per student of community services within the academic year (Campus Compact, 2012).

To date, no published study has examined the application of SL to a health and fitness program tailored to firefighters, nor has SL been examined in association with an exercise science major. Additionally, though qualitative methods have been used to assess SL student outcomes in international studies (Tonkin & Quiroga, 2004) and among dental hygiene students (Keselyak, Simmer-Beck, & Bray, 2007) via assessment of journal entries, no study has assessed undergraduate exercise science student SL outcomes via a student questionnaire (Service Learning Organization, 2009). As a result, the purpose of this study was to examine retrospectively if exercise science students provided health benefits to a community in need of a service—specifically, a local fire department—while meeting the learning objectives of the SL experience. Thirty-four students enrolled in an exercise physiology course participated in an SL activity serving 90 firefighters. Course-related content included an examination of epidemiology and special populations in addition to the physiology of exercise. The service activities included student involvement and assistance with the design, implementation, and data collection for a health and fitness program tailored to firefighters under the supervision of course faculty.

A Review of Service Learning in Allied Health Higher Education

Though there is no published study examining the application of SL to exercise science programs, SL applied to other allied health curricula has been examined, including its application in the development of health promotion and research skills in nursing and other allied health disciplines (Reising et al., 2008). Nursing students screened and educated communities at increased risk for hypertension and diabetes. Outcomes of the study included increases in health-related knowledge among the priority population specific to the risk factors and treatments for hypertension and diabetes. Student learning objectives relative to health promotion outcomes, assessment skills, civic engagement outcomes, and research skills also increased post-SL activities. Though there was no comparison group to document that these changes represented an improvement compared to standard delivery of nursing curriculum, Reising and colleagues (2008) concluded that the “real life” application of nursing didactic content, in addition to the provision of a community health service, met the objectives of the nursing course. Similarly, Nokes and colleagues (2005) found significant increases in measured civic engagement scores (3.4% increase post) in an examination of SL applied to a 15-hour SL activity. Student outcomes reflecting critical thinking and social competence were reduced after the activity and were associated with reduced measures of perceived self-confidence. Nokes and colleagues (2005) pointed out that this outcome could be interpreted positively or negatively, as the nursing student’s perception of his or her critical thinking and social competence may be relatively adjusted within the context of an applied setting in the “real world” versus the classroom.

Beling (2003) examined SL applied to physical therapy students and compared student knowledge of and attitudes toward elderly patients and faculty evaluations in a cohort of 40 physical therapy students and a comparison group of the same size. Results included an increase in aged-population-related knowledge and positive attitudes in the students, with no change in the comparison group. Faculty evaluations by students involved in the SL activity were significantly lower versus the comparison students. Beling (2003) argued that faculty evaluations may not adequately address the faculty role in SL curriculum, or it could be the perception among students that the faculty is less involved compared to traditional learning environments.

Reisling, Allen, and Hall (2006) examined SL in the context that most closely resembles a firefighter-specific health and fitness program. Nursing students were engaged in a community health screening involving the administration of patient medical histories and clinical assessment skills such as heart rate, blood pressure, and counseling skills with over 700 screenings performed over 2 years. The goal of the screening program was to identify individuals with hypertension or risk factors for chronic diseases such as cardiovascular disease and diabetes. The student learning outcomes included significant increases in clinical skills associated with blood pressure and heart rate, as well as increased skill outcomes relative in counseling, establishing patient action plans and referrals, and self efficacy. The benefits to the community served included positive health behavior changes reported by the clients.

A Review of Health and Fitness Programs for Firefighters

Over 1 million firefighters are currently employed in the United States, and approximately 46% of these service personnel are over the age of 40 (United States Fire Administration, Department of Homeland Security, 2011). The top causes of death in the United States are attributed to cardiovascular disease and associated risk factors (Centers for Disease Control and Prevention, 2011); these mortality statistics do not differ in firefighters. For example, the top cause of on duty death in firefighters is a heart attack (Wagner et al., 2006), similar to the general population. Cardiovascular risk-factor intervention programs, as well as general health and wellness programs, have demonstrated reduced morbidity and mortality rates and provide specific benefits to firefighters if modified to accommodate their job-specific tasks and environmental challenges (Cady, Thomas, & Karwasky, 1985). Although risk-factor intervention programs tailored to firefighters are not prevalent, researchers have observed some benefits associated with firefighter-specific programs that include regular exercise, education, and lifestyle modification strategies, though previous studies have not aligned specific outcomes with SL objectives and associated findings among exercise science students.

The specific physiological demands and challenges placed on firefighters have been examined (Bugajska, Zuzewicz, Szmauz, & Konarske, 2007) in addition their associated increased risk for coronary events (Dibbs, Thomas, Weiss, & Sparrow, 1982). Examination of mortality rates of firefighters reveals that cardiovascular disease represents the top cause of on-duty death and disability (Heyer, Weiss, Demers, & Rosenstock, 1990). Training programs aimed at increasing firefighters' fitness levels may reduce their risk of death associated with cardiovascular disease or positively impact risk factors (Cady et al., 1985). Communities and government agencies are interested in programs that can cut costs associated with disability and premature death in firefighters (Walton, Conrad, Furner, & Samo, 2003).

Cady and colleagues (1985) began a health and fitness program for firefighters in Los Angeles, California, with the goal of increasing the physical fitness of over 1,800 firefighters. Baseline tests

included electrocardiograms, blood pressure, blood lipid analysis, firefighter-specific functional fitness tests, and flexibility tests. The intervention consisted of exercise programs and education sessions in addition to daily on-duty exercise time. Follow-up data revealed a 16% increase in firefighter-specific functional fitness tests and a significant reduction in smoking from 44% to 25% of the population.

Green and Crouse (1991) examined the effects of a mandatory exercise program on the risk of heart disease in firefighters. Similar to Cady and colleagues (1985), baseline testing was administered to a cohort of firefighters beginning in 1977 with follow-up data repeatedly measured thru 1986. Baseline tests included body fat percentage, blood lipids, and VO₂ max (oxygen delivery and extraction capacity). The cohort was assessed each year with data revealing a significant decrease in body fat, total cholesterol, and VO₂ max variables compared to the control group. Green and Crouse (1991) argued that the differences (though significant) were small and could argue for the establishment of a mandatory exercise program—or against it, considering the costs associated with implementing health and fitness programs.

Job performance and its association with health status and fitness level were examined in firefighters (Rhea, Alvar, & Gray, 2004). Specifically, job performance measures were higher and significantly correlated with tests of aerobic fitness, upper body strength, upper body endurance, squat endurance, and 400-meter sprint time. Rhea et al. (2004) argued that job specific exercise training programs could increase the efficiency and effectiveness of job-specific tasks in addition to providing the firefighter with general health benefits associated with regular exercise.

Exercise training was also examined with respect to lowering perceived stress levels in firefighters (Throne, Bartholomew, & Farrar, 2004). A group of 53 firefighters underwent 16 weeks of exercise training and was then compared to a control group. Exercise consisted of aerobic rowing, in addition to any exercise training that they were doing at the time. Simulated firefighter-specific stress was examined at baseline and at 16 weeks using a firefighter strategy-and-tactics drill. Baseline tests revealed no differences in perceived stress between the two groups; however, after exercise training, the exercise-trained group demonstrated reduced blood pressures and heart rate responses to the same simulated stressor. Throne et al. (2004) concluded that exercise training could provide job-specific stress management benefits in addition to documented health benefits associated with aerobic exercise.

Exercise training may also benefit firefighter recruits. Roberts, O’dea, Boyce, and Mannix (2002) examined the effects of 16 weeks of supervised exercise training on body fat, aerobic fitness (VO₂ max), flexibility, and upper body endurance and strength on 115 firefighter recruits. Training consisted of aerobic exercise 3–5 times per week and strength training 2–5 times per week. Post data revealed a 28% increase in VO₂ max, a 17% increase in upper body endurance and strength, a decrease in body weight, and an increase in lean body mass. Roberts and colleagues (2002) concluded that a training program should be mandatory for all new firefighters—primarily due to the fact that baseline data specific to aerobic fitness (VO₂ max) was lower than desired levels but was increased to levels consistent with the metabolic demands of firefighting after exercise training.

Aerobic capacity and fitness is specific to the job demands of a firefighter and can also be cardioprotective (Faria & Faria, 1991). The associations between blood lipids and aerobic capacity with regular exercise were examined for 32 weeks in 38 firefighters. Exercise training consisted of aerobic cycling, rowing, walking, or jogging in addition to circuit weight training 3 days a week for a minimum of 30 minutes. Significant increases in VO₂ max and decreases in total cholesterol were

observed, suggesting that a firefighter-specific training program may reduce mortality associated with cardiovascular disease by positively modifying the risk factors for the disease and acute coronary events (Faria & Faria, 1991).

Specific to the costs associated with on-duty injuries in firefighters, Walton et al. (2003) examined work-related injury rates, causes of injuries, number of claims, and the average cost per type of injury in a 7-year period in the state of Illinois. Of the over-1,300 claims, overexertion and back injury accounted for over one-third of the claims, which amounted to over \$9,000 per firefighter claim. Walton et al. (2003) argued that prevention programs that would include regular physical activity may reduce the costs associated with overexertion injuries and related claims.

Summary

Researchers have examined SL applied to allied health higher education primarily in the nursing, pharmacy, physical therapy, education, and occupational therapy fields. In addition, studies are generally in agreement that health and fitness programs assist firefighters with the physical demands of their jobs and modify cardiovascular risk factors that may lead to reduced mortality and morbidity associated with cardiovascular disease. The purpose of this study was to analyze secondary data collected among firefighters receiving SL-related services and students engaged in SL to assess, in aggregate, the applicability of SL in exercise science curricula. A secondary analysis of variables such as heart rate, blood pressure, endurance, strength, and perceived stress was compared before and after for the firefighters, and an SL questionnaire that was distributed to the students was retrospectively examined. Several of the most compelling studies examining SL have provided data to support both the intervention and student-related outcomes; as a result, the firefighter-specific and student-related data were retrospectively analyzed and presented together in this study. Positive outcomes among the firefighters and students participating in SL can potentially make a compelling argument for incorporating SL into exercise science curricula.

Theoretical Framework

Similar to other examinations of SL, this study is composed of two parts: analysis of benefits to the beneficiaries of the SL activities (firefighters) and analysis of learning objectives among participating students. Theoretical frameworks supporting the provision of a health and fitness program for firefighters, as well as aligning SL activities with higher education courses, guide this investigation.

Firefighting as a profession is characterized by moderate to high levels of job strain (Cendales et al., 2012), with researchers suggesting the theory that job strain is an aggregate stressor stemming from a combination of job-associated psychological demands and low decision latitude (Karasek, Baker, Marsner, Ahlbum, & Theorell, 1981). Generally, high levels of job strain have been associated with increased risk of cardiovascular disease (Karasek et al., 1981). Specifically, job strain among firefighters has been associated with increases in blood pressure (Cendales et al., 2012) and marked increases in both blood pressure and heart rate while on duty compared to off duty, independent of physical demands (Steptoe, Mark, Evans, & Snashell, 1995). Given that Throne et al. (2004) concluded that exercise training may provide job-specific stress management benefits in addition to documented health-benefits association with aerobic exercise discussed in the literature review, the provision of a health and fitness program may provide physical and mental health benefits to the firefighters examined in this study.

The literature review documents the increased prevalence of SL in higher education and, in particular, the health sciences as well as observations of relevant gains in learning objectives among student participants. Researchers have applied cognitive theory to SL and argue that the potential transformative nature of these academic experiences has the potential to increase didactic learning outcomes. Rockquemore and Schaffer (2000) suggest that an SL-specific theory of engaged learning is revealed in qualitative analysis of student journals. Fifty SL students progressed through a series of cognitive stages in a variety of education- and health-related experiences—including an initial adjustment to the environment, normalization, and, finally, engagement, during which students actively sought answers to course-related questions within the contexts of their SL environments.

Considered together, theoretical support for physical and mental benefits among firefighters and student learning outcomes among participating students merits an examination of these factors via secondary data analysis postimplementation of an SL activity within an exercise science curriculum.

Methods and Procedures

The examination of the application of SL applied to a health and fitness program tailored to firefighters is a retrospective quantitative analysis of secondary health and fitness variables among firefighters and SL objectives among participating students at baseline compared to postimplementation of a university-based health and fitness program consisting of education, exercise prescription and training, and stress management sessions. Specific research questions include

1. Is there a pre/post difference in weight, heart rate, blood pressure, oxygen saturation, body fat, estimated VO_2 max, pushups, sit ups, hand grip, long jump, flexibility, and perceived stress among firefighters?
2. Among participating students, what proportion finds that the SL activity enhanced communication skills, was aligned with the course, enhanced relations with faculty, enhanced problem-solving skills, and included knowledge gained through interaction with student peers?

Posing these questions together in one study can provide information relative to the applicability of SL in exercise science curricula.

Firefighters and students participated in a university-based wellness program from 2005 to 2008. Though data were collected among firefighters to determine efficacy of the program, and student-learning questionnaires were distributed to assess fit with the SL course, this study brings together the outcomes of the beneficiaries of SL (firefighters) and the providers of SL (students), similar to other studies of SL in allied health.

Variables examined at baseline and at semiannual intervals during program implementation for the firefighters included resting heart rate, blood pressure, oxygen saturation, weight, and body composition. Fitness variables included estimated VO_2 max measured through a graded exercise test using the Bruce protocol (American College of Sports Medicine, 2009), timed sit ups, pushups, hand grip dynamometry, and long jump for the examination of core endurance, upper body strength, and lower extremity power, respectively. The Duke Health Profile (Duke, 1989–2005) was used to assess perceived anxiety and stress. The Duke Health Profile assesses six health measures—including physical, mental, and social variables via questionnaire—and has been validated externally by comparison to similar questionnaires including the Sickness Impact Profile and internally by clinically valid differences in scores among adults with varying physical and mental abilities

(Parkerson, Broadhead, & Chiu-Kit, 1990). Additionally, the Duke Health Profile has been specifically used to assess perceived health among firefighters with significant reductions observed in perceived physical health associated with longer duration shifts (Lynne, 2009).

Student SL objectives related to the course *Exercise Physiology* were examined after student participation in the program through a student questionnaire of SL outcomes (Campus Compact, 2012). These included a series of questions assessing the students' perceptions of their involvement in SL. For example, if the student perceives that actively taking the blood pressure of a firefighter enhances the learning process associated with learning to take blood pressure measurement, one of the student learning objectives will be met. Though this questionnaire is recommended by Campus Compact to assess student-associated outcomes, tests to determine validity and reliability of the questionnaire have not been conducted. The firefighters participating in the program consisted of a cohort of 90 firefighters—89 males and 1 female with a mean age of 34 years. An institutional review board from the university approved the study in 2005, which required maintenance of confidentiality, provision of informed consent, and voluntary participation of student volunteers engaged in SL. The student cohort consisted of 34 *Exercise Physiology* students. *Exercise Physiology* is a required junior-level course within the exercise science major at the university. The student participants consisted of 20 females and 14 males.

The intervention following baseline testing included lectures describing the benefits of regular exercise, cardiovascular risk factors, and components of a healthy diet. Lifestyle modification strategies, stress management exercises, cooking demonstrations and firefighter-specific topics relevant to health and fitness and chronic disease prevention were also addressed during education and exercise sessions. Baseline testing provided specific information to aid in exercise prescriptions for the firefighters. Supervised exercise sessions consisted of 20–40 minutes of cardiopulmonary exercise followed by 10–15 minutes of resistance training, stretching, and exercises specific to tasks associated with the job of a firefighter. For example, proper lifting biomechanics, transfer and transport of heavy objects, and heat-tolerance activities were preceded by stretching and followed by cool-down exercises. The frequency of exercise and education classes for firefighters was once per week for 8 weeks. The duration of sessions was 1 hour. Secondary analysis of data collected at the beginning of the program in 2005 and the end of the program in 2008 is included in this study. All testing, administration of exercise prescriptions, and education sessions were conducted by the exercise science faculty and allied health professionals associated with the wellness program and were assisted by the exercise science students.

Data analysis included secondary analysis of descriptive statistics for the examination of low, high, mean, and standard deviations, as well as paired *t*-tests used to determine if changes in mean data were statistically significant among firefighters. Quantitative assessments of student-learning objectives were assessed via the Campus Compact questionnaire (Campus Compact, 2012). This questionnaire provided ordinal Likert scale responses to questions associated with the SL experience as it related to the target course. Student-associated SL data was not statistically analyzed, as there was no comparison group, and only one posttest was administered to the students. These limitations are associated with a secondary retrospective analysis of data collected initially for other purposes—specifically, assessment of the efficacy of the health and fitness program and student satisfaction of the SL experience.

Results

The physiological variables examined for the firefighters before and after the health and fitness program (Table 1) revealed a reduction in weight, an increase in resting heart rate, no change in blood pressure, an increase in oxygen saturation and body fat percentage, and an increase in VO₂ max. Pushup, hand grip, and long jump scores increased; sit up and perceived stress decreased after the program. Student learning objectives depicted in Figures 1–5 reflect a majority of students perceiving that the experience was related to course content and enhanced communication skills, problem solving skills, and (to a lesser extent) enhanced the relationship with faculty and stimulated learning from peers.

Table 1: Percent Changes and Significance for Firefighters (N = 90)

Variable	Percent Change	Significance
Weight	6.25	ns
Resting Heart Rate	+4.7	ns
Resting Systolic Blood Pressure	0	ns
Resting Diastolic Blood Pressure	0	ns
Resting Oxygen Saturation	+1.0	ns
Body Fat	+4.5	ns
Estimated VO ₂ Max	+9	.039*
Pushup	+8	ns
Sit Up	-5	ns
Hand Grip	+13	.03*
Long Jump	+1.1	ns
Flexibility	-2.1	ns
Perceived Stress	-34	.00*

Note: *Statistically significant: $p < .05$

Statistically significant changes associated with the physiological variables examined in the firefighters were an increase in estimated VO₂ max scores, an increase in hand grip scores, and a reduction in perceived stress. A significant increase in VO₂ max is arguably one of the most important determiners of health and fitness, offers protection from cardiovascular disease, and is highly associated with the physical demands of firefighting (Faria & Faria, 1991). The metabolic demand of firefighting is 13 metabolic equivalents, or 45.5 ml/kg/min of consumed oxygen (Bugajska et al., 2007), and the 9% increase from 39.5 to 42.9 ml/kg/min represents a capacity that is within 94% of what the job demands. A significant increase in hand grip scores can be correlated with an increase in upper body strength; however, limitations of hand grip dynamometry include a weaker association with upper body strength in trained individuals, as well as the association between hand grip strength and total upper body strength (Innes, 1999). Finally, a significant decrease in perceived stress was documented before and after program implementation. Though this is an encouraging initial finding, it is also possible that the high magnitude of the reduction in scores is the result of threats to internal validity—specifically, the use of the same quiz before and after. Variables demonstrating insignificant changes should continue to be monitored for statistical significance.

Student SL data are depicted in Figures 1–5 and revealed positive outcomes, with the majority of students reporting that they “agreed” or “strongly agreed” that work with the firefighter health and

fitness program was related to course content, enhanced problem solving and communication skills, and enhanced relations with faculty.

In attempt to assess communication skills, students were asked if the work they performed in the community enhanced their ability to communicate in a real world setting. Thirty-five percent of the students responded that they strongly agreed with that statement, 40% agreed, 20% were neutral, and 5% disagreed with the statement. No students strongly disagreed with the statement. See Figure 1, below.

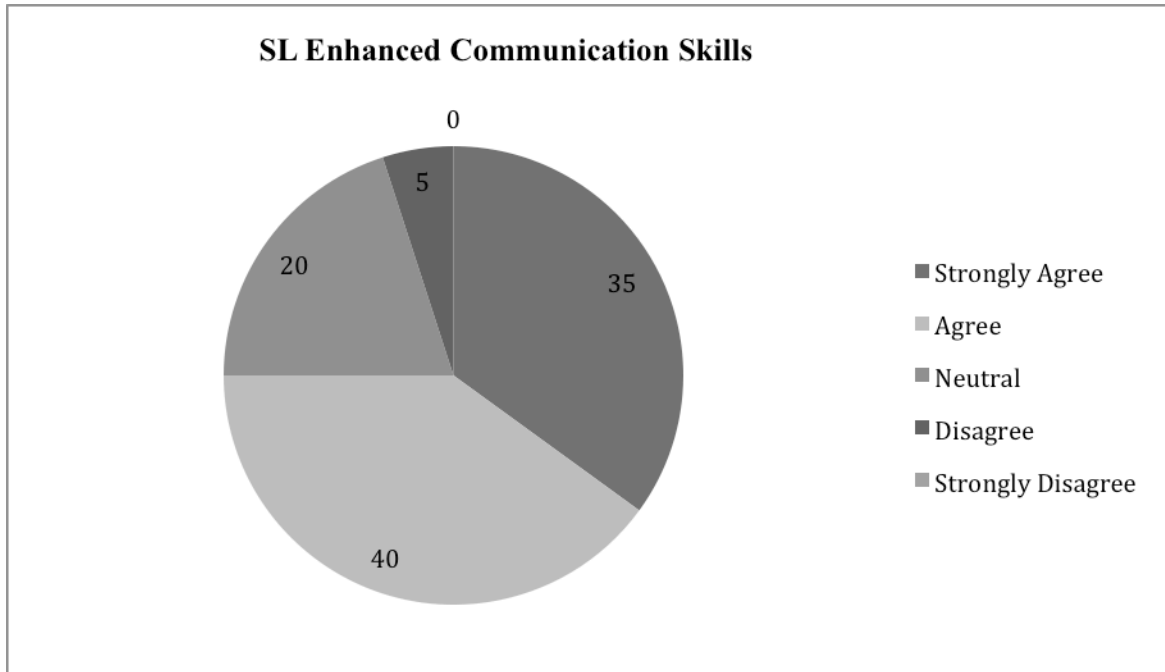


Figure 1: Service Learning and Student Communication Skills (N = 34)

To assess alignment with the course, students were asked whether the community work they did helped them to better understand the lectures and readings in the course. Sixty-six percent of the students responded that they strongly agreed with that statement, 24% agreed, and 10% were neutral. There were no students who disagreed or strongly disagreed with that statement. See Figure 2, below.

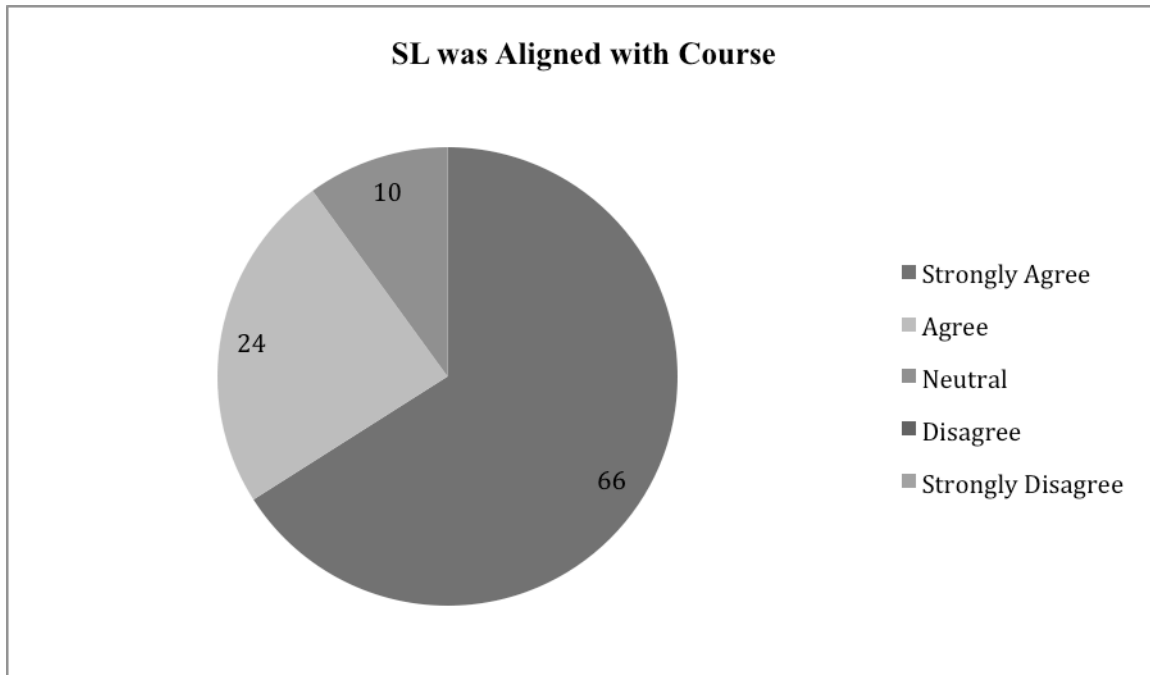


Figure 2: Service Learning and Academic Alignment With Course (N = 34)

To assess student and faculty relationships, students were asked if the community work they performed in the class enhanced their relationships with the faculty members. Fifty percent of the students responded that they strongly agreed with that statement, 30% agreed, 10% were neutral, 5% disagreed, and 5% strongly disagreed. See Figure 3, below.

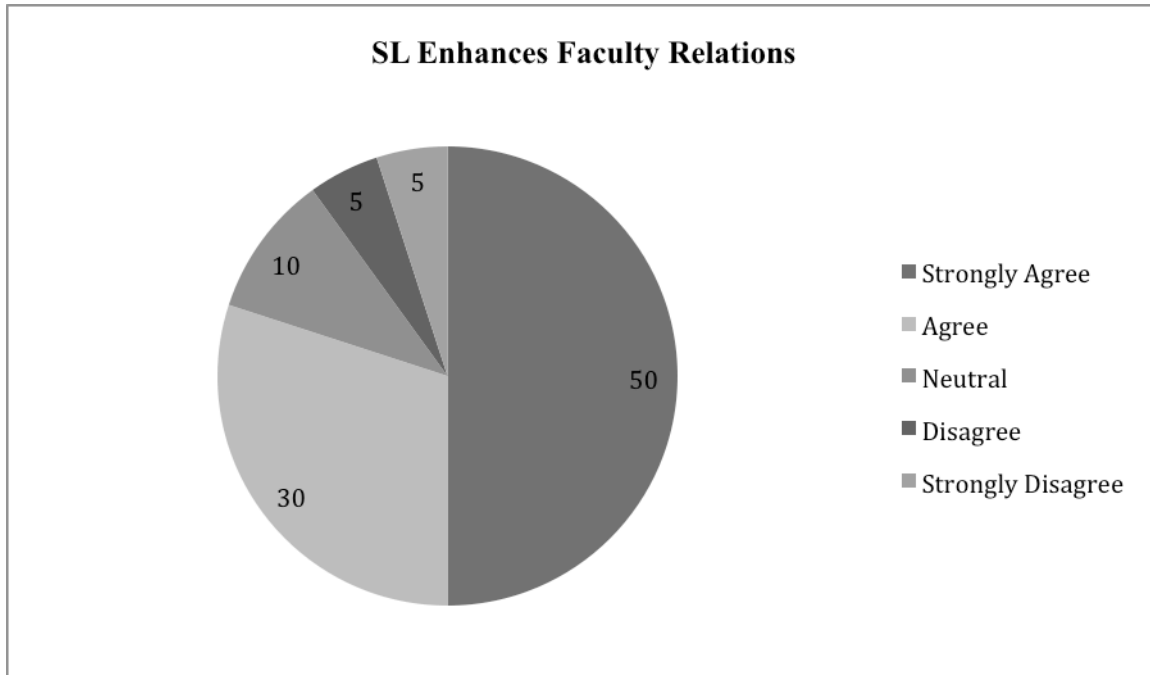


Figure 3: *Service Learning and Enhanced Faculty Relations (N = 34)*

To assess peer involvement in learning, students were asked if the other students in the class played an important role in their learning. Fourteen percent of the students responded that they strongly agreed with that statement, 36% agreed, 20% were neutral, 20% disagreed, and 10% strongly disagreed. See Figure 4, below.

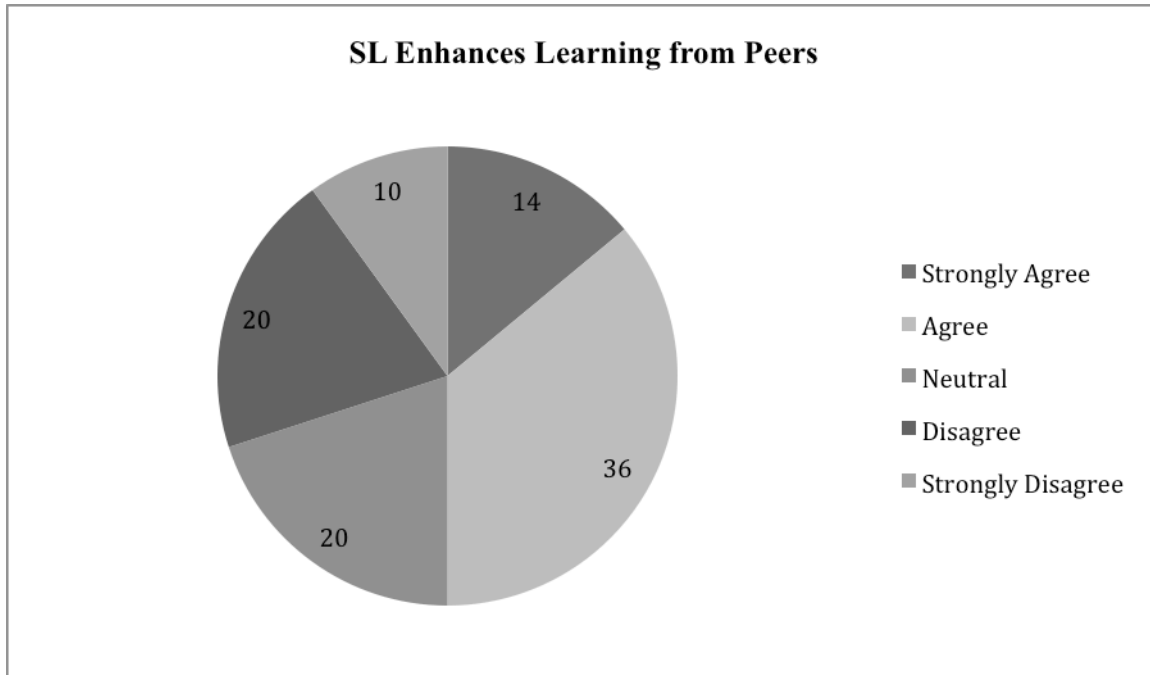


Figure 4: Service Learning and Learning from Student Peers (N = 34)

To assess problem-solving skills, students were asked whether the community aspect of the course helped them to develop their problem-solving skills. Fifty percent of the students responded that they strongly agreed with that statement, 35% agreed, 10% were neutral, and 5% disagreed. There were no students who strongly disagreed with that statement. See Figure 5, below.

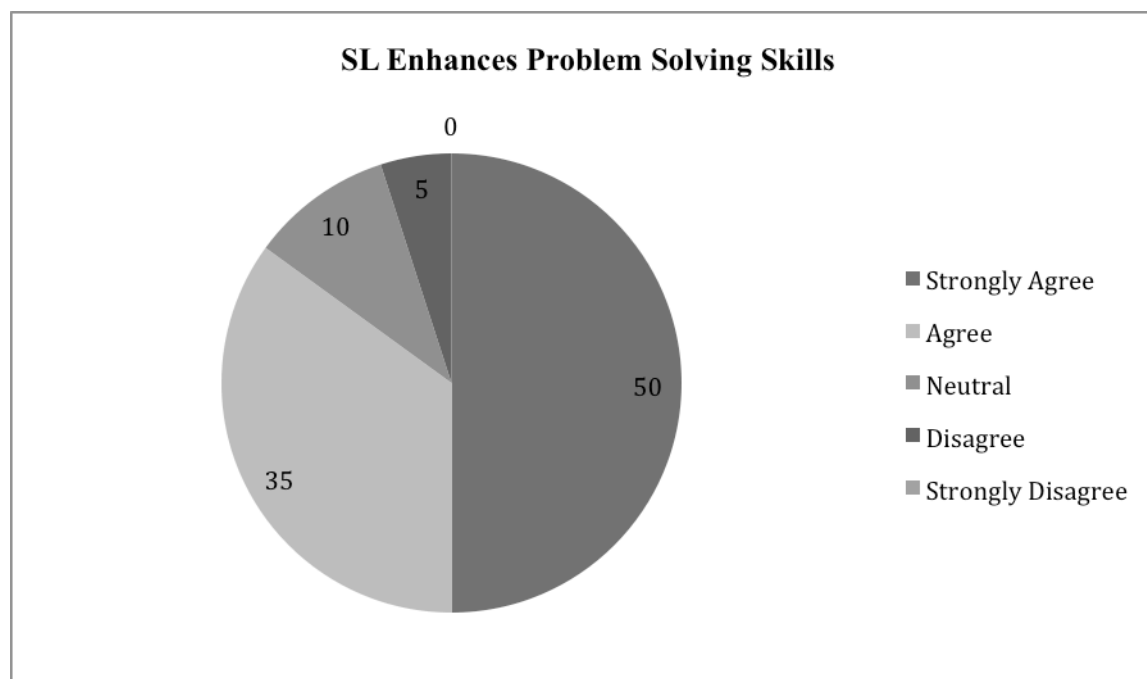


Figure 5: Service Learning and Problem-Solving Skills (N = 34)

Discussion and Conclusions

Within the context of the research questions, positive changes in some health and fitness variables among the firefighters were observed and are consistent with other similar firefighter-specific health and fitness programs, such as improvements in VO₂ max observed by Green and Crouse (1991) and reductions in perceived stress (Throne et al., 2004).

SL objectives were also met with this activity, suggesting that aligning SL with exercise science courses can benefit the priority population being served, as well as the participating students. Observations worth more consideration include the majority of students failing to view the SL activity as enhancing learning from student peers, given that the interaction between and among peers during testing and program implementation was quite high. Students worked in pairs to collect data and supervise exercise prescriptions; however, *interaction with* peers and *learning from* peers are distinct. The extent to which they are learning from one another appears to be limited in this study. The extent to which the students appear to be learning from their interactions with the faculty and with the firefighters appears to be high according to their reports, though previous studies concede that this variable can actually be ill-impacted due to a decrease in classroom faculty

and student interactions (Beling, 2003). Additional objective data, such as grades or test performance, could also be used to compare students involved with SL to those who are not. Relative to past examinations, Beling (2003) found an increase in knowledge and attitudes in students working with senior physical therapy patients, and Nokes and colleagues (2005) documented an increase in civic engagement scores associated with student participation in SL. Brush, Marker, and Lazarus (2006) argued that participation in SL by medical students improved academic and professional performance.

Rockquemore and Schaffer (2000) point to possible cognitive pathways by which students gain knowledge in SL that are applicable to the study, including anecdotal observations that are aligned with students going through an adjustment period and normalization of the environment, followed by engagement, during which many course-related details were discussed and examined within the context of the services provided to the firefighters. These stages could also be further examined in exercise science students.

With a lack of a comparison group for the firefighters and the students, it is not possible to determine that significant changes after program implementation are due to the program alone, or if no program or a different program would yield similar or different findings. Comparison groups for the firefighter intervention group and student cohort would further answer the research question of how firefighters and students are impacted by the health and fitness program compared to firefighters and students who are not involved in the program. Given the nature of the questionnaire data, however, it would not be possible to assess a comparison group of students. Other variables previously discussed, such as exam or course grades, could provide evaluative tools for future studies.

Based on examination of physiological data from the firefighters and student-learning questionnaires, it can be concluded that the criteria for effective application of SL have been met. The firefighters demonstrated significant increases in their cardiopulmonary fitness levels and hand grip scores and a decrease in perceived stress scores, while the majority of participating exercise science students found the application and activities relevant to the *Exercise Physiology* course and helpful in development of communication skills, problem-solving skills, and relationships with faculty. Given that one of the primary objectives of SL is fostering civic responsibility while providing a service to priority populations, implications for social change among students are augmented by the potential social change resulting from enhanced health and fitness of service personnel. Health benefits for the firefighters can also help the communities they serve by improving essential services and emergency management.

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