Robotics & Education

RI 16–867: Human–Robot Interaction
April 10, 2017
Hello!

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Big Ideas

1. Existing efforts and programs in educational robotics

2. General forms and trajectories of educational robotics research

3. Overview of Arts & Bots as an example of educational robotics research
Arts & Bots
Existing efforts to identify and support student talent in engineering and computer science are not sufficient.
Arts & Bots combines robotics components and craft materials to foster creativity and engagement.
Arts & Bots is aimed at training non-technical teachers to recognize engineering design and computational thinking affinities.
Teachers integrate Arts & Bots into non-technology classes.
Arts & Bots was used in 7th and 8th grade poetry classes.

El Dorado
by Edgar Allen Poe
Example videos:

El Dorado: vimeo.com/58730311

The Pasture: vimeo.com/58725738
Arts & Bots was used in 7th grade health to explore the musculoskeletal system.
Arts & Bots Studies

Participatory Design Series
Workshops
Partner Teachers
Pioneer Teachers
Math-Science Partnership

Robot Diaries
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2007-2010

Arts & Bots Pioneers
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2010-2014

Arts & Bots Math-Science Partnership
--
2013-2017
Our studies were based on Mixed Research Methods – combining quantitative and qualitative data sources.

- Classroom Observations
- Class Project Calendars
- Student Time Surveys & Exit Tickets
- Teacher Surveys & Logs
- Student Surveys - Knowledge
- Student Surveys - Attitudes
- Teacher Interviews
- Student Design Portfolios
- Teacher Talent Inventories
“I always thought technology was far too complex for me to ever have even a basic understanding of programming and how it works. I now know that I will be able to learn basic programming skills if I choose to do so”

7th grade male, technology education/history
Students demonstrated increased technical language in describing systems.

47.2%

Watched: Video of a craft-based robotic flower

Prompted: “What parts did Evan use to make the flower?”

n = 89
Students demonstrated increased technical language in describing systems.

$\chi^2 (1) = 41.09$, $n = 89$, $p < .0001$
Students in Arts & Bots had significant increases in systems engineering scale scores.

Below is a list of actions. Check off whether each action is an input of information, the output of information, or the processing of information.

Answer options: Input, Output, Processing

1. A beep from your computer
2. Pressing a button on your phone
3. A printout from your printer
4. Thinking about which soda you want from a machine
5. A picture on your computer monitor
6. Talking into a cell phone
7. A calculator adding a sum
8. The movement of a remote controlled car
9. The ringing of your alarm clock
10. Your digestion of breakfast

Students in Arts & Bots had significant increases in systems engineering scale scores.

Pre-Survey

Post-Survey

\[ Z = -4.820, \ p < .0001, \ r = .41, \ n = 138 \]
“it made me feel more connected and confident using the robotic elements it made the technology feel more accessable[sic] instead of just something really smart people or nerds do”

8th grade female, accelerated language arts
Primary Arts & Bots Pioneer Findings

1. Learning about Robots
2. Improved Confidence
3. Breaking Technology Stereotypes
4. Supported Teamwork Skills
Questions about Arts & Bots?
Educational Robotics Systems
There are three principal components of education interventions.
There are many different educational robotics programs used in K-12 schools.

Finch Robot

LEGO MINDSTORMS

www.districtadministration.com

hitchamsict.blogspot.com
Finch Robots were designed to support computer science classes in high school and college.

- Developed in the CMU CREATE Lab
- Promotes engagement and practical applications with computer science concepts
- Designed as to complement introductory computer science classes
  - Support for 10+ languages: Python, Processing, Scratch, Java, C++, and many more
LEGO MINDSTORMS is the most widely used educational robotics platform.

- Developed in the MIT Media Lab
- Middle school to college age students in technology classes and extracurriculars
- Is the basis for 90% of educational robotics studies (Barreto and Benitti, 2012)
  - About 15,600 results in a Google Scholar search
Robotics competitions are frequently used to motivate students participate in STEM.

FIRST – Girls of Steel

VEX Robotics

www.frc.ri.cmu.edu
There are many educational robotics products sold commercially, but research is rather limited on their effectiveness.

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Read and Discuss

Skim section: “4.3 Is robotics an effective teaching tool? What do the studies show?”


Identify shortcomings in or findings about educational robotics that you find interesting.
Integrating education into robotics research can increase the impact of the project.

- Working with teachers and students can snowball impact

- Consider the Broader Impacts that robotics research can have
  - Funding agencies like the NSF are interested in outreach and dissemination
Educational Robotics research approaches can be classified by the focus and type of research.
The educational systems is a very complex ecosystem with many stakeholders.

- Students
- Teachers & Educators
- Administrators
- Parents
- Policy Makers
- Education Researchers
Discussion

One major criticism of educational robotics, in K-12 schools, is that robotics interventions are most commonly focused on teaching concepts directly related to robotics, such as programming, designing and building robots and that teaching these concepts distract school resources away from core subjects like history, language and math.

What do you think of this argument?

Do you agree that robotics activities are too limited to be valuable in schools?
Do you think that robotics can provide other benefits to students to justify the resources required?