

# Service Learning in Introductory Computer Science

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## ABSTRACT

Academic service-learning (ASL) focuses on clearly aligning course learning objectives with community needs and has evolved into a highly effective pedagogical approach across the spectrum of disciplines and institutional types. Unfortunately, there are not many examples of its use in computer science. If service learning is incorporated into computer science, it is generally in the upper level courses where students have a larger skill set. This paper presents an academic service-learning approach in an introductory computer science course. This is important on multiple fronts. With the declining enrollments, especially among females, coupled with students' desire to make a difference in their world, we need to insert this pedagogical approach as early into the curriculum as possible. We will show an example of what can be done in an introductory course and discuss the positive effects on female enrollments.

## Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer Uses in Education – *collaborative learning*.

## General Terms

Human Factors

## Keywords

Service Learning, CS1, undergraduate projects, gender gap in computing

## 1. INTRODUCTION

Siena College is a small liberal arts college in the Franciscan tradition where the mission of the college includes service to others. In the fall of 2008, Siena was awarded a Learn and Serve America Higher Education Grant (2006-2009, CFDA# 94.005) from the New York / Pennsylvania Campus Compact Consortium to begin building a network of faculty employing ASL pedagogy throughout New York's Capital Region. ASL, primarily a term used in the United States, indicates a mutually beneficial relationship in which university students provide a service for a community based organization (CBO) and in so doing learn course content in and through the service provided.

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In preparation for grant activities, faculty attended a two-day retreat on the Mission of the College at which current research on the effectiveness of ASL was reviewed [6]. Funded grant activities also included a two-day intensive training program for faculty covering ASL pedagogical techniques. After attending the retreat and the grant funded ASL training, the authors decided to pilot the implementation of ASL in an introductory computer science course.

The idea of incorporating ASL into an introductory computer science course was intriguing, but there was concern. Previous work focused on involving students in ASL in upper level courses where the students have more computing experience [2, 3, 11, 16, 18]. The authors were attempting to find a project for first year students that could benefit a CBO, remaining true to the ASL philosophy by attending directly to course learning objectives, and provide a meaningful experience for students.

Simultaneous to the college encouraging more ASL in courses, the Computer Science department was changing its breadth-first introductory course, Introduction to Computer Science, to offer themed sections allowing multiple entry points into the major. This created a serendipitous opening to propose two themed offerings in Fall 2009, "Intro to CS using Alice" and "Intro to CS using Alice with ASL".

Introduction to Computer Science (CSIS110) is a required course for all computer science, math, accounting and physics majors. It may also be used by students to satisfy CS minor requirements, technology literacy requirements within a major such as sociology, or quantitative requirements for the core set of courses required for a bachelor's degree.

Thus, students take CS for a variety of reasons. Since CS is not a required high school course in the United States, many students are unaware of the breadth and depth of CS as a field of study or a career. Therefore, while many students take CS, the number of incoming first-year students declaring CS as a major is typically low. Our numbers of incoming first-year students are rising, but a significant number of our majors come from students who are required to take CSIS110 and realize that they are successful with and enjoy CS. In this context, the Computer Science department's goal is to double the number of declared CS majors by the end of their freshman year.

With an already full introductory course and a language change from Visual Basic to Alice, the department was nervous about maintaining the academic rigor, incorporating service and not overwhelming the students.

This paper begins by explaining ASL, describes how it was accomplished in CSIS110, then discusses learning outcomes and reflects on what could be done to improve the course.

## 2. ACADEMIC SERVICE LEARNING

Academic Service Learning has been a recognized pedagogical method for more than twenty years. The field of ASL was well underway in many institutions of higher education when Barbara Jacoby and Associates cataloged the variety in 1996 [6]. Since then, ASL pedagogy has continued to develop and address crucial questions about student learning, community impact, course management, and other issues [6, 14]. From more clearly aligning course learning objectives with community needs, to building university based service-learning infrastructures, and the development of assessment measures, ASL has evolved into a highly effective pedagogical approach utilized across the spectrum of disciplines and institutional types.

ASL practitioners today seek to maintain rigor, and attend to the real needs and concerns of, and impacts on, CBOs. ASL, by its focus on and concern for course learning objectives and academic rigor, is distinct from more general forms of community service performed by college students.

Recent literature in the field has highlighted the needs for a developed infrastructure to support faculty willing to embrace this pedagogical approach [5, 11, 14]. At Siena, this infrastructure is built on a fifteen-member AmeriCorps/VISTA program that places post-graduate fulltime volunteers in CBOs for a year of service. These VISTA Fellows, along with the undergraduate AmeriCorps service leaders at Siena, connect CBOs in a sustainable way to the academic life of the college.

This infrastructure aids in addressing the logistical hesitations and implementation challenges that arise in the course of an ASL project [11]. It also becomes a conduit for identification of CBO needs and a means for connecting needs to academic courses.

## 3. GENERAL FORMAT OF COURSE

The course met two times a week for 55 minutes of lecture over a 15 week semester. Additionally, the class met in smaller groups for 2 hours of lab each week. All sections of the ASL theme were taught by the same instructor. There were 41 students: 25 males and 16 females. Their majors were varied as illustrated in Figure 1. The most common majors, representing 72% of the class, were math, accounting and computer science.

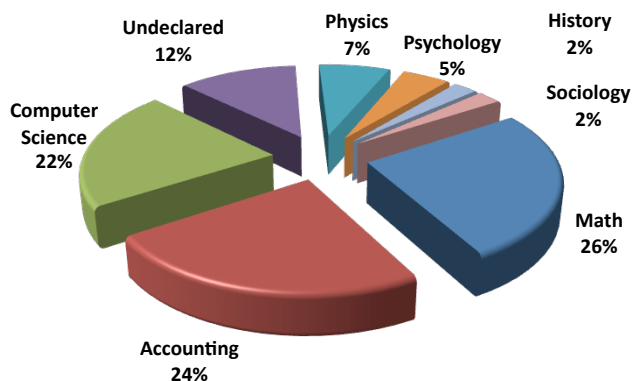


Figure 1: Distribution of Students by Major

Even though computer science majors accounted for only 22% of the class, there were students in the class who were taking courses toward a computer science minor or information systems minor. Many of the remaining students were enrolled in the course simply because it was required for their major.

Since this is an introductory course, we know that their computer science experience is weak. The next set of data is used to assess the overall maturity of the student. Figure 2 illustrates that the majority of the students were freshmen followed by juniors.

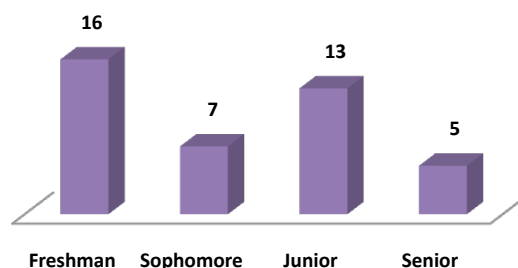


Figure 2: Distribution of Students by Class

The instructor was nervous to have so many potential challenges in the class including: maintain the academic rigor, perform community service with a group of inexperienced, immature students, and a goal to double the number of computer science majors by the end of the freshman year. Would incorporating more work into the introductory course, help or hinder this goal?

The grade for this course was divided as follows: homework (20%), labs (20%), exams (50%), class participation (5%) and service project (5%). This distribution was similar across all themed sections of CSIS110. The only difference was the 5% assigned for the service project was used for other purposes in the non-service Alice section of the course. The goal of the course design was to embed ASL as both a deliverable project and a learning mechanism.

## 4. SERVICE PROJECT

The CBO the class worked with was Music Mobile, which is dedicated to “bringing learning and love to the neighborhoods of Albany, NY.” [1] Through innovative educational programs, learning and training materials, and original songs, Music Mobile builds peaceful communities and empower individuals to be responsible local and global citizens.

In the summer of 2009, Music Mobile became a partner to the College by hosting a VISTA Fellow and several Siena Bonner Service Leaders. In the course of developing a three-year partnership plan, ASL staff learned of the need for Music Mobile to communicate their curriculum to a new multi-media generation. These needs seemed to fit well with the learning objectives of the Introduction to Computer Science course. In this course students need to become familiar with the Alice language and create a finished product using the computer science knowledge they acquire across the semester. By bringing together the needs of Music Mobile and the course learning objectives, we hoped to create meaningful learning for students *and* simultaneously serve the greater community.

With the support of the ASL staff, a planning meeting with Music Mobile was held and a common set of objectives for our collaboration was outlined. The parameters for the project were clarified and the level and types of input needed from Music Mobile staff were clarified. The project was then added to the organization of the course and entered into the syllabus for the subsequent semester.

## 4.1 Description

With 41 students, the authors had to develop a project that did not require the students to travel to the CBO as the logistics would be overwhelming. The creative aspect of Alice worked well with the creative focus of Music Mobile. The staff of Music Mobile believed that the students' knowledge of computers, programming and skills in teamwork, writing and communication could provide an important service for Music Mobile by creating entertaining and accessible animations. From the beginning, ASL staff assisted in managing Music Mobile staff expectations as these were introductory students and this initial project was a pilot. Music Mobile was willing to work with us on the project despite these limitations because they understood too that such partnership leads to volunteers and subsequent higher-level partnerships.

Classes were divided into 11 self-selected groups of 3 or 4 students. Each group selected one of Music Mobile's songs and created an animation in Alice to accompany the song. The second part of the project required the students to create an interactive game to illustrate one of the social issues addressed by Music Mobile. Many students chose a theme related to the song they animated, however they were not required to do so.

## 4.2 Details

The founder and executive director of Music Mobile came to visit the class during the first week in September to introduce herself and her program. It was an interesting first visit as she typically sings songs for young children and she was faced with a room full of college students at 9:15 in the morning! While the first visit may have been considered "awkward", it was necessary for the success of the project and highlighted some of the ancillary learning that often takes place in ASL courses (ie. working with clients). Students were able to put a face to the program, ask questions about the purpose of her organization and get an understanding of some issues that they couldn't have understood just by listening to her songs. For example, one of the things that the students learned through the visit was that all characters used in Music Mobile literature are gender and race non-specific. Music Mobile staff explained that this was deliberate so that no one was alienated or seen as the "bad guy". The students worked hard to be sure to incorporate this aspect of Music Mobile's philosophy into their animations.

In addition to aligning course objectives with service goals, the aforementioned ASL training emphasized and assisted faculty with creating highly structured project implementation plans. From the very beginning of the semester, students had clear directions and timelines for project expectations. To ensure that the students were progressing toward a finished product, deadlines were set for each of the following tasks: select a group, select the song, present storyboard to instructor, submit non-interactive animation, present interactive storyboard to instructor, submit interactive animation and the presentation to the service partner.

ASL pedagogy also emphasizes building of student capacity early on in the semester to meet project targets. Thus, the beginning of the semester focused on Alice. By focusing on the capacity of students to work in Alice early on in the semester, students then had time to work on the service project throughout the semester.

Additionally, storyboarding skills were developed among the students. Storyboarding is an excellent way to outline the animations and to help students stay on track. Storyboards also presented review opportunities to ensure that students kept the tenets and philosophies of Music Mobile in mind while developing the animation. For example, several groups forgot that the characters should be gender and race non-specific. Conversely, through discussion with the groups, the instructor was convinced that some animations were better served by having a group of diverse and identifiable characters. These conversations created unique teaching opportunities for both the technical computer science knowledge as well as the conversations about human values and representation that may not be as present in standard computer science curriculum.

Each finished project submission consisted of an Alice application, printouts of all code, and a design document including the storyboards, a discussion of any decisions made in the design process and several screen shots of the working project. A copy of this was also given to the CBO during the presentation.

## 4.3 Final results

As is to be expected in an introductory course, the results of their animations ranged from haphazard to spectacular. Some groups obviously threw the project together at the last minute, while others spent many hours creating a beautiful final product. The requirement of a design document and a presentation in addition to the animation was done to ensure that each person in the group was able to contribute where they felt strongest thus accommodating the variety of learning styles presented by students. The groups that had business majors had excellent design documents and presentations, while the groups with math and/or computer science majors had very detailed animations. Groups with both sets of majors had excellent overall projects.

When members of the CBO saw the results of the students' work, they were excited and thrilled with the results.

Two examples of student work follow to demonstrate the merging of technical expertise with ideas on human values and representation. One group animated a song named "I Cried". They did an excellent job of coordinating the actions in the animation with the music. They had several scenes: bedroom, kitchen, school as these are all mentioned in the song. Their interactive project built on this song and had the user answer questions based on the song. Therefore the user had to be attentive to the words in the song and then answer questions about it. Their project also incorporated pictures and words to help the children learn to read. (Figure 3)

Another project, Music Mobile's favorite, was an animation of the song "EARTH". The group went all out and created several scenes from around the planet to show how we are all part of this world. They had rural, suburban, urban and arctic scenes each with their own animations that coordinated with the music. (Figure 4)



Figure 3: Screenshot of an interactive animation



Figure 4: Screenshot of "EARTH" Animation

## 5. EVALUATION

At the completion of the course, the students were asked to complete an anonymous survey. The questions were answered on a scale of 1 (strongly disagree) to 7 (strongly agree). The results were overwhelmingly positive as seen in Table 1 (see full distribution in Appendix A). The lowest ranked survey question was whether they thought more courses in their major should have ASL projects. While it is the lowest score, it should be noted that a 5.1 is considered an “agree” on the scale.

Table 1: ASL Survey Results

Directly related to the learning outcomes of course	5.6
Valuable learning experience	5.6
Important to use my knowledge and skills for other’s benefit	6.5
More courses in my major should have service learning projects	5.1
Better understanding of Alice as a result of completing this project	5.3
Like to do another hands-on project like this in future	5.3
Future CSIS110 students should participate in a service learning project	5.7
Enjoyed this project	5.4

Another comparison method is the campus-wide course evaluation completed by 100% of the class. Last year’s students rated the question “classes were interesting” at an 8.5 on a scale from 1 (poor) to 10 (excellent), while this year’s students rated it an 8.4. The overall rating of the course remained the same as last year at 8.4. While these numbers may not seem significant, it is important to note that there was also a language change from last year. Alice proved to be unstable with music and random number generation that caused a lot of frustration with the students. If we

compare the sections of Alice with ASL to the non-service Alice we see that the overall course rating and the interest level of the class for the non-service Alice were both rated 7.2. Although this is a small sample size, it appears that including ASL mitigated the negative, frustrating effect of switching to a new programming language. When we separate the survey results for Alice with ASL out by gender, we see that the females in the overall course rated it at an 8.8 and the males, 8.1.

### 5.1 Recruiting New CS Majors

So, how did this translate into students continuing in computer science? Typically, we offer two sections of Introduction to Programming (CSIS120), the next course in the sequence, filling approximately 40 seats. This year, we closed both sections of the class and could have run a third as we filled all 50 seats. Eight of the sixteen women went on to the next course, with five of them declaring computer science as their major and three others pursuing a computer science minor. At least two of these minors would declare computer science as a major if New York State offered a certification to teach high school computer science. The overall retention of all students was 51% with 52% of the males continuing to the second course and 50% of the females. This is compared to 36% overall, 42% males and 30% females from the past five years and 31% overall, 23% males and 38% females from the non-service section of Alice.

### 5.2 Pro’s and Con’s

On the negative side, the students were aware of the added project work related to the service project. Comments that appeared in the evaluations that attest to this include:

- “I did not like the amount of work that came along with this class.”
- “Sometimes piles on too much homework”,
- “The workload tended to get intense and it put a lot of stress on myself and other students to have to complete it all on time as well as do other work for other classes.”

In talking with the students about the experience, they were generally happy with the projects they created for Music Mobile. One of the suggestions from the students was that they would have liked more interaction with the CBO to ensure that they were on the right track with their projects and to receive more input as to what would make a better animation.

Overall, the authors, department and CBO were pleased with the quality of the work that the students created. The group work enabled the students to develop an animation that was more complex than they would have done on their own. Students also felt that they were contributing to the local community.

## 6. FUTURE DIRECTION

The small sample size of this pilot project limits the power of our findings. We would like to develop a more accurate assessment tool for future offerings of this course and begin a systematic assessment over time and across various ASL and non-ASL offerings to better allow for more generalizable results. Some of the questions we would like to further evaluate include the students’ changed perception of computer science as a field, their likelihood to take more computer science courses and their development of skills such as client relations, presentation, project problem solving, and teamwork.

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## APPENDIX A:

