

## A Brief Artbotics Exploration for Educators

### Motivation

The motivation for this effort is to introduce educators to alternative methods for exposing youth to science, technology, engineering, and mathematics (STEM) concepts through robotics. Art and computer science may appear like two unique fields without overlap. Animation, gaming, and computer graphics are obvious examples of where art and computer science overlap; the robotics field is another, albeit more subtle, example. There is an inherent need for creativity, visualizing, and interaction design within the robotics field; thus blending art and robotics is natural and practiced [1]. Approaching robotics from an artistic perspective may prove useful in exposing youth to STEM concepts.

### Background

Robots provide an interactive way to teach STEM concepts. As outlined in [2], goal-oriented, thematic integrated curriculum, and project-based approaches are the primary methods used in educational robotics. Qualitative and quantitative results from educational robotics assessments indicate the activities had positive impact on the students [3][4][5][6].

Art is a core topic for youth education, despite it commonly being a point of debate. It is difficult to determine just how art benefits other fields. Eisner details the difficulty of measuring the art education benefits, although intuitively they are understood [7][8]. Practicing art allows students to explore transforming their visions, ideas, and feelings into an art form [7]. Eisner outlines lessons learned while practicing art and how they are useful elsewhere [8]:

1. There can be more than one answer to a question and more than one solution to a problem; variability of outcome is okay.
2. The way something is formed matters.
3. The importance of imagination and of refining and using the sensibilities.
4. The capacity of an art form to touch us depends on the relationships that are composed by artists.
5. Intrinsic satisfactions matter.
6. The importance of being flexibly purposive in the course of one's work.

Blending art and robotics is not a new concept, as Wilson discusses in [1]. It is, however, a relatively new concept within the field of education. There are benefits to teaching youth robotics and art, as previously discussed. The combination of robotics and art provides a new perspective to explore STEM concepts. Students are encouraged to transform their visions, ideas, and feelings into an art form using robotics as the media.

Artbotics is a collaborative effort, between the University of Massachusetts Lowell, the Revolving Museum, and Lowell High School, focused on revealing art and computing concepts using robotics [9]. It started in 2006 as a pilot summer program for graduating high school and early college students. Since then, the program has grown to support an annual summer program for middle school, after school program for high school, and semester courses for college. A two-day educator workshop is held during the summer to disseminate Artbotics. The preliminary feedback on the Artbotics curriculum was positive; the students felt engaged in the creating process [10]. The programs have grown since the time of the publication.

STREAM is an annual educator workshop exploring how to use robotics in teaching STEM [11]. The two-day workshop provides educators with a breadth of hands-on activities involving robot technologies intending to inspire instruction. The workshop also provides the opportunity to share new methods and technologies, such as Artbotics. Dr. Holly Yanco directs Artbotics and the STREAM Workshop. She would like to include an Artbotics exploration in the 2010 STREAM Workshop; this would complement the other robotics methods on

the agenda.

## Question

Is it possible to give educators a motivating and useful introduction to the Artbotics concept in a three-hour timeframe?

## Objectives

1. Using the Artbotics high school and college classes as inspiration, design a three-hour program for approximately 50 educators.
2. Incorporate progressive techniques discussed in class and utilized in the Artbotics class: project-based activity [12], group collaboration [13], and intrinsic motivation [14].
3. Evaluate the program impact through solicited feedback and observed educator involvement.

## Approach

There are logistical constraints under which this program is to be designed:

1. Timeframe = 3 hours
2. Audience = ~50 adult educators (assume they are not familiar with the hardware)
3. Hardware = standard Artbotics kit containing a Super Cricket board, motors, and sensors.

The program will have three primary phases: introduction, activity, and presentation. This is the general flow employed in the other Artbotics programs. It will provide the educators with a sense of being in a full Artbotics program.

During the introduction, the educators will form groups of three to four members. The intent is to promote group collaboration and idea sharing between the members. The groups will be given a basic overview of the hardware. It is necessary to present the tools, or media, to the educators. The goal is to get them familiar so they are encouraged to explore the media.

The majority of the time will be devoted to the activity. This is the project-based portion of the workshop. In the Artbotics course, the students are given a theme for the gallery show. The students explore the robotics media under the given theme. The educators will have a similar experience. Although the workshop will not end with a gallery showing, there is a presentation. The educators will be given a theme and additional materials to guide the robotics exploration. The theme and materials should be carefully chosen to promote creative exploration while balancing the time constraint.

The final phase of the program is the presentations. Although the groups will be encouraged to use their resources during the activity, they will stand up and explain their creation, process, and lessons. This is a traditional tactic in art education; presenting the piece is owning the piece for better or worse.

## Work Plan

1. Hardware introduction
  - a. Get familiar with the Artbotics kit (I have to explore the hardware to determine what it can/can't do).
  - b. Document the exploration for potential use during the workshop.
  - c. Collect materials used in the exploration for reference material.
  - d. Consider potential themes while exploring the hardware.
2. Activity design

- a. Come up with a list of themes; run these by Dr. Yanco for input/feedback.
  - b. Narrow the list to a top three.
  - c. Play with additional materials to use in creating art forms under each of the three themes.
    - i. Is there a common set of materials that can be used for each theme? Perhaps to provide a foundation to build a piece?
  - d. Consider a three-dimensional activity to simulate sculpture.
    - i. Perhaps wire or clay would be of use.
  - e. Document the design creation – theme, brainstorming, and lessons; this will feed the activity description.
  - f. Obtain feedback on the activity from Dr. Yanco and educator contacts (perhaps I can get feedback from the class members).
  - g. Present the three activity designs to Dr. Yanco; prepare pros and cons for each and make a suggestion.
  - h. If possible, test the activity design with a group of select colleagues for input.
3. Program documentation
    - a. Formally document the final activity design for presentation at the workshop.
    - b. Collect appropriate reference materials for the hardware.
    - c. Finish the final activity piece for show during the workshop.
  4. Evaluation material
    - a. Create the pre and post workshop surveys.

## Outcomes

The three-hour Artbotics program package will contain the deliverables from this effort:

1. Activity documentation and surveys
2. Hardware references and necessary code base
3. Finished art piece for showing at the workshop

This material will be implemented during the STREAM Workshop taking place in June 2010.

## Future Work

The focus for this effort is ultimately executing the three-hour Artbotics program during the 2010 STREAM Workshop. The evaluation of the program will determine activity usefulness in giving educators a sense of being in an Artbotics class. The evaluation results will be used to drive improvement. Alternative activities should also be explored for future workshops.

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