

# Educational Robotics



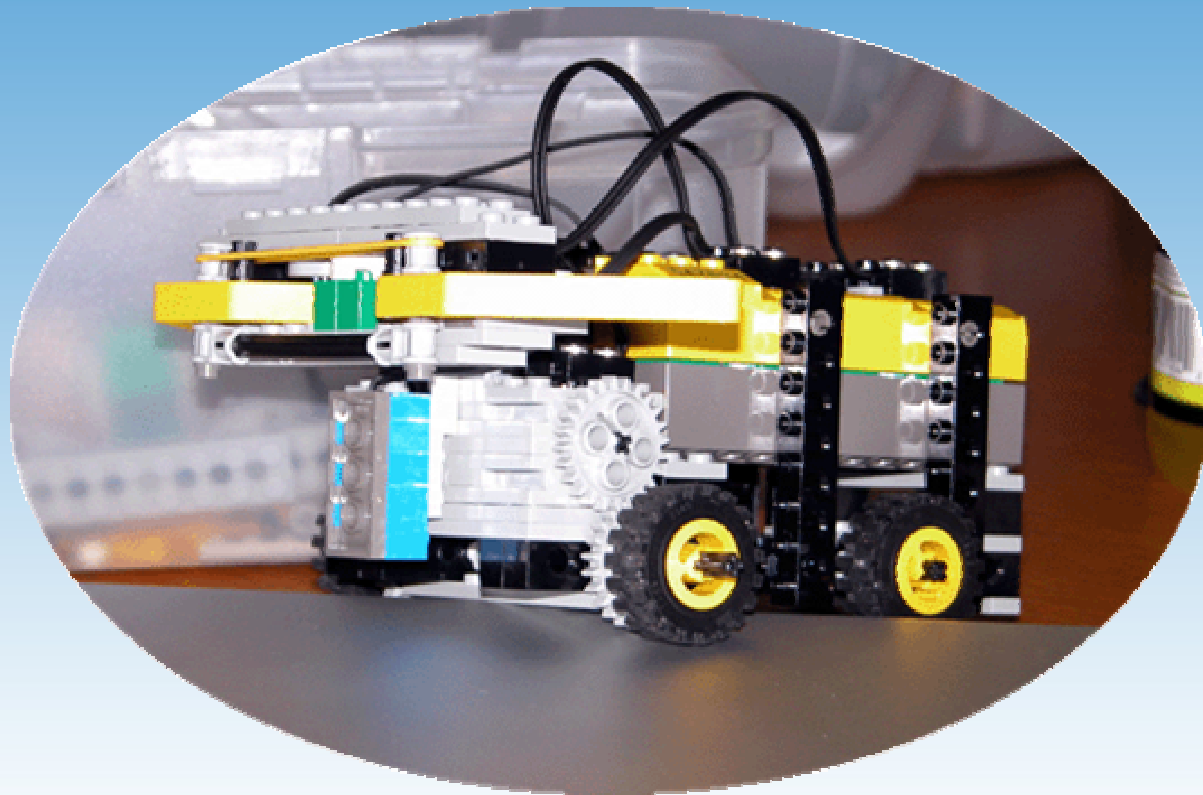
# Background

- Constructionism – Piaget's
- Through a hands on environment students will better understand fundamental science, math, and technology related concepts.

*"Tell me I forget,  
Show me I remember.  
Let me do and I understand.."*

Confucius 551-479 BC

Using Lego Robots is an interesting and exciting way to engage students.



**Goal:** To develop a curriculum, materials and supplemental resources for use in classroom and after school environments.

# Implementation

We spent valuable time becoming comfortable with the LEGO Mindstorm Invention System and RoboLab, in order to . . .

- Understand the technology
- Anticipate technical difficulties
- Identify the fundamental concepts necessary to implement the curriculum.

# Design Process

- Developed preliminary curriculum and constructed the basic materials.
- Tested and evaluated the lesson plans and resources in a classroom environment.
- Based on our experience we modified the materials to accommodate different populations and take into account what we learned.
- Re-tested and evaluated the tailored curriculum and materials in various settings.

# First Iteration

- 5-Block robotics lesson
- Intended to introduce technology to a young age.
- An opportunity for us to experience teaching in a classroom environment.
- Allowed us to evaluate issues such as:
  - Group Dynamics
  - Age
  - Gender
  - Culture

# Joe's Class

- PS164 in Washington Heights, New York
- One Teacher for ~thirty students.
- 6<sup>th</sup> grade students.
- Both male and female students from predominantly Hispanic families.





# Assessment of the First Iteration

- Encountered numerous technical difficulties
- We acquired new teaching techniques
  - Real-world examples
  - Behavior management
  - Abstraction of the complex ideas
- Evaluated the effectiveness of our lesson plan through a pre/post-test
- Observed the students in their natural setting in order to determine how they interacted with the robots

# Second Iteration

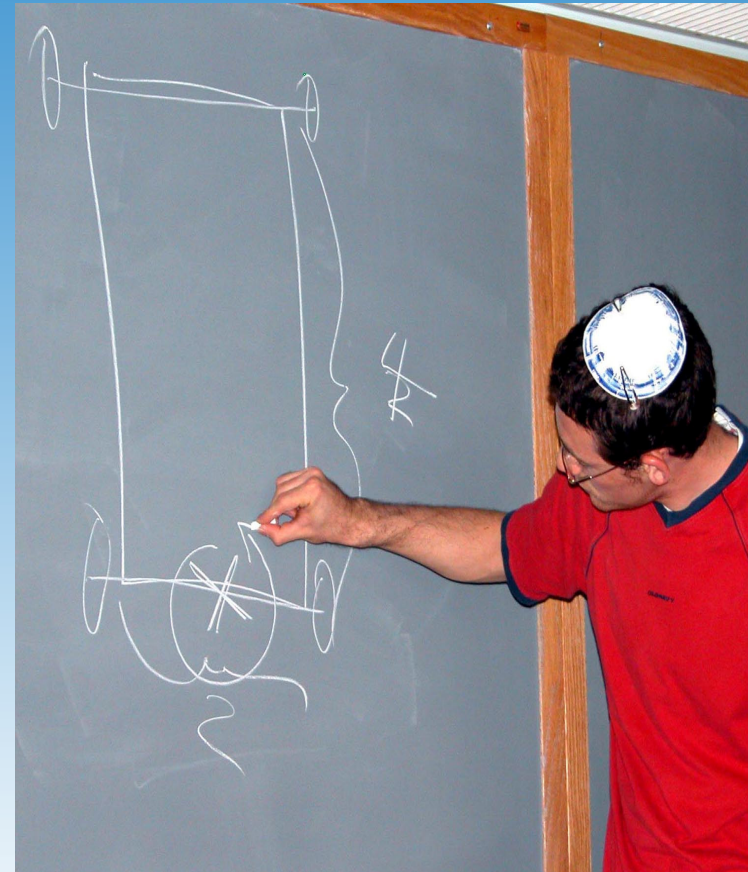
- High School program on the Barnard College Campus
- 5 week program meeting twice a week
- 9 robotics sessions of 1 ½ hrs each
- Age group: 9-12 grade
- Gender: ~ 75% female
- No board certified teacher present – we were the authoritative figures
- Group size: ~ 3 per group

# STEP

- Science and Technology Entrance Program (STEP)
- For students from broad socio-economic backgrounds
- Intended to increase the number of students that attend college and pursue science and technology related fields.

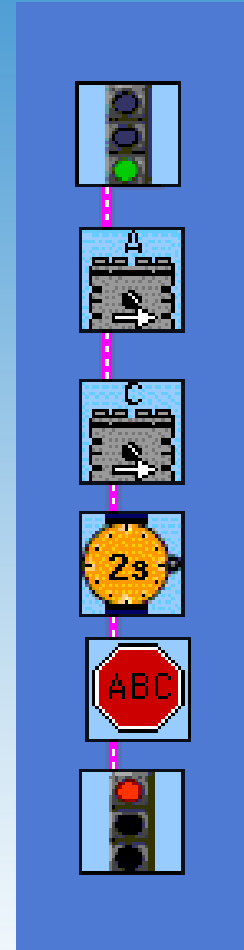
# Building a Robot

- Began by having students construct the Robot themselves
- Students obtained a firm understanding of the working dynamics of their Robot
- Students were also introduced to Design principles



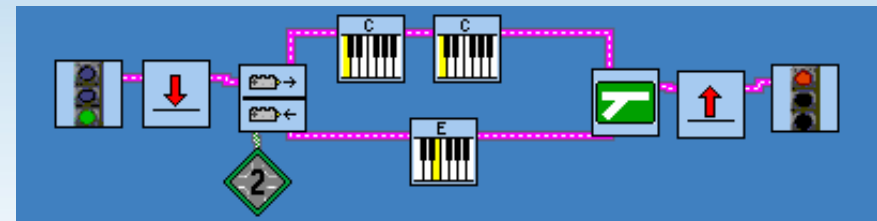
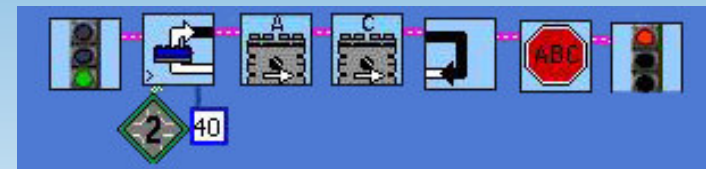
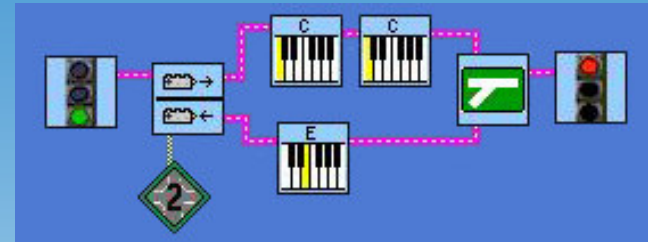
# Programming a Robot

- Graphical Programming, RoboLab, Environment designed by Lego
- Familiarity with Programming Environment
- Basic Understanding of Sequential Execution
- Uploading a Program to the Robot



# Advanced Structures

- Basic logic, if something is true then do this, else do that
- Concept of repetitive action
- Concepts of nested structures
- Concept of iterative design



# Third Iteration: Playing to Win

- Community Center in Harlem
- 10 robotics sessions for 2 hrs each
- Age group: 9-12 grade
- Gender: evenly distributed
- Group size: 2-3 per group, more than that became disruptive
- Taught by two other undergraduates using our curriculum, materials and resources

# Assessment of the Third Iteration

- Obtained valuable feedback from fellow undergraduates using our lesson plans, materials and resources
- Encountered behavioral issues and willful disinterest
- Despite behavior issues students “responded better in Robotics Class than any other”



# Lessons from Third Iteration

- Not all students desire to learn
- It is better to give uninterested students large, “cool” looking challenges than small ones
- Robots are extremely effective for gaining and keeping students attention

# GK12

- Funded by National Science Foundation
- Assists teachers to integrating technology into the classroom in meaningful ways.
- Columbia University hosted several workshops to teach GK12 teachers about Lego Mindstorm Robots and Probes.

# GK12 Workshop

- Majority of teachers had never worked with Robots before.
- Lesson plan consisted of material and resources used with students in previous workshops.



# Teaching Robotics with GK12

- Normal curriculum supplemented with teaching recommendations based on our experience
- Heavy emphasis was placed on how to troubleshoot mistakes most often made by students
- Very positive response from teachers

# Conclusion

- Developed a lesson plan
- Tested and revised it through three iterations
- Improved the lesson plan and materials based on experience
- Presented the result to K-12 teachers with warm reception