

Extended Abstract – Teaching Computer Programming to a Diverse Student Body Through Service Learning

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Abstract - The first year of engineering technology can be daunting for any student, let alone the diverse student body at Queensborough Community College, where many of the students are not native English speakers. When these students take Introduction to Computer Programming, most often in their second semester, many of them have never written a single line of code. Not only are standard programming assignments confusing to many of them, but they can also seem irrelevant or uninteresting. This paper describes how students have been able to make the connection between the computer programs they create and their usefulness through the high-impact teaching strategy of service learning. The process starts with six labs teaching them the fundamentals of programming in Visual Basic. This is followed by a step-by-step process of meeting with the client, reflection, planning, and creating and presenting their work to the client. The client's comments are then reflected upon and used to create an improved version of their work for their final projects.

Index Terms – Academic Literacy, Computer Programming Instruction, Diverse Population, Service Learning

INTRODUCTION

According to [1]: “Queensborough Community College is one of the most diverse colleges in the nation. Our students come from 129 countries, speak 99 different languages, and show an almost equal representation of the major ethnic groups. Over 30 percent of the students were born outside the USA. They come from every corner of the globe including Asia, North and South America, Africa, Europe, and Australia. The top five non-English native languages are Spanish, Chinese, Korean, Bengali, and Russian.” From this diverse community, about sixteen students take my section of the Introduction to Computer Programming (ET-502) class every semester. This class is a requirement for Computer Engineering Technology and Telecommunications Technology majors, and an elective for Electronic Engineering Technology majors at QCC.

When I started teaching ET-502, I quickly understood why Visual Basic was the language of choice in a class that is taken by students with no programming experience. Visual Basic's Graphical User Interface allows a student to make something visual and “clickable” in just two sessions.

The final labs I inherited were a bit dry, though, focusing on such topics as calculating Ohm's Law. While it was good that the assigned programs were tied into the rest of the curriculum, some members of the class had yet to take their first electronics course and therefore, for them, the assignments were “boring” and “irrelevant,” words a professor never wants to hear.

After my first semester, my department chair introduced me to some members of the Service Learning Department. Service Learning had been used with some success in social science, English, and biology, and they were looking to expand it into engineering technology. While service learning has been around since the 1990s, it has only been used in engineering and engineering technology more recently [2], [3].

Through discussion we determined that among the courses I teach, most of which are introductory electronics courses with a long list of objectives and subsequent courses, Introduction to Computer Programming would be the best fit, with its lack of follow-on courses and its currently unpopular projects.

CHOOSING A CLIENT

All service-learning projects require a Community-Based Organization (CBO) to serve as a sort of client for the work done by the class [4]. For ET-502 we had to find a client who would benefit from the relatively simple programs that my students, who had never programmed before, could write over the course of a single semester. As luck would have it, many of the members of the Service Learning Department were also in the Basic Skills Department, which has since changed its name to the Academic Literacy Department. With such a diversity of native languages at QCC, many of our students will have gone through the Basic Skills Learning Center (BSLC), which would provide many members of my class with a true understanding of the clients' needs, since they will have studied how to read and write English there themselves.

DECIDING ON THE PROJECT

The Academic Literacy Department and I have worked together every semester to come up with a project that would be useful to them and their students while being feasible for Introduction to Computer Programming students to create within the limits of a weekly three-hour, one-credit

course. For the six semesters that my section of ET-502 has been run as a service-learning class, there have been two main types of programs. One is a multiple-choice quiz, with questions ranging from reading comprehension one semester, to QCC's sustainability efforts (e.g., recycling) another.

In other semesters the students have written variations on a "Word Perception" game. This was inspired by [5], in which a page is filled with rows of words. On the left side of the page is a single word (e.g., "blanket"), while the right side has five more words, one of which exactly matches the word on the left (e.g., "blank blanket bland strand blankly"). The student is asked to go through each row of the table, crossing out the matching word on the right as quickly and with as few errors as possible. The Academic Literacy Department requested that this be turned into a game in which the first word would appear for a limited amount of time and then disappear, to be followed by the five choices. Users would then click on the matching word and the game would continue. It was also requested that if users picked the correct matching word, then they would have less time to read the next word, while if they picked the wrong word, they would be given more time.

STUDENT PREPARATION

While the students are told on the first day that their final project will be a service-learning project, the details of this project are kept from them until after their first six lessons, which are designed to give them all of the skills that they will need to create the final project. As mentioned in the previous section, the project does vary, but the topics they will need to know remain fairly consistent. The concepts and the order in which they are taught are shown in Table 1.

TABLE 1

INTRODUCTION TO COMPUTER PROGRAMMING PRE-PROJECT SCHEDULE

Week	Topics
1	Introduction to Visual Studio, Forms, Objects, Object Naming Conventions
2	Programming Actions, Access Keys, List Boxes, Commenting, Flowcharts
3	Variables, Timers, If...Then Statements
4	Loops, Arrays, Random Numbers
5	Radio Buttons, Check Boxes, Group Boxes, Subroutines
6	Message Boxes, Reading Text Files

Some of these concepts are required for every project, while others, such as the timer and random numbers, may not be essential but can be used by the student if he or she so chooses. For example, a multiple-choice quiz may be timed or untimed if the client does not specify one or the other, or the words in the Word Perception game can be randomized.

WORKING ON THE SERVICE-LEARNING PROJECT

In this section we will follow a student, J.R., though the process of working on his service-learning project, the Word Perception game.

I. Students Reflect Before They Start the Project

After the students finish the first six labs, a representative from the Service Learning Department introduces J.R. and the rest of the class to service learning and explains what the game should entail. Students are then asked to write reflections relating how they feel about the project. This not only gives them practice on the soft skills that are required by all engineers [6], but also gives me the opportunity to ensure that all students understand what they are being asked to do. Some students in the past have thought that they would be *taking* a quiz rather than *making* a quiz. Here is some of what J.R. had to say:

"Designing a program that's going to be used in the real world is both exciting and pretty scary. This project is going to be the first time I ever designed a program that's going to be used by other individuals..."

II. Students Create a Flowchart to Illustrate How Their Project Will Work

The students are then asked to create a flowchart so they can show the logical steps they will then translate into a Visual Basic program. They will have seen flowcharts all semester, but since this is the most complicated program they will have written, I let J.R. and the other students work together on the whiteboard with my guidance to come up with a workable algorithm, which they then copied and submitted.

III. Students Work on the Beta Version of Their Projects

Students are given a scoresheet with a list of tasks their programs must perform. Tasks for the Word Perception game include the following:

- When the keyword disappears, the five choice words must appear (10 points).
- The amount of time that the key word appears on the screen must decrease if the user gets a correct answer (5 points).

A screenshot of the beta version of J.R.'s program is shown in Figure 1.

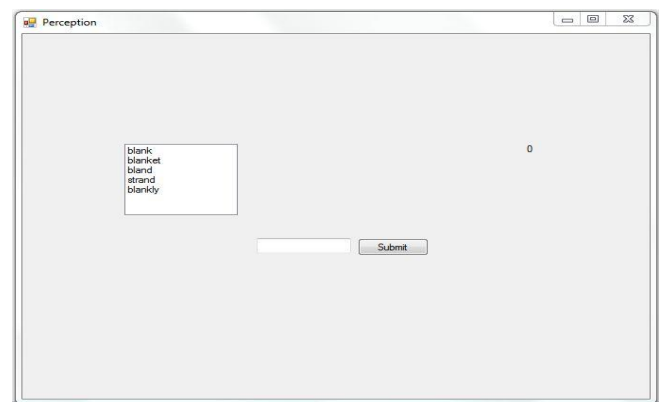


FIGURE 1
J.R.'S BETA VERSION OF THE PROJECT

There are five answer choices shown in a list box on the left side of a gray form with a centered text box in which the user is to type his or her answer choice. J.R. completed some, though not all, of the items on the checklist I provided.

IV. Students Present Their Work to the Client

J.R. and the rest of the class went to the BSLC to present their work to their clients, who included staff, students, and, in the Spring 2013 semester, education majors. The clients interacted with the students and filled out surveys expressing their opinions of the students' programs.

V. Students Reflect on What Worked...and What Did Not

This was part of the response, in the words of J.R.'s post-experience reflection:

"... Most of the testers told me that the game was pretty fun. They also told me that I have to change a lot of things. The testers told me to change the font size, take out the textbox, slow down the timer, and other stuff. I'm going to change my game by adding a paragraph explaining how to play the game. I will also make the font size larger and then remove the textbox..."

VI. Students Revise Their Projects Based on Client Needs

J.R. and the rest of the class were then given a few more requirements based on the overall response of the clients. In Spring 2013 this included the following:

- Your background must be something other than the default gray (10 points).
- Typing in the answer word will not be allowed for the final version of your program. The answer words must be selected in some other way (10 points).

As before, the students were given the freedom to make their programs work and look however they wanted, as long as they met the itemized requirements from the client.

VII. Students Present Their Final Projects to the Client

On the last day of the semester, students presented their final projects to the client. J.R.'s work is shown in Figure 2.

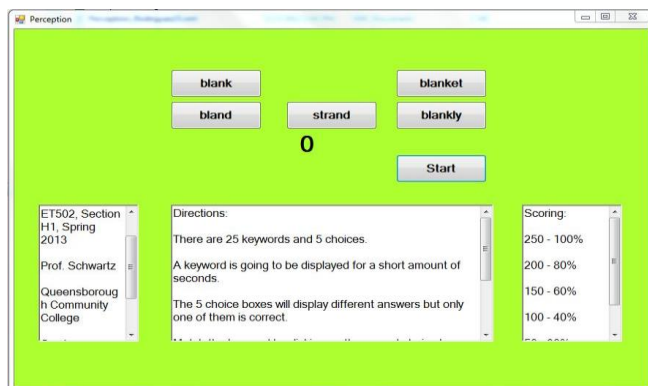


FIGURE 2

J.R.'S FINAL VERSION OF THE PROJECT

The background is no longer the default gray, the directions are now given on the form, and the textbox has been replaced with individual buttons for each of the answer choices, which are in a larger font than in Figure 1.

J.R. and the rest of the class have now had a memorable experience in which they were asked by a client -- not just their professor -- to create a program, have met with the client for comments and criticism, and have re-written their programs to meet with their clients' needs, some of which may have been changed or clarified. The difference in the attitude of the students toward their work from when I taught this class without service learning is gratifying.

FUTURE WORK

As is evident from this paper, service learning has given me increased job satisfaction, has given my students their first experience of writing a computer program to meet a client's needs, and has given the BSLC some software that their students can use to practice their reading skills. It is clear to me that service learning improves the ET-502 experience, but this is anecdotal. How will we measure the effect service learning has had on our students?

Starting in Spring 2012, at the beginning and at the end of the semester, the Service Learning Department administered surveys to my students, as well as those in other classes, to determine how students' experiences in Service Learning helped increase their workplace skills. These surveys included the following questions:

- "Is what you learned in this class relevant to your life and the lives of others?"
- "Did this service-learning aspect of the course help you follow directions more completely?"
- "Did the service aspect of the course help you learn material from your course more effectively?"

The results of these pre- and post-surveys are in the process of being analyzed at the present time. I look forward to seeing the results.

ACKNOWLEDGMENT

The author would like to thank the following people, without whom this work would not have been possible: Sharon Ellerton, QCC service learning pioneer in the sciences and co-formulator of the pre- and post-service-learning surveys; Arlene Kemmerer, co-formulator of the surveys and Service-Learning Project Co-ordinator who, along with Service-Learning Project Co-ordinator Mary Bandziukas, showed my students that a client can be a harsher critic than a professor might ever be; Jo Pantaleo, Programming Director of the BSLC, who brought the Word Perception Quiz concept to my attention; Cristina DiMeo, Service-Learning Project Co-ordinator and my Service-Learning interpreter at times; Jean Amaral, exceedingly helpful Research Librarian; and Stuart Asser, QCC Engineering Technology Department Chair, who introduced me to the Service Learning Department at just the right time.

REFERENCES

- [1] Fact Book – Office of Institutional Research and Assessment.
Accessed Online: May 17, 2013, p. 18.
<http://www.qcc.cuny.edu/oira/factbook.html>
- [2] Ropers-Huilman, B., Carwile, L., and Lima, M., “Service-learning in engineering: a valuable pedagogy for meeting learning objectives”, *European Journal of Engineering Education*, Vol. 30, No. 2, May 2005, pp. 155-165.
- [3] Dukhan, N., Schumack, M.R., and Daniels, J.J., “Implementation of service-learning in engineering and its impact on students’ attitudes and identity”, *European Journal of Engineering Education*, Vol. 33, No. 1, March 2008, pp. 21-31.
- [4] Queensborough Community College, Service-Learning Webpage.
Accessed Online: May 20, 2013.
<http://www.qcc.cuny.edu/servicelearning/>
- [5] Miller, W. M. and Steeber de Orozco, S., *Reading Faster and Understanding More, Book One*, 1990, pp. 12-13.
- [6] Kumar, S. and Hsiao, J.K., “Engineers Learn ‘Soft Skills the Hard Way’: Planting a Seed of Leadership in Engineering Classes”, *Leadership and Management in Engineering*, January 2007, pp. 18-23.