Examining the Impact of Service-Learning on College Science Students' Self-Report of their Learning Styles[1]

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Abstract

Service-learning has garnered a great deal of attention as a teaching methodology with the potential to influence students' development as citizens while providing them rich contexts in which to learn academic material. Many believe that service-learning is related to gains in academic achievement, though the mechanisms underlying this relation are not well understood. In this research, an attempt was made to clarify a mechanism by which service-learning may foster gains in academic achievement. Science majors enrolled in a K-12 service-learning partnership completed a quantitative instrument, the Inventory of Learning Styles. Participants reported that views about their own learning changed significantly during the service-learning program, such that they became more conceptual in their approaches to learning content and began to take responsibility for their own knowledge construction. These changes in learning views have been correlated with greater academic success in previous research.

Introduction

The land-grant university's threefold mission of teaching, research, and extension is one of its significant strengths. The history and value of this mission are incorporated into undergraduate teaching programs in colleges of agriculture, and frequently undergraduate students conduct research as part of their college experience (Kardash, 2000; Knauft, 2006; Seymour et al., 2004). Meshing extension or outreach activities with teaching has been more difficult. The recent development of service-learning as a teaching methodology has provided a framework for faculty to include outreach components in their courses, effectively combining the teaching and extension missions.

Service-learning

Service-learning has garnered an increasing amount of attention in the literature from researchers and practitioners alike (Boyle-Baise, 2002; Butin, 2003; Scott, et al., 2005). For this study service-learning is described with a variation of the definition provided by the National Service-Learning Clearing House (2006). It is as follows: Service-learning activities combine service objectives with learning objectives with the intent that the activity fosters change in both the recipient of the service and the provider of the service. This is accomplished by combining service tasks with structured opportunities that link the tasks to self-reflection, self-discovery, and the acquisition and comprehension of values, skills, and knowledge content.

Research has indicated that service-learning programs can foster positive attitudinal outcomes in students who participate in them. It has been reported that service-learning programs aimed at helping marginalized groups in society (e.g., college students participate in a project to ameliorate poverty) may lead to an appreciation of diversity and a sense of civic responsibility for the students involved (Barton, 2000; Good, 2005; Jones and Abes, 2004; Jones and Hill, 2001). There have been some reports in the literature of service-learning positively influencing students' academic achievement as measured by traditional means (e.g., GPA, course grades, exams), but evidence in this area is conflicting (Butin, 2003; Michael, 2005; Strage, 2004). The relationship between service-learning in higher education and college students' academic performance needs to be investigated if service-learning is to be considered an effective instructional methodology by academics and not just viewed as soft teaching designed to improve university and community relations. However, making broad claims about effects of service-learning on academic achievement is not prudent, given that service-learning programs vary widely in terms of their goals and outcomes (Butin, 2003). In light of current conflicting evidence about the effects of service-learning on academic achievement, this investigation specifically focused on understanding mechanisms by which university student learning habits might be influenced as they participated in a service-learning partnership.

[1]Acknowledgement: This material is based on work supported by the University of Georgia College of Agriculture and Environmental Sciences, Office of Academic Affairs with additional assistance from the National Science Foundation under Grant No. EHR-0314953.
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Service-learning in Science

Five years ago, a university-based service-learning program was created with the goal of exposing local elementary school children to the range of science activities conducted in a college of agriculture. At the same time, the program provides support for elementary school teachers and gives university students an opportunity for service-learning. The program is called Project FOCUS (an acronym for Fostering our Community's Understanding of Science), and through it upper division college students, primarily science majors, are paired with partner elementary school teachers in schools of a county that also contains a large southeastern university. To participate, students must enroll in a three-semester-hour course that is graded on an A-F scale. Requirements in the course include spending at least three hours per week in the elementary school working with a teacher and his or her students and participating weekly in an hour-long reflection session led by a science education graduate student. Participants also spend additional time in preparation (designing inquiry lessons, gathering supplies, etc.) for their teaching role in the schools and are required to submit weekly reflective journals on their experiences.

Each pairing of student and teacher within this partnership is different, but in general, it can be said that the students serve as content specialists for their partner teachers, and work to prepare and implement science lessons in the teachers' classrooms (Scott et al., 2005). The reflection sessions serve as a means to assist students in understanding elementary school science pedagogy, provide ideas and simulation of lessons and activities, and provide students opportunities to discuss their experiences working in education. The weekly reflections sections are characterized by open-ended discussion among the students about their experiences in the schools. Early in the semester, the instructors focus on preparing students to feel prepared as they moved into the classroom by providing them tools to use in classroom management efforts and lesson planning. For example, with regard to classroom management students are encouraged to minimize their students' idle time, learn the pupils' names, and practice positive reinforcement. With regard to instruction and lesson planning, instructional models are given and discussions are held on the importance of tapping multiple intelligences in their delivery. In the latter half of the experience, the students present their best classroom lesson to each other. These presentations involve teaching the lesson to the other FOCUS students as well as submitting a formal write up of the lesson plan to the instructors. These lessons are then posted to the internet for use by other students in the class, students in subsequent semesters, and elementary school teachers. The remainder of the reflection sessions are driven by student comments and concerns based on their time in the schools. Topics include issues pertaining to multicultural education, education reform, and teaching lessons to students with special needs.

The FOCUS program began at the urging of a local elementary school parent volunteer, who is also a practicing microbiologist at a nearby university. She indicated that the elementary school teachers felt ill-qualified to teach science, and thus spent very little, if any, instructional time on science with their students. Additionally, high stakes elementary school tests in the state currently stress reading and math. Teachers felt that science would need to receive less emphasis so they could spend more time working to improve students' scores on reading and math tests. Yet, the teachers wanted help in providing science instruction in their classrooms. The FOCUS course has been offered fall and spring semesters and is now completing its fifth year. Typically 40-45 students enroll in the class. Including the spring 2007 class, over 400 students have participated, providing 16,000 hours of additional science instruction in the local school system. Nearly 8,000 children have participated in science lessons through this partnership.

Learning Regulation and Academic Outcomes

FOCUS began as a tool to expose young people to science disciplines related to agriculture, to give university students a chance to work in the community, and as a service for the elementary teachers and their students. Quite unexpectedly, the supervising graduate student and faculty instructor began to notice additional advantages of the program for the enrolled college science students. In their reflective journals and in class discussions, many students discussed how their new role as a teacher was changing how they viewed their own learning. One student described how she'd used manipulatives for teaching her 3rd grade students about chemical bonding and realized she could use them herself to study for a test in organic chemistry. “I just decided to teach it to myself the way my professor should have,” she commented. Statements like this one seemed profound, because it suggested students in this class were taking responsibility for their own knowledge construction and regulating their learning, rather than passively expecting a professor to transfer or give knowledge to them (Scott et al., 2005).

Operational Definitions

Learning regulation occurs either within or outside the learner. If a student is a self-regulated learner, then they accept responsibility for their own knowledge construction, and choose and engage learning strategies that further understanding in their course studies (Vermunt, 1998). Additionally, self-regulated learners do not rely solely on external measures of their success in understanding material. For example, a self-regulated learner might realize that even though they made an A on a course test involving recall of learned material, they may not necessarily have a firm grasp of the covered content

on a conceptual level (Vermunt, 1998). Conversely, if a student is an externally regulated learner, then they wait for some external source (professor, textbook, etc) to transfer knowledge to them. This puts the action of learning outside the learner. If an externally regulated learner makes an A on a recall test, then they make the assumption that they have mastered the material because of that performance on an external indicator (Vermunt, 1998).

Self regulation of learning is a metacognitive phenomenon in that it involves the examination of the status of ideas within ones own cognitive framework and is a necessary first step toward becoming a critical thinker (Kuhn, 1999; Piaget, 2003). FOCUS instructors have observed that experiences in this service-learning course encouraged students to evaluate their own and others' thinking, thereby taking steps toward becoming more critical thinkers.

Purpose

This research examined the influences on learning regulation that accompanied participation in a service-learning activity. It is hypothesized that changes in the participants' views on the regulation of learning might serve as an indicator of how students in a school-based service-learning course changed their understanding of and approach to learning in a broader sense. Anecdotal evidence suggested that "the participating student makes an impact through the application of their energy and expertise in the community and then returns to the university changed with regard to their knowledge, motivation, and direction" (Scott et al, 2005). Such change in motivation, direction, and view of knowledge, has been correlated in previous studies with greater academic achievement, as measured by traditional means, in university studies (Boyle et al., 2003). The purpose of this study is to determine the effect of FOCUS on the learning regulation of the college science majors who participated in the program. The study did not attempt to investigate participants' academic achievement, but rather their self-reported learning styles. The link between learning styles and academic achievement has previously been reported (Boyle et al, 2003; Vermunt, 1998; Zimmerman, 2002).

Methods

In an empirical attempt to "increase integration of existing models of student learning" Vermunt (1998) created an instrument, the Inventory of Learning Styles (ILS). In this study, the ILS was used to measure how FOCUS students' self-report of their own learning styles changed during their participation in this service-learning course. This questionnaire was designed to assess students' learning styles and consists of 100 Likert-type items with responses ranging from 1 (I do this seldom or never or I disagree entirely) to 5 (I do this almost always or I agree entirely). The learning styles are characterized by weightings in a factor analysis of self-report scores of the four learning components to which his synthesis of the literature most specifically pointed. These four components are cognitive processing, metacognitive regulation, mental learning models, and learning orientations.

Inventory of Learning Styles (ILS)

In his ILS, Vermunt (1998) developed scales and subscales to assess the four learning components. For the cognitive processing strategies, or the methods students use to process material while they learn, he uses three scales; Deep Processing, Stepwise Processing, and Concrete Processing. These scales represent levels of sophistication in processing, with Deep Processing being the most sophisticated processing strategy, and Concrete Processing being the least sophisticated. Students who process matter deeply are likely to look for connections between topics and critically assess claims made by the teacher or the textbook. Students who process material in a stepwise fashion are likely to memorize material and study using a detail by detail approach, rather than looking for relationships between topics. Students who process material concretely pay attention to aspects of the course which have practical utility.

The Deep Processing scale consists of two subscales. These are Relating and Structuring and Critical Processing. The Stepwise Processing scale also consists of two subscales; the Memorizing and Rehearsing subscale and the Analyzing subscale. It is important to note, that while Vermunt (1998) uses the term subscale in his instrument, the subscales are not scalar in the true sense of the word. Rather, the subscales simply represent multiple ways students may exhibit the characteristics of the scale.

The regulation strategies students use in their learning are assessed on the ILS using three scales, Self Regulation, External Regulation, and Lack of Regulation. Again, these represent a continuum of sophistication in regulation, with Lack of Regulation being the least sophisticated approach and Self Regulation being the most sophisticated approach. Students who regulate their own learning are likely to test their own progress using questions they write during their studying and are likely to use material beyond the course text as they learn. Conversely, externally regulated students are likely to learn material exactly as it is presented in the text, and rely on external measures, such as test scores, to determine their level of mastery in a subject. Furthermore, students who utilize no regulation strategies, find it difficult to assess whether they have mastered content, are not clear on what they need to remember in the course, and have an insufficient understanding of course objectives. The Self Regulation scale consists of two subscales. These are the Learning Processes and Results subscale and the Learning Content subscale. The External Regulation scale also

consists of two subscales, the Learning Processes subscale and the Learning Results subscale. Again, Vermunt uses the term subscale to represent different ways a student may exhibit Self or External regulation.

Learning orientations, or motivations, are assessed on five scales. Vermunt (1998) labels these scales as Personally Interested, Certificate Directed, Self-test Directed, Vocation Directed, and Ambivalent. Again, the scales represent a continuum of sophistication in terms of motivation. Students with a Personally Interested orientation are genuinely interested in the material they are studying and enjoy their work in courses related to their major. Students with a Certificate Directed orientation see the diploma as the main reason for pursuing their studies. Students who are Self-test Directed are motivated by proving their proficiency in their coursework. Students with a Vocation Directed orientation are motivated by preparing for a chosen profession. Finally, students with an Ambivalent orientation are unsure of their purpose in pursuing education.

Students' mental models of learning, or their ideas about how learning occurs, are assessed using five scales on the ILS. These five scales are Construction of Knowledge, Intake of Knowledge, Use of Knowledge, Cooperation, and Stimulating Education. Students with a Construction of Knowledge model of learning work to construct their own knowledge and insights and may consult references beyond the course requirements of their own accord. Students with an Intake of Knowledge model of learning believe knowledge is provided by the elements of their education such as the professor and the textbook. Students with a Use of Knowledge model of learning believe learning occurs when material encountered can be used in everyday life. Students with a Cooperation model of learning place a lot of value on studying with other students and sharing learning. Finally, students with a Stimulating Education model of learning believe the teacher or text should stimulate learning in them.

In his research using the instrument, Vermunt (1998) consistently found four learning styles; undirected, reproduction-directed, meaning-directed, and application-directed style. Vermunt (1998) used four-factor principal component analysis to uncover the learning styles based on these four components. In other words, learning styles are characterized by certain patterns of responses along the fore mentioned scales. For example, the undirected style had high loadings of lack of regulation, an ambivalent learning orientation, and cooperation and stimulating education models of learning. The reproduction style had high loadings of ILS subscales memorizing and rehearsing, analyzing, external regulation of learning processes, and learning results. Additionally, the style was characterized by an intake of knowledge model of learning and certificate and self-test-directed learning orientations. The application directed learning style has high loadings of concrete processing, use of knowledge as a mental model of learning, and vocational and certificate-directed learning orientations. Finally, the meaning-

Table 1. Sample items from Vermunt's (1998) Inventory of Learning Styles

Learning Component	ILS Scale	ILS Sub-Scale	Sample Item
Cognitive Processing Strategies	Deep Processing	Relating and Structuring	I try to see the connection between the topics discussed in different chapters of textbook.
		Critical Processing	I compare my views of a course topic with the views of the authors of the textbook used in that course.
	Stepwise Processing	Memorizing and Rehearsing	I repeat the main parts of the subject matter until I know them by heart.
		Analyzing	I work through a chapter in a textbook item by item and I study each part separately.
	Concrete Processing		I pay particular attention to those parts of a course that have practical utility.
Metacognitive Regulation	Self Regulation	Learning Processes and Results	To test my learning progress, I try to answer questions about the subject matter which I make up myself.
		Learning Content	In addition to the syllabus, I study other literature related to the content of the course.
	External Regulation	Learning Processes	I learn everything exactly as I find it in the textbook.
		Learning Results	I test my learning progress solely by completing the questions, tasks, and exercises provided by the teacher or the textbook.
	Lack of Regulation		I notice that I have trouble processing a large amount of subject matter.
Learning Orientations	Personally Interested		I do these studies out of sheer interest in the topics that are dealt with.
	Certificate Directed		What I want in these studies is to earn credits for a diploma.
	Self-test Directed		I want to prove to myself that I am capable of doing studies in higher education.
	Vocation Directed		The main goal I pursue in my studies is to prepare myself for a profession.
	Ambivalent		I wonder whether these studies are worth all the effort.
Mental Learning Models	Construction of Knowledge		If I have difficulty understanding a particular topic, I should consult other books of my own accord.
	Intake of Knowledge		To me, learning is making sure that I can reproduce the facts presented in a course.
	Use of knowledge		To me, learning means acquiring knowledge that I can use in everyday life.
	Cooperation		I have a need to work together with other students in my studies.
	Stimulating Education		When I have difficulty understanding something, the teacher should encourage me to find a solution by myself.

Table 2. Vermunt's Learning Styles and Associated Scales of the ILS

Vermunt's Learning Styles	Weightings of Scales and Subscales in Vermunt's (1998) factor analysis
Undirected	Lack of Regulation Ambivalent Learning Orientation Cooperation and Stimulating Education
Meaning Directed	Relating and Structuring Critical Processing Self Regulation of Learning Processes Self Regulation of Learning Content Construction of Knowledge Personal Interest
Reproduction Directed	Memorizing and Rehearsing Analyzing External Regulation of Learning Processes External Regulation of Results Intake of Knowledge Certificate Learning Orientation Self-test Directed Learning Orientation
Application Directed	Concrete Processing Use of Knowledge Vocational Directed Learning Orientation Certificate Learning Orientation

directed learning style is characterized by high loadings of relating and structuring, critical processing, self-regulation of learning processes and learning contents, a construction of knowledge learning model, and a personally interested learning orientation. Boyle et al. (2003) found that students self report using the ILS could predict academic performance as measured in a traditional sense (GPA). Specifically, Boyle, et al. (2003) reported that students who identify with Vermunt's (1998) meaningful learning style, characterized by self regulation and constructivist views of learning, exhibited better academic outcomes than those who were externally regulated and had an intake view of learning. Sample items from the ILS are listed in Table 1. A concise explanation of the relationship between responses on the ILS and the learning styles describe by Vermunt (1998) are listed in Table 2.

Instructors in this course had observed enrolled students changed their approaches to learning and adopted strategies and models consistent with Vermunt's (1998) meaning-directed learning style, while exhibiting fewer behaviors and attitudes consistent with the reproduction-directed learning style he outlines. Based on these observations the ILS was a logical instrument to uncover ways the FOCUS experience influenced learning styles in college students. The ILS was not administered to a control group of students. This decision was made for two reasons. First, the students enrolled in FOCUS self-select to participate in this service-learning experience, which made finding a comparable control group difficult. Second, the goal of this study was to develop understanding about a phenomenon the researchers witnessed which was unique to FOCUS. All three authors have extensive experience teaching in more traditional settings, and thereby recognized the advantages the university students experienced as specific to this experience.

Data Collection

Students enrolled in FOCUS were asked to complete Vermunt's (1998) Inventory of Learning Styles (ILS, Vermunt, 1998) at our second weekly meeting in spring semester 2006. They had one week to complete the inventory and returned it by the third class meeting. The inventory was completed prior to any significant experience in the elementary classrooms or in reflection sections. This ILS will be referred to as the pre-FOCUS data. Of the 32 students enrolled in the class, 30 students (8 males and 22 females) completed the ILS. This inventory, consisting of 100 Likert-scale items, provided information regarding the students' views about their own learning regulation prior to their work in the course. During the last week of classes in spring semester, the students completed the ILS again. This iteration is referred to as the post-FOCUS data. Data was analyzed using the SPSS-X statistical package (Green and Salkind, 2005). To insure adequate reliability of each scale, items were removed from subscales if their deletion made the Cronbach alpha rise. Reliability estimates for the scales ranged from 0.62 to 0.84 along the scales of the ILS. A paired item t-test was used for each subscale, comparing the pre and post means from the ILS.

Results and Discussion

After participation in FOCUS, students' responses on the ILS reflected some differences in their views regarding learning and are summarized in Table 3. Three areas showed significant change at $p \leq .05$. Specifically, the means significantly decreased in the analyzing subscale of the stepwise processing scale and the results subscale of the external regulation scale. The mean of responses for the use of knowledge scale significantly increased.

It was hypothesized that students enrolled in FOCUS would report an increased level of self-regulation in their learning after this experience, yet there was no significant change in the Self Regulation scale of Vermunt's (1998) ILS. However, participation in FOCUS did impact student self-reports on three other scales of the ILS, suggesting that FOCUS has the capacity to influence students in ways that lead to more meaningful learning. Specifically, after participation in FOCUS college students reported themselves as less externally regulated in their learning. The decrease in the mean value on the results subscale of the External Regulation scale indicates that FOCUS students were less dependent on their

Table 3. Results of the paired item t-tests comparing the pre FOCUS and post FOCUS means along each scale and subscale of the ILS

Measured Learning Component	Scale	Subscale	$\bar{X}_{pre} - \bar{X}_{post}$	t† p	††
Cognitive Processing Strategies	Deep processing	Relating and structuring	.0267	.178	.860
		Critical processing	.1111	.860	.397
	Stepwise processing	Memorizing and rehearsing	.0333	.225	.824
		Analyzing	.2333	2.125	.042*
	Concrete processing		.0933	.861	.396
Learning Regulation Strategies	Self regulation	Learning processes and results	.0067	.055	.957
		Learning content	-.1583	-1.305	.202
	External regulation	Learning processes	-.2000	-1.421	.166
		Learning results	.3000	2.666	.012*
	Lack of Regulation		-.1167	-.763	.452
Learning Orientation	Personally Interested		-.0083	-.090	.929
	Certificate Directed		-.1556	-.917	.367
	Self-test Directed		-.0583	-.483	.633
	Vocation Directed		-.2250	-1.964	.059-
	Ambivalent		-.0222	-.153	.880
Mental Learning Model	Construction of Knowledge		-.1000	-.935	.357
	Intake of Knowledge		-.1667	-1.240	.225
	Use of Knowledge		-.1556	-2.191	.037*
	Stimulating Education		.0000	.000	1.000
	Cooperation		-.1000	-.737	.467

*Sig. $\alpha \leq .05$

t-statistic describing standard error from 0.

p-value describing the probability of obtaining values equal to or greater than the observed statistic

professor or their textbook for determining when they had reached mastery of material. As part of a separate, qualitative study, comments in journal entries supported this finding. For example Carrie's (all names are pseudonyms) final journal entry mentioned:

"…This [the realization that the student is largely responsible for learning] represents a pretty big turnaround in the way that I have viewed my schoolwork. Through this experience I recognized the fact that it is the student's responsibility to meet the teacher halfway. By this I mean that it is easy to blame not learning something on the teacher's ineptness, but in actuality, sometimes it is the student's job to try to grasp the concept on his own. Maybe the teacher should have done a better job, but maybe the teacher just presented the information in a way that did not appeal to the way that particular student learns best (Carrie, Final Journal Entry)."

This type of realization is important, because research suggests that decreasing dependence on external regulators is a necessary step toward accepting responsibility for one's own learning (Kuhn, 1999; Munby and Roberts, 1998). Further, accepting responsibility for one's learning has been shown to predict gains in motivation and academic success (Findley and Cooper, 1983).

FOCUS students were less likely to report using the analyzing strategy on the Stepwise Processing scale. This is viewed as a positive outcome of participation in the program, because a decreased tendency to study items in a chapter or lecture detail by detail likely precedes a tendency to assimilate material more meaningfully and integrate it into a cognitive framework to obtain conceptual understanding. Such integration requires metacognitive ability, in that a student must evaluate the status of their own ideas, the ideas they are encountering in their studies, and work to bring those sets of ideas into a useful construct (Kuhn, 1999). Journal entries also supported this conclusion from the ILS administration. Students commented that they became more aware of reaching a conceptual or "big picture" level of learning. Breanna's comments on this issue are particularly clear, and representative of a theme that emerged in the journal data:

"Being in this program has helped me to better understand my own learning. I came to fully appreciate knowing details and being able to piece them together in the big picture. When themes or details are left out of a lecture, I tend to notice more often now. In the classroom, I saw that my word choice as a teacher is important. I began to realize that putting ideas into my own words is important for me to understand lecture material, as it is for my students. So in my own

classes, I began to put ideas in simpler terms or altogether reword them myself if the professor's word choice did not suit me best (Breanna, Final Journal Entry)."

Additionally, students reported being more inclined to look for practical applications of material they encountered in their courses after participation in FOCUS. This is another change which has been previously associated with increases in motivation and academic success (Findley and Cooper, 1983). This may have resulted from students working in an elementary setting, where science is generally taught in a more concrete manner than it is in a college science course. For example, when students teach a unit about electricity and magnetism, they draw on daily experiences the elementary students will be familiar with, such as turning on a flashlight. In a lesson about plant parts, elementary students might see a salad made with roots, stems, and leaves. In this way, university students are bringing their own science knowledge into concert with daily life to help make it meaningful for the elementary students with whom they work. One student, Matt, commented on the need to help children learn through "practical application:"

"As I have stepped into the role of teaching, I also began to realize things about learning that I never really knew before. Teaching made me really think about what it takes to actually learn something. Again, most of what I experienced has always been in the back of mind as correct. … Learning, especially at the childhood level, really needs practical applications where new concepts are physically tested and proven. When I explained to my class on the board how negatively charged atoms were negative because of a difference in electrons and protons, I could see that they understood what I said; however, it wasn't until I brought them outside and had them model the atoms, with some students representing electrons and protons that I could see they really appreciated the subject. It was even more prevalent when I would ask them to do something and they would get it wrong. I think when they reasoned through it and finally found the right answer; they were really able to fixate that knowledge (Matt, Final Journal Entry)."

It is not surprising that when FOCUS students repeatedly turned abstract science concepts into concrete examples for their students, it led the university students to cultivate the habit of looking for such practical applications of material to further their own understanding.

Service-learning as pedagogy is becoming increasingly popular as a component of university courses and as a means to improve university-community relations, but naysayers still have concern about the effectiveness of service-learning as a tool for meaningfully impacting college students' progress in a traditional classroom setting. During participation in FOCUS college students viewed science instruction from the perspective of a teacher as they refreshed their content knowledge, outlined goals for lessons, struggled with engaging students with different learning styles, and otherwise worked to help students become successful in science. In this quantitative study, service-learning participation improved the methods students used to learn subject matter in other courses. This allows a glimpse at how a school based service-learning course has the capacity to influence college students' own academic achievement by improving approaches to their own learning. These results add concrete examples to the perceived value of service-learning in university courses and may demonstrate a means for other instructors to measure the potential positive impact of service-learning for university students.

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