Robots in Education: Student Perspectives from the Classroom and from the Field

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Abstract

The pedagogical use of robotics in collegiate courses in Engineering and Artificial Intelligence and also as part of K-12 enrichment is slowly becoming mainstream. However, few courses combine these two areas by putting the college students in the field with young children. This paper describes a new course at California State University Long Beach, CECS 401: Robots for Educators. An overview of the course is presented along with the narrative from three students describing their experience of working with students from local high schools and after-school programs in a low-income community.

Introduction

When the topic of educational robotics is broached there tend to be two distinct areas of discussion: the use of robots in AI [1] and the use of robots in K-12 outreach and enrichment [2]. Rarely does a single course combine these topics. In addition, most courses assume some sort of background or future pursuit in the field of computer science. At California State University Long Beach the Computer Engineering and Computer Science Department is reaching out to non-majors (particularly students preparing to teach technology and programming courses at the middle or high school level.) who would benefit from an introductory level competence in robotics. In the Fall of 2005 the course CECS 401: Robots for Educators was offered for the first time.

CECS 401: Robots for Educators

CECS 401 was intended for students pursuing a Minor in Computer Science or a B.S in Educational Technology with an Option in Technology and Engineering Education, but was open to everyone. A novel part of this class was the inclusion of service learning. Service learning (SL) is a teaching method that allows students to see and experience the relationship between theory and practice as they draw together their community service experience with readings, lectures, and classroom discussion. Unlike simple volunteer activities, when done correctly, SL will allow the student to benefit from the experience as much as the community. CECS 401 students worked with high school students visiting the campus as part of the Women at the Beach program, and BLAST (Better Learning After School Today) at the Carmelitos Housing Development in Long Beach.

Course Objectives

To facilitate group work, the course met only once a week for five hours at a time. The first part of the semester focused on basic building and programming skills. The second part focused on developing lesson plans, and the third was a team challenge that incorporated the skills learned in the first part of the semester. The 20 hours of service learning were performed outside of classroom time. The course objectives included:

1. An Understanding of Robotics Terminology
2. Knowledge of Robotics Design
3. Knowledge of Basic programming constructs
4. Application of theory to practice
5. An understanding of the benefits of "hands on learning" in the K-12 classroom
6. The ability to write lesson plans for the use of robotics technology.
7. The ability to communicate effectively in writing and oral presentations for multiple age appropriate audiences.

The goal of this course was to give students the opportunity to gain hands-on experience in problem solving and computer programming while constructing and programming robots. The robotics equipment used included the Handyboard [3], Lego Mindstorms Invention System 2.0 [4], and some homegrown electronics. Students were required to

purchase or rent the Mindstorms Kit. The department provided all other hardware and additional Mindstorm kits for use at the service learning sites. Little to no background in computer science or engineering was required so the majority of the programming was completed using the Mindstorm GUI-based software. However, Interactive C [5] was also used for programming the Handyboards.

Participants

Student Participants

Nine students enrolled in the course. It was a diverse group of students from a range of majors (from Education, to Computer Engineering, to Criminal Justice) and student rankings (Sophomore to a Graduate student). While just one of the students was female, a third were minority students (see Table 1).

Race	Gender	Grade	Major
Hispanic	Male	Grad	Educational Technology
Caucasian	Female	Senior	Human Development
Hispanic	Male	Junior	Computer Eng
Caucasian	Male	Senior	Engineering Technology & Engineering Education
Caucasian	Male	Junior	Criminal Justice
Hispanic	Male	Senior	Engineering Technology & Engineering Education
Caucasian	Male	Junior	Computer Science
Caucasian	Male	Senior	Engineering Technology & Engineering Education
Caucasian	Male	Soph	Management Info Systems

Table 1: Student Demographics

Carmelitos

The Carmelitos Housing Development is composed of 62 acres of government housing located in the heart of Long Beach City, California. While the average income in Long Beach City is $37,270 ($4000 less then the national median), most of the people living within Carmelitos earn less than half that amount. There are over eight hundred children residing there though, and all of them have after school needs. In response, Long Beach BLAST (Better Learning After School Today) [6] was launched in September 2000.

BLAST is a non-profit organization dedicated to improving after school learning for at-risk children and youth through collaboration with the community (cite). BLAST prepares volunteers to work with children at-risk for school failure. BLAST's main service is to recruit, train, place, and support college student volunteers as academic mentors helping children at-risk for school failure. BLAST recruits college student volunteers from California State University Long Beach (CSULB) and Long Beach City College (LBCC).

Women Engineers at the Beach

Women Engineers @ the Beach [7] is important outreach and recruitment effort of the College of Engineering at CSULB. The purpose of this one-day program is based on the understanding of some common points regarding factors that affect girls' success in engineering, technology, and other non-traditional career fields. The program draws over 200 to 400 female students, once every semester, from Southern California elementary, middle schools, high schools, and community colleges.

Student Perspectives

The remainder of this paper is the personal perspectives of three CSULB students who enrolled in the course. The first is an undergraduate in Criminal Justice and the second is an undergraduate in Computer Science. Each has described his background with computers and children and the biggest challenges faced during the course. They also address what they feel were the largest benefits for students they worked with. The third narrative, from a graduate student in Educational Technology, describes the first day at Carmelitos.

Student One

My Background

I had no prior background in computers prior to involvement in the CECS department. I received my first introduction to what computers were capable of in the CECS department. I came across web design, programming, networking, etc…. As I learned more in the minor, I tried more at home. Coupling that with learning from some of my friends and I have made major gains in knowledge and capabilities since my first PC.

Like many of the students in the course, my only real experiences with kids were in the family. When I got involved with the CECS department I found myself working with kids across different age categories. When I was at Carmelitos I worked predominantly with kids under 10. Since the program was age limited it made sure we would not be working with older kids. Later on I participated in the Women at the Beach program. This brought in a group of female high school students. In some ways, they were more of a handful than the kids at Carmelitos were. Last time I worked with young people was at the Elizabeth Learning Center. This was a high school with emphasis on computers and technology training. I was there to instruct the students on building robots for a competition called Botball [6]. We used Legos to construct robots that would perform in a battle like competition.

Biggest Challenges

When working with kids in general the biggest challenge is always getting through to them, getting them to listen to and hear you. Once that is achieved, you have to get them to understand you. After that you have to get them to trust you. Achieving all this becomes a very challenging task. It involves being consistent and truthful, respectful and straightforward, knowledgeable and polite. It also involves being fun. If you can offer some humor and give them a fun time great strides can be made in a fairly short amount of time.

Personally, some of the hardest challenges I found were at Carmelitos and during Women at the Beach. When we were at Carmelitos we were working with kids that came from underprivileged homes. We had a tough time trying to get young kids interested. They wanted to play and we were trying to teach. What I found was that the same kids usually showed up week after week and they worked under the same people. Therefore, we decided to have them work with us to build cars for a drag race. This got them engaged in a constructive and educational process without them realizing it. They were having fun. In addition, at Carmelitos we had to worry about theft of the Legos from the kits. There wasn't much we could do about this but it was an issue we had to deal with.

With Women at the Beach, it was a tougher group. They were only with us for a short amount of time and were uninterested at best. They wanted to explore the CSULB campus not mess around with simple engineering jobs. This was one challenge that unfortunately we couldn't meet with everyone. Trying to convince a group of teenage girls to motorize a model car didn't go over as well as I had hoped.

Biggest Benefits to the Students

I think the biggest benefit to the students had to have been a chance to learn something about something different. In school it is always the same subjects – math, English, biology, chemistry, the same old subjects – over and over. Since our topic was creative engineering and our medium was Legos, we offered the students something new. We gave them a chance to break away from convention and express themselves. They were able to work with gears and blocks, wheels and shafts. They built cars, towers, houses, and all kinds of normal items. While this might not be impressive, during the processes of building these items they learned basic engineering. They witnessed first hand the complexity of building everyday devices and structures, things taken for granted. Learned roughly how society is constructed from the ground up. I hope that they even walked away looking to try it again the next day.

Student Two

My Background

I remember when I was younger my dad bought an Apple IIc and I thought it was the coolest thing ever. The only computer related class I took in high school was an Adobe Photoshop/Illustrator introduction course where I learned how to use both programs to manipulate photos and create my own images. I have used computers as long as I can remember to regularly look up information, play games, read news, and make music. Nevertheless, it wasn't until the end of my second year in college that I took my first computer engineering/science class. The following semester I took a variety of Computer Science classes including CS1, Networking, and this course.

As the oldest of four children, I have always felt somewhat responsible for my siblings as well as being a good role model. In the past I worked as a janitor for a preschool where I cleaned the facility a couple days a week. While I was there I would play around and watch them from time to time when a teacher would need to get away for a few minutes. Currently, I work at an alternative education high school in Huntington Beach where I work with teenagers and young adults. I perform weekly orientations during which I am responsible for ensuring all new students feel welcome, pass on all necessary information, and administer various tests. Most of the time I work in the office as an assistant but I also occasionally help tutor some of the students in math and science.

Biggest Challenges
The biggest challenge for me was trying to come up with interesting topics and ideas that would still be educational. The next two challenges were (1) doing all of this while learning the information myself and (2) dealing with erratic attendance by the students. You had to assume that your audience may or may not be the same students you worked with last time.

Biggest Benefits to the Students
If nothing else, I would have to say the biggest benefit to the students was the exposure they had to the basic concepts of programming and engineering. Now those students who participated can say, "Hey I kind of know what programming is because I did some when I played with robots." More substantially, I think that having older students come and work with them helped show the importance of staying in school and gave them an understanding of what being a college student is all about. Furthermore, having a cool older person (us college folk) come and take an interest in their lives and paying attention to what they had to say made it easier for them to listen to and learn.

Student Three

Participating in this Robotics CECS 401 class with its service oriented structure has given me the opportunity to once again serve my community. I have in the past worked with at risk youth and special education programs, but I had yet to see anything quite like Carmelitos. Our first encounter with the children of Carmelitos was an apprehensive one. They were not sure of us and we did not know what to expect from them. But after a few minutes of ice-breaking activities and small talk, we were able to start with the lesson. As a side note, it must be stated that some of the children were at first more preoccupied with other subjects, such as gossip and picking on others, but after some redirecting and coaching they were soon engulfed with the matters at hand.

Our first lesson guided the children through the Lego Robotics kit movie, this helped fuel the children's imagination with pictures of robots and what they could accomplish. After the movie the children were asked to draw circles, with their eyes closed and their non-dominate hand (an exercise from Drawing on the Right Side of the Brain [8]). Following the doodling activity the children were asked to look for two circles that might represent eyes, once the eyes were found it was just a matter of them tracing the rest of the drawing and transforming their doodle into a robot. The children were asked to name the robot drawing and specify what the robot's abilities were.

Subsequent to the drawing exercise the children where introduced to the Lego Kit via a quick introduction of each piece. Then they were asked to build the tallest, sturdiest structure they could possibly build, with fifteen pieces of Lego blocks. After every five minutes, three more pieces of Legos were given to each individual to add to their structures.

The lesson was extremely successful. The children were interested and cooperated fully. They had many questions, ranging from how Legos are made to NASA projects. It was obvious many of these children had never had the opportunity to play with these types of objects before, which makes sense; many of these families would rather spend $200.00 on food and clothing then on a Lego kit. Nevertheless, frequent exposure to such activities is vital for these children intellectual growth.

References

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[8] Andrews, Betty. Drawing on the Right Side of the Brain, Tarcher Publishing, 1989.