Educational Robotics in Formal and Informal STEM Learning

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NSF Funded Silicon Prairie Initiative for Robotics in Information Technology (SPIRIT)
http://tekbot.unl.edu/SPIRIT2/
STEM: Science, Technology, Engineering & Mathematics

1) STEM Coined by NSF
2) Evolving into “meta-discipline”
3) Encourages student problem-solving, discovery, exploration, and engagement
4) Called U.S. “Sputnik moment”
5) Robotics are a great “STEM” context, we have and several NE initiatives, grants, projects
Challenges of the T and E of STEM

1) T & E struggling for traction in many schools
2) No field teacher certification in T & E
3) CS: Only supplemental endorsement
4) Eng: No endorsement beyond Ind. Tech
5) Impacts CS and Engineering Pipelines
6) Efforts: Hour of Code, Project Lead the Way, First Lego League, Wearable Technologies
Science

Technology

Engineering

Mathematics...

In spite of the efforts of both those in government and the private sector, the outlook for America to compete for quality jobs has further deteriorated over the past five years. The Gathering Storm increasingly appears to be a Category 5.

*The Gathering Storm Revisited, 2010*
Let’s look at one company:

Lockheed Martin Will Retire More Engineers Than Total U.S. Output!
The CEENBoT Platform

- CEENBoT – An Open Source Educational Robotics Platform
- Many Options!
  - Remote controlled
  - Light Sensor – bump
  - Texas Instrument Programmed
  - Graphical User Interface Programmed
  - C+ Programmed
The CEENBoT at PKI
Bringing Higher Ed, K12, and Informal Education Closer Together

• We use the CEENBoT to inspire PKI students and level playing field
• NSF grants have allowed CEENBoTs into the K-12 to enhance STEM Learning
• The CEENBoT is penetrating after-school informal science learning environment
• Collaborations with other universities are expanding
• In PKI it represents an evolving student portfolio
Nebraska Robotics Expo

Showcased by Nebraska Loves Public Schools:
http://nelovesps.org/story/robots-take-over-the-classroom/
Invention and Innovation
STEM Class:
Lewis and Clark
Middle School, OPS

• STEM Elective Course
• Focuses on Engineering Design
• Experiential Learning (STEM Units & Challenges)
• Topics: Renewable Energies, Robotics, Experimentation, City Planning, Scale Models, Functional Prototyping
• Engage in local, state, national competitions
• Gateway to further STEM courses
Two Websites

http://spirit.unomaha.edu

http://ceen.unl.edu/TekBots/Spirit2/
SPIRIT Lesson Plan
Five Components

A – Asking Questions
E – Exploring Concepts
I – Instructing Content
O – Organizing Instruction
U – Understanding Learning
EXPLORING Concepts (The Power Steering Is Out!)

Summary:
Students explore the relationship between the horizontal and vertical distances traveled from one point to another.

Outline:
- Student pairs will drive the CEENBot from one location to another using one 90-degree turn.
- Students will predict the number of units from the starting location to the 90-degree turn (Run).
- Students will predict the number of units from the 90-degree turn to the ending location (Rise).
- Students will predict the straight path distance from one location to the other (Slope).

Activity:
In this lesson, students investigate how the slope of a line connecting two coordinate points is calculated. Students will select “locations” on a coordinate plane marked on the floor. Each student will record his/her “location” as a coordinate point. Pairs of students will be randomly selected to “travel” to one another’s “location” using the CEENBot and driving criteria. All students will record the horizontal and vertical distances traveled by the CEENBot. The student pair will then travel in a straight path from one “location” to the other, and will measure the distance of the path using a meter stick.

Grade Level: 6-8
Standards: SA, TA, EB, MA, MD, ME
Mathematics Concepts: Slope
Collaborative Project Assessments

### Teacher Assessments

- Classroom Observation Instrument
- Teacher PD Survey Begin
- Teacher PD Survey End
- PD Environment Observation
- Teacher Liability Release
- Daily Teacher Feedback Form
- Teacher Saturday Workshop Feedback
- Constructivist Learning Environment Survey
- Teacher Professional Development Survey
- Teacher/Facilitator Pilot Test Feedback
- Student Feedback Form
- Sample Robot Content Assessment Questions
- Sample 21st Century Skills Questionnaire
- Sample Interest Questionnaire
- Longitudinal Survey
- Kuder Career Planning Survey Sample

### Student Assessments

- Student Robot Reflection
- Youth Assessment Letter
- Student Content Instrument (4H Robotics)
- Student Attitude Instrument (4H Robotics)

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**Collaborative Project Rubric**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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<tbody>
<tr>
<td>Curriculum Goals &amp; Technologies (Curriculum-based technology use)</td>
<td>Technologies selected for use in the instructional plan are strong, aligned with one or more curriculum goals.</td>
<td>Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.</td>
<td>Technologies selected for use in the instructional plan are minimally aligned with one or more curriculum goals.</td>
<td>Technologies selected for use in the instructional plan are not aligned with any curriculum goals.</td>
</tr>
<tr>
<td>Technology Selection(s) (Compatibility with curriculum goals &amp; instructional strategies)</td>
<td>Technology selection(s) are appropriate, given curriculum goals and instructional strategies.</td>
<td>Technology selection(s) are approximately appropriate, given curriculum goals and instructional strategies.</td>
<td>Technology selection(s) are minimally appropriate, given curriculum goals and instructional strategies.</td>
<td>Technology selection(s) are inappropriate, given curriculum goals and instructional strategies.</td>
</tr>
<tr>
<td>&quot;Fit&quot; (Context, instructional strategies and technology are compatible)</td>
<td>Content, instructional strategies and technology are highly compatible, given the instructional plan.</td>
<td>Content, instructional strategies and technology are moderately compatible, given the instructional plan.</td>
<td>Content, instructional strategies and technology are minimally compatible, given the instructional plan.</td>
<td>Content, instructional strategies and technology do not fit together within the instructional plan.</td>
</tr>
</tbody>
</table>


See SPIRIT website for Teacher / Student Assessments
Field Tests in the Schools

Full Annual Reports on SPIRIT Website

Also see Robotics in K12 Education

IGI Book
Power of Collaboration

“If you want to go quickly, go alone. If you want to go far, then go together”

African Proverb

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