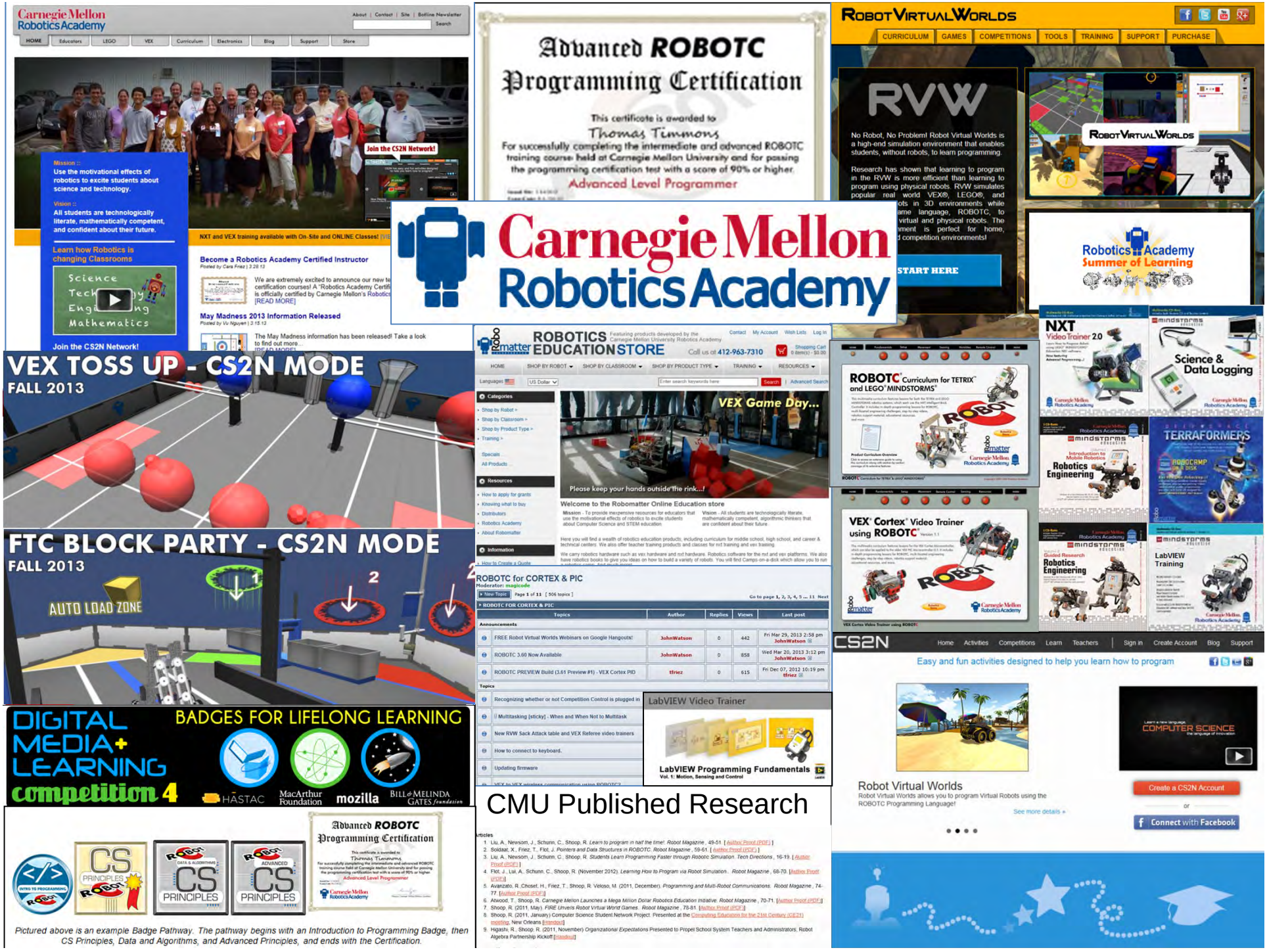
Robot Virtual Programming Games that work with NXT-G, LabVIEW, and ROBOTC

What We Will Cover Today

- Introduction
- What are Robot Virtual Worlds
- Research behind Teaching Programming with RVWs
- RVW Resources and Demonstrations
  - Competition Resources
  - Demo of NXT and LabVIEW in RVW
  - Math Tool Integration
  - Level Builder
  - Model Importer
- Recruit Schools and Teachers for our Research Project


Carnegie Mellon Robotics Academy
Advanced ROBOTC Programming Certification
This certificate is awarded to
Thomas Timmons
For successfully completing the intermediate and advanced ROBOTC training course held at Carnegie Mellon University and for passing the programming certification test with a score of 90% or higher.
Advanced Level Programmer
ROBOTVIRTUALWORLDS
CURRICULUM GAMES COMPETITIONS TOOLS TRAINING SUPPORT PURCHASE
RVW
No Robot, No Problem! Robot Virtual Worlds is a high-end simulation environment that enables students, without robots, to learn programming.
Research has shown that learning to program in the RVW is more efficient than learning to program using physical robots. RVW simulates popular real world VEX®, LEGO®, and
ots in 3D environments while
ame language, ROBOTC, to
virtual and physical robots. The
ment is perfect for home,
competition environments!
START HERE
Carnegie Mellon Robotics Academy
Mission ::
Use the motivational effects of robotics to excite students about science and technology.
Vision ::
All students are technologically literate, mathematically competent, and confident about their future.
Learn how Robotics is changing Classrooms
Science
Mathematics
Join the CS2N Network!
Join the CS2N Network!
NXT and VEX training available with On-Site and ONLINE Classes!
Become a Robotics Academy Certified Instructor
May Madness 2013 Information Released
The May Madness information has been released! Take a look to find out more...
Carnegie Mellon Robotics Academy
ROBOTICS EDUCATION STORE
Call us at 412-963-7310
HOME SHOP BY ROBOT SHOP BY CLASSROOM SHOP BY PRODUCT TYPE TRAINING RESOURCES
VEX Game Day...
Please keep your hands outside the rink...!
Welcome to the Robomatter Online Education store
ROBOTC Curriculum for TETRIX and LEGO MINDSTORMS
NXT Video Trainer 2.0
Science & Data Logging
Introduction to Mobile Robotics
Robotics Engineering
TERRAFORMERS
ROBOCAMP
VEX Cortex Video Trainer using ROBOTC
Robotics Engineering
LabVIEW Training
VEX TOSS UP - CS2N MODE
FALL 2013
FTC BLOCK PARTY - CS2N MODE
FALL 2013
AUTO LOAD ZONE
ROBOTC for CORTEX & PIC
Moderator: magicode
Topics Author Replies Views Last post
Announcements
FREE Robot Virtual Worlds Webinars on Google Hangouts! JohnWatson 0 442 Fri Mar 29, 2013 2:58 pm JohnWatson
ROBOTC 3.60 Now Available JohnWatson 0 858 Wed Mar 20, 2013 3:12 pm JohnWatson
ROBOTC PREVIEW Build (3.61 Preview #1) - VEX Cortex PID tfriez 0 615 Fri Dec 07, 2012 10:19 pm tfriez
Topics
Recognizing whether or not Competition Control is plugged in
Multitasking [sticky] - When and When Not to Multitask
New RVW Sack Attack table and VEX Referee video trainers
How to connect to keyboard.
Updating firmware
LabVIEW Video Trainer
LabVIEW Programming Fundamentals
Vol. 1: Motion, Sensing and Control
CS2N
Home Activities Competitions Learn Teachers Sign in Create Account Blog Support
Easy and fun activities designed to help you learn how to program
Robot Virtual Worlds
Robot Virtual Worlds allows you to program Virtual Robots using the ROBOTC Programming Language!
See more details »
COMPUTER SCIENCE
Create a CS2N Account
or
Connect with Facebook
DIGITAL MEDIA+ LEARNING competition 4
BADGES FOR LIFELONG LEARNING
HASTAC
MacArthur Foundation
mozilla
BILL & MELINDA GATES foundation
Advanced ROBOTC Programming Certification
CS PRINCIPLES
CS PRINCIPLES
CS PRINCIPLES
Pictured above is an example Badge Pathway. The pathway begins with an Introduction to Programming Badge, then CS Principles, Data and Algorithms, and Advanced Principles, and ends with the Certification.
CMU Published Research
Articles
1. Liu, A., Newsom, J., Schunn, C., Shoop, R. Learn to program in half the time!. Robot Magazine , 49-51. [Author Proof (PDF)]
2. Soldaat, X., Friez, T., Flot, J. Pointers and Data Structures in ROBOTC. Robot Magazine , 59-61. [Author Proof (PDF)]
3. Liu, A., Newsom, J., Schunn, C., Shoop, R. Students Learn Programming Faster through Robotic Simulation. Tech Directions , 16-19. [Author Proof (PDF)]
4. Flot, J., Lui, A., Schunn, C., Shoop, R. (November 2012). Learning How to Program via Robot Simulation.. Robot Magazine , 68-70. [Author Proof (PDF)]
5. Avanzato, R, Choset, H., Friez, T., Shoop, R. Veloso, M. (2011, December). Programming and Multi-Robot Communications. Robot Magazine , 74-77. [Author Proof (PDF)]
6. Atwood, T., Shoop, R. Carnegie Mellon Launches a Mega Million Dollar Robotics Education Initiative. Robot Magazine , 70-71. [Author Proof (PDF)]
7. Shoop, R. (2011, May). FIRE Unveils Robot Virtual World Games. Robot Magazine , 78-81. [Author Proof (PDF)]
8. Shoop, R. (2011, January) Computer Science Student Network Project. Presented at the Computing Education for the 21st Century (CE21) meeting, New Orleans [Handout]
9. Higashi, R., Shoop, R. (2011, November) Organizational Expectations Presented to Propel School System Teachers and Administrators. Robot Algebra Partnership Kickoff [Handout]

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SCHOOL OF COMPUTER SCIENCE

THE ROBOTICS INSTITUTE

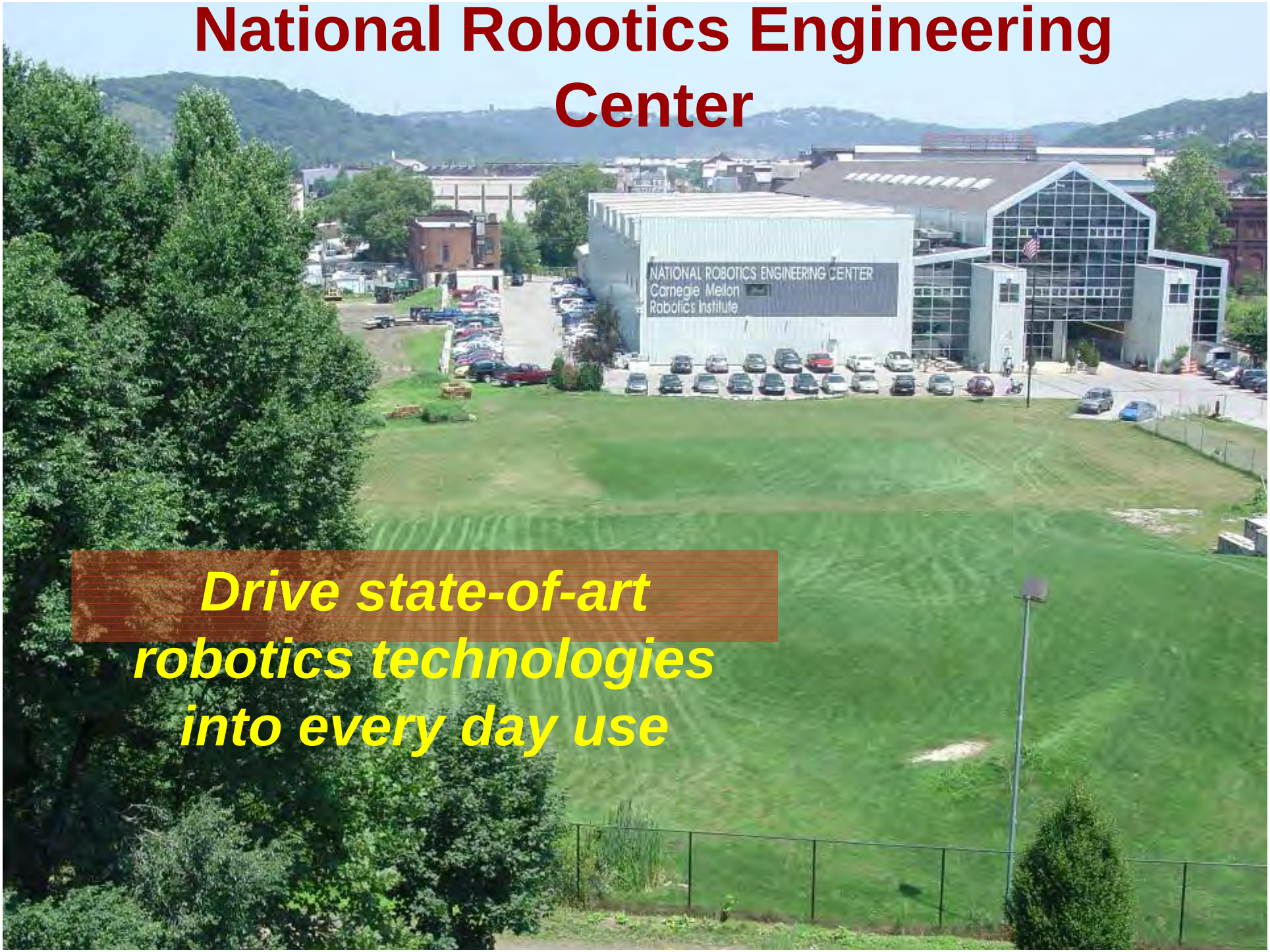
Basic robotic research

Applied robotic research

Carnegie Mellon
Robotics Academy

Educational robotic research

National Robotics Engineering Center



Drive state-of-art robotics technologies into every day use

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Worlds

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Computer Science is the Language of Innovation!

Transportation

- Electronic flight control systems (autopilot, fly-by-wire)
- Route planning (which planes/trucks, which routes)
- Inventory tracking (barcode scanners, RFID, satellites, web interface)
- Airport traffic control

Business & Finance

- High-speed stock trading (algorithms, online trading system)
- Business model and market simulations
- Accounting Software
- E-commerce/Credit Card Processing
- Internet Storefronts
- Router/Network Devices
- Video Monitors/Onscreen Displays

Health Care Equipment

- Heart Monitors
- CT Scanners
- Patient Monitoring
- Medicine

Security

- Security scanners (airports, sports arenas)
- Red light cameras
- Credit card fraud/theft detection
- Facial recognition and identification
- Border sensor networks

Green Homes/Buildings

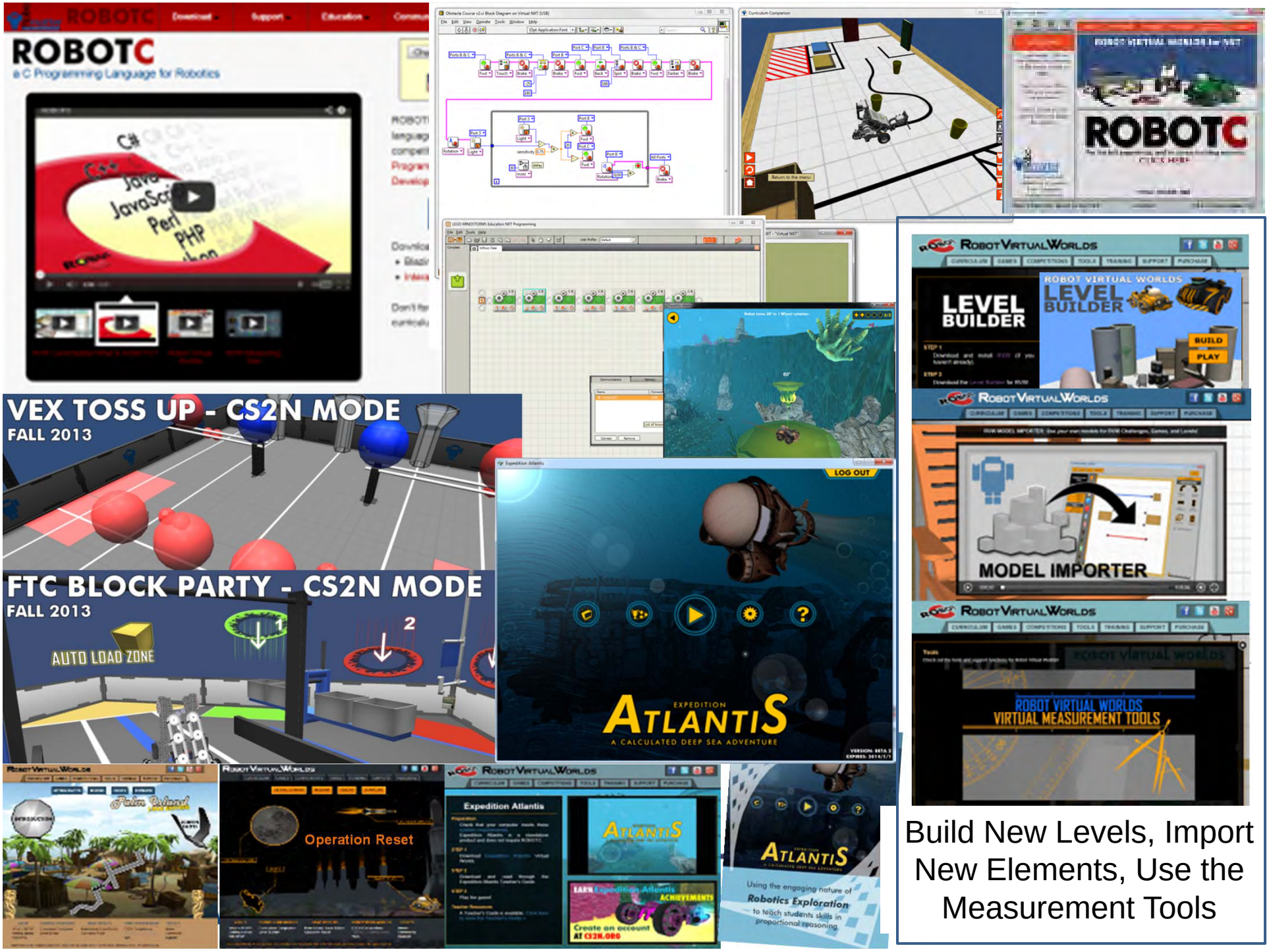
- "Quality of Life" Smart Homes
  - Remote access to senior citizen homes
  - Smart kitchens and bathrooms
  - Medicine dispensers and monitors
- Thermostats HVAC
- Solar/Wind/Geothermal Systems

Embedded Systems

- Cars
- Cell Phones
- Modern Appliances (microwaves, refrigerators, stoves, dryers, washers)
- Industry/Factory automation
- Robots
- CNC machinery

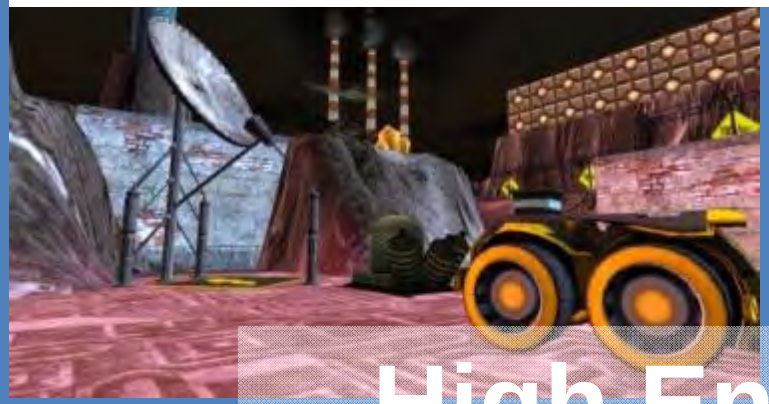
Entertainment Media

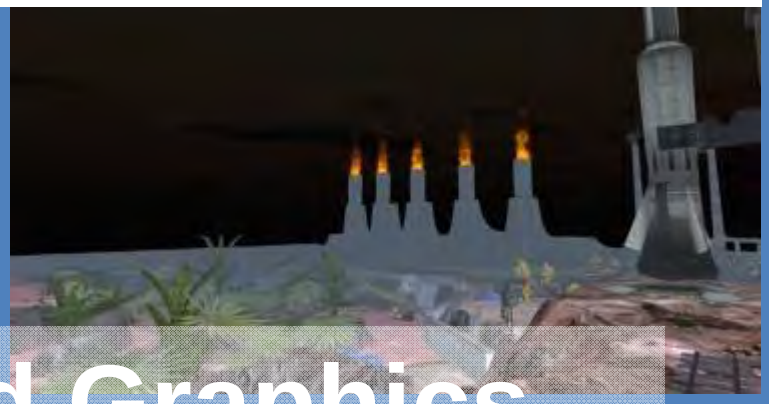
- Video games
- Special effects (algorithmic filters)
  3D crowd imagery (movies with lots of digital "extras")
- Motion capture



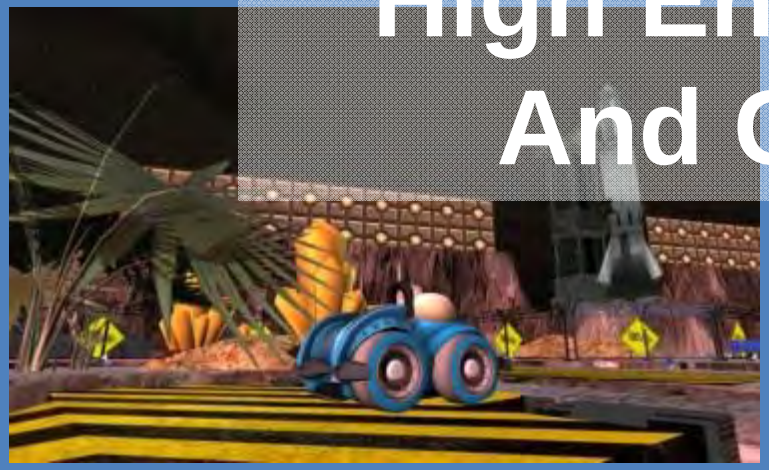
Build New Levels, Import New Elements, Use the Measurement Tools

Robot Virtual Programming Games that now work with NXT-G, LabVIEW, and ROBOTC



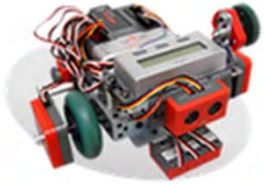


High End Graphics And Gamelike



Story Driven Gameplay

Description of the Research



We recruited a teachers that:

- Taught multiple sections of Level One robotics during the same semester
- Agreed to use the same curriculum in each section
  - Use the same tests, challenges, and lectures.
- Agreed to have all students take pre and posttests
- Agreed to have one class use Robot Virtual World simulations and have the other class use physical robots

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Research Results

Students Learn Programming Faster Through Robotic Simulation

By Alison Liu, Jeff Newsom, Chris Schunn, and Robin Shoop

ROBOTIC systems are everywhere—we just don't call them robots. We call them cell phones, bank machines, cars, microwaves, the Internet. Robotic technologies are ubiquitous and are making it easier for people to drive cars, access money, find restaurants via their cell phone, or cook their food using a microwave. Robotic systems are possible because of computer science and sensing.

Schools everywhere are using robotics education to engage kids in applied science, technology, engineering, and mathematics (STEM) activities, but teaching programming can be challenging due to lack of resources. This article reports on using Robot Virtual Worlds (RVW) and curriculum available on the Internet to teach robot programming.

It also reports the results of a research study that compared the test scores of students learning to program LEGO and VEX robots using virtual robots versus physical robots. The study was conducted by Carnegie Mellon University's Robotics Academy and the University of Pittsburgh's Learning Research and Development Center, and the results proved to be positive from both a teaching and learning perspective. This study builds on numerous studies involving teaching novice programming using robots (Roberts et al., 2011).

Reports indicate that the U.S. increasingly does not meet its own demand for CS professionals, and as a consequence has to rely on foreign-born talent (National Science Board, 2010; ScienceDaily, 2007). Since many secondary schools in the U.S. offer few if any computer science courses (Goldweber & Stephenson, 2008; Robelen, 2010), this trend will likely continue. For example, a 2008 survey showed a drop in the percentage of secondary schools providing CS courses from 78% in 2005 to 45% in 2008 (CSTA, 2008).

In part, the focus on high-stakes testing topics coupled with increased emphasis on Advance Placement courses has squeezed out coursework in many areas, including computer science. In addition, the sophistication of systems that students use on a regular basis is so far

The Brains of the System

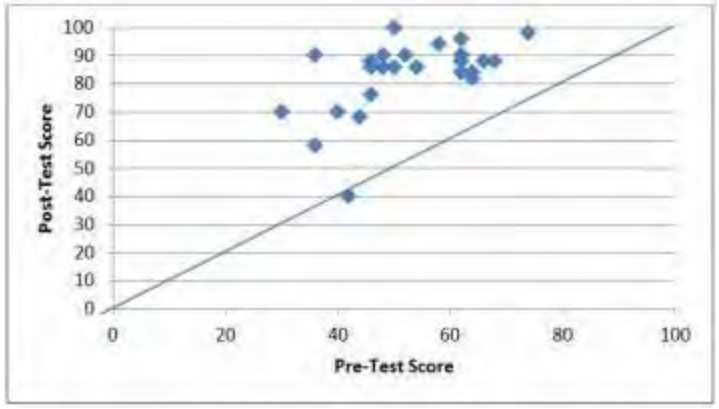
The brains of robotic systems are driven by computer science (CS) and the computational thinking that CS education produces. CS will play a key role in nearly all future innovation, including advancements across all STEM fields, but the United States has entered a significant national decline in the number of college graduates with basic and advanced CS-STEM degrees. This downward trend is particularly pronounced in CS (CRA, 2008).

Scene from the Operation Reset programming game

A LEGO Mixing Bot

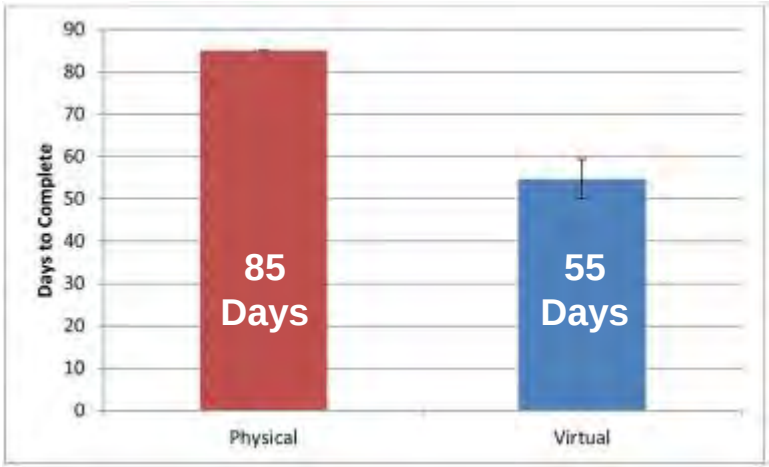
Alison Liu is a graduate student, the University of Pittsburgh. Jeff Newsom is a technology teacher, Penn Trafford High School, Pittsburgh, PA. Chris Schunn is a cognitive scientist, the University of Pittsburgh, and Robin Shoop is a former technology teacher and currently the director of Carnegie Mellon Robotics Academy.

16 techdirections • MARCH 2012



Pretest score vs posttest score. Points above the line improved on the posttest compared with the pretest.

Condition	Pre-Test Average	Post-Test Average	Average Time Taken
Physical	50.2 (*SD*=11.2)	82 (*SD*=10.6)	85.0 (*SD*=0.0)
Virtual	55.9 (*SD*=11.5)	84.5 (*SD*=14.6)	54.7 (*SD*=18.2)



Days taken to complete the course separated by condition.

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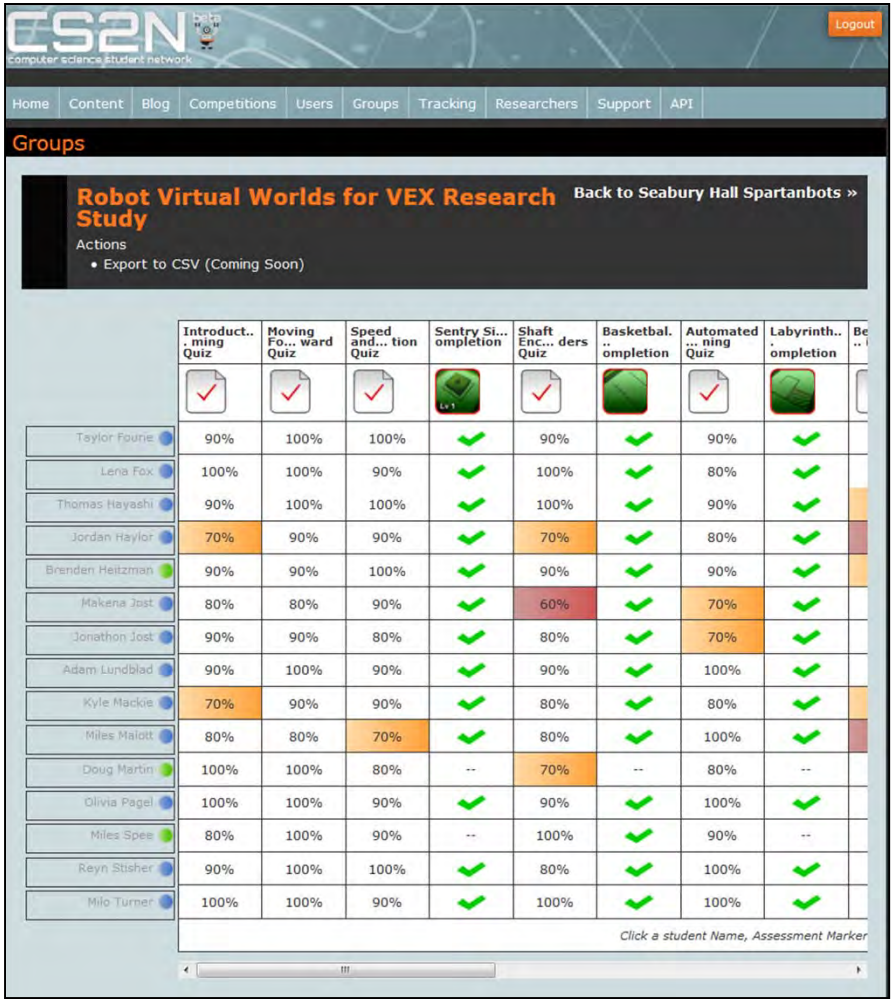
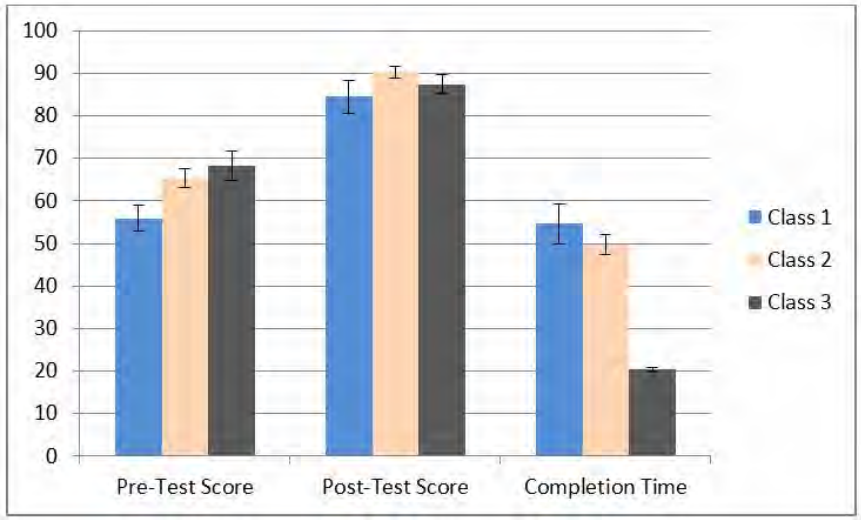
Research Results





We compared Jeff's class with two other CS2N internet based classes that were using only the RVW software and found:

- Similar gains between pre and posttest results.
- And similar amount of time to complete the curriculum in two of the three cases.

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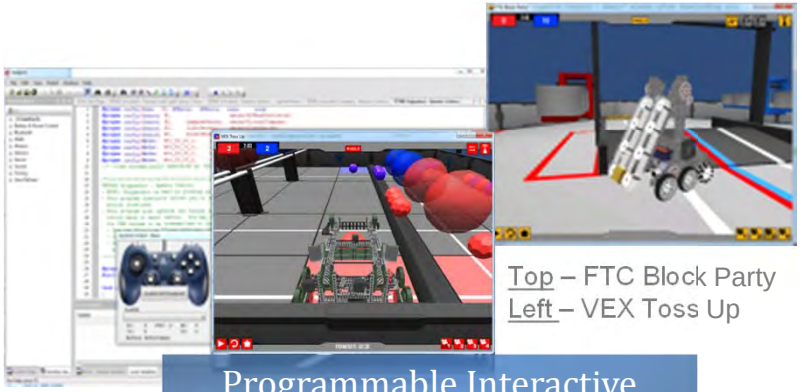
Robot Virtual World Technology

Links Virtual Worlds with Reality. Use the Same Language on Virtual and Real Robots



Top – FTC Block Party
Left – VEX Toss Up

Programmable Interactive Games w/multiple robot types

Story Driven Robot Programming Games

Scaffolded Fun *"Edutainment"* Environment to Teach Computer Science

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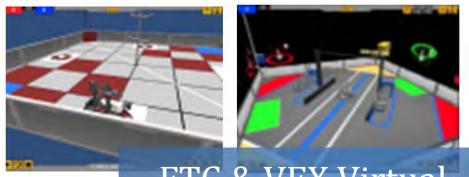
Tools to Teach Programming Using Virtual Robots

Current Game-Like Worlds

Palm Island

Ruins of Atlantis

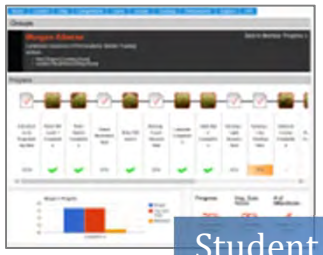
Operation Reset



FTC & VEX Virtual **Programming Only** Competitions

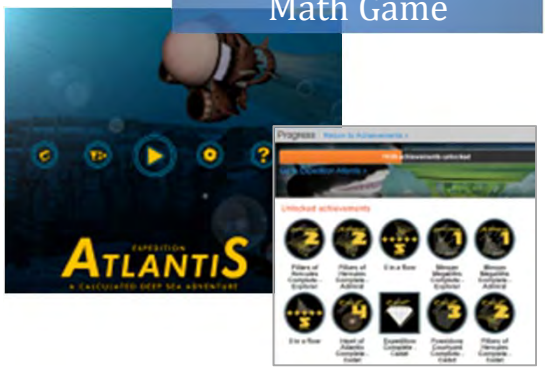
Automated Assessment Tools

RVW Curriculum Companion



Student Earn Badges

Expedition Atlantis Math Game



Certifying Teachers

Computer Science and Robotics Certification

- Algorithmic Thinking
- Syntax, Statements, and Structures
- Robot Mathematics
- Control and Feedback of Motors and Sensors
- Boolean Algebra/Conditional Statements
- Variables/Functions/Parameters
- Pedagogy
- Programming User Interfaces
  - Buttons
  - Joystick
- Troubleshooting/Debugging Code
- Arrays
- Case Statements
- Multi-Tasking
- Multi-Robot Communications
- Pointers
- Recursion

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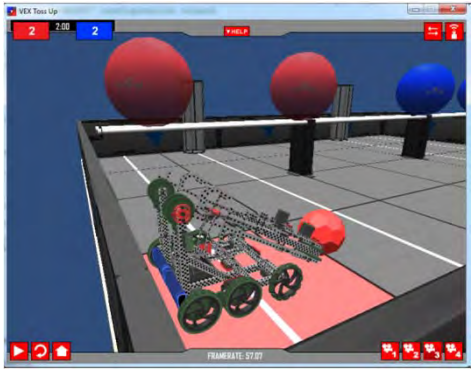
Resources for the Robotics Competition Community

Toss Up



Block Party

The Actual Game Simulation

A Modified Game that can be Challenged using Autonomous only mode

Supporting Teaching Programming in Classrooms

For the past two seasons we've made two versions of the game. At the top is the actual *FTC Game Simulation* that uses allows both autonomous and driver control.

At the bottom is a specially designed game that we've developed specifically to teach robot programming. *This game uses all of the elements of the FTC game, but includes additional features that allows the game to be challenged in an autonomous only mode.*

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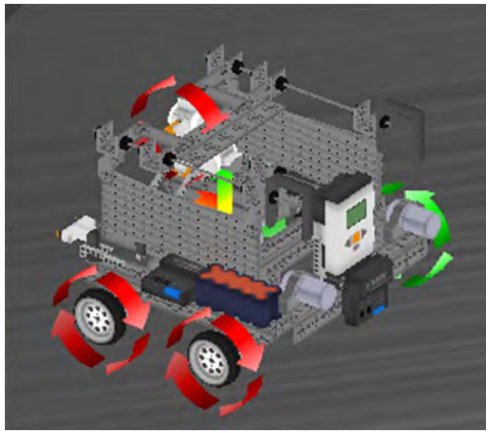
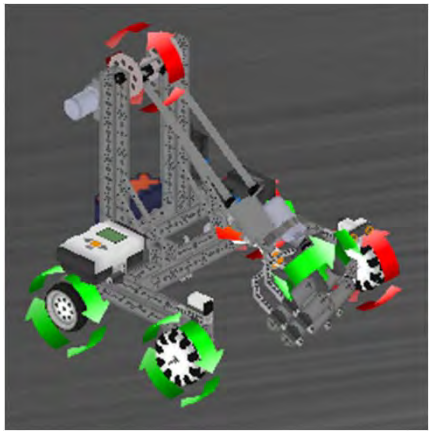
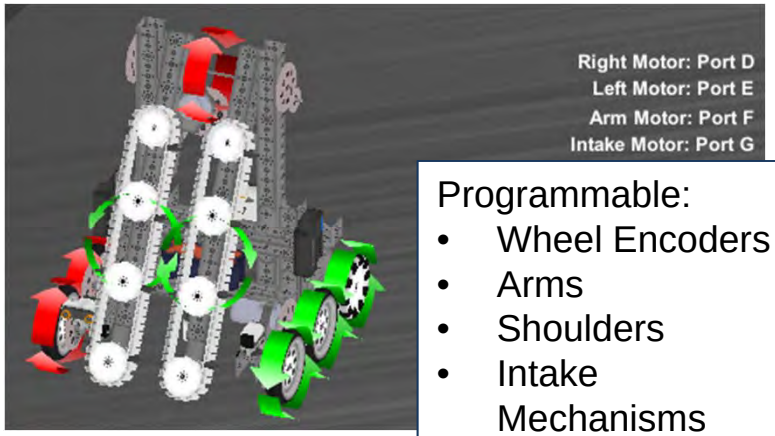
Multiple Programmable Robot Types

FTC Robots



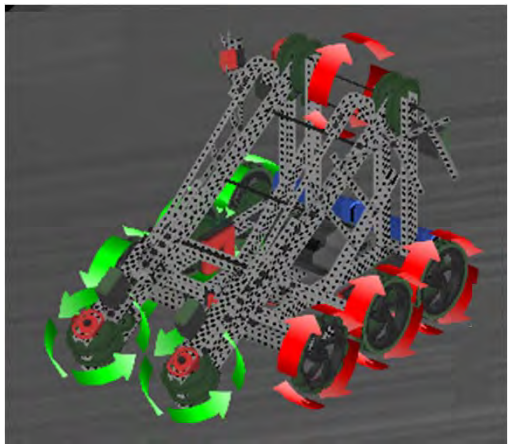


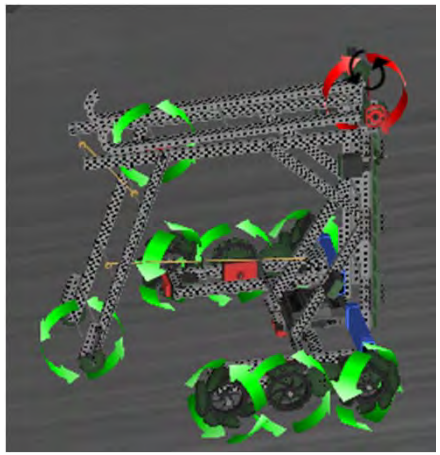


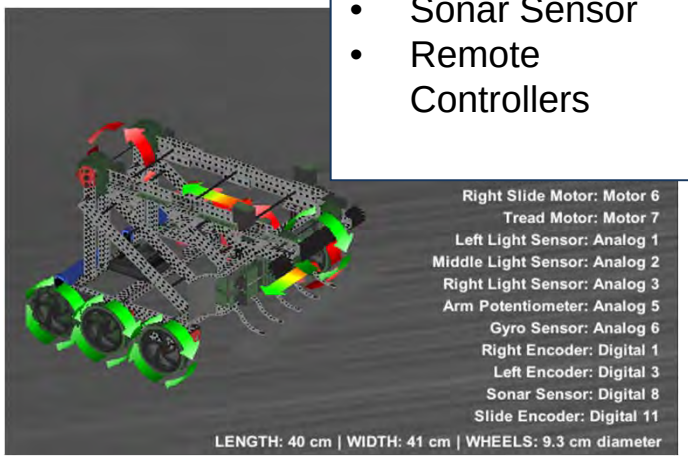
Programmable:

- Wheel Encoders
- Arms
- Shoulders
- Intake Mechanisms
- Gyro Sensor
- Light Sensor
- Sonar Sensor
- Remote Controllers

VEX Robots







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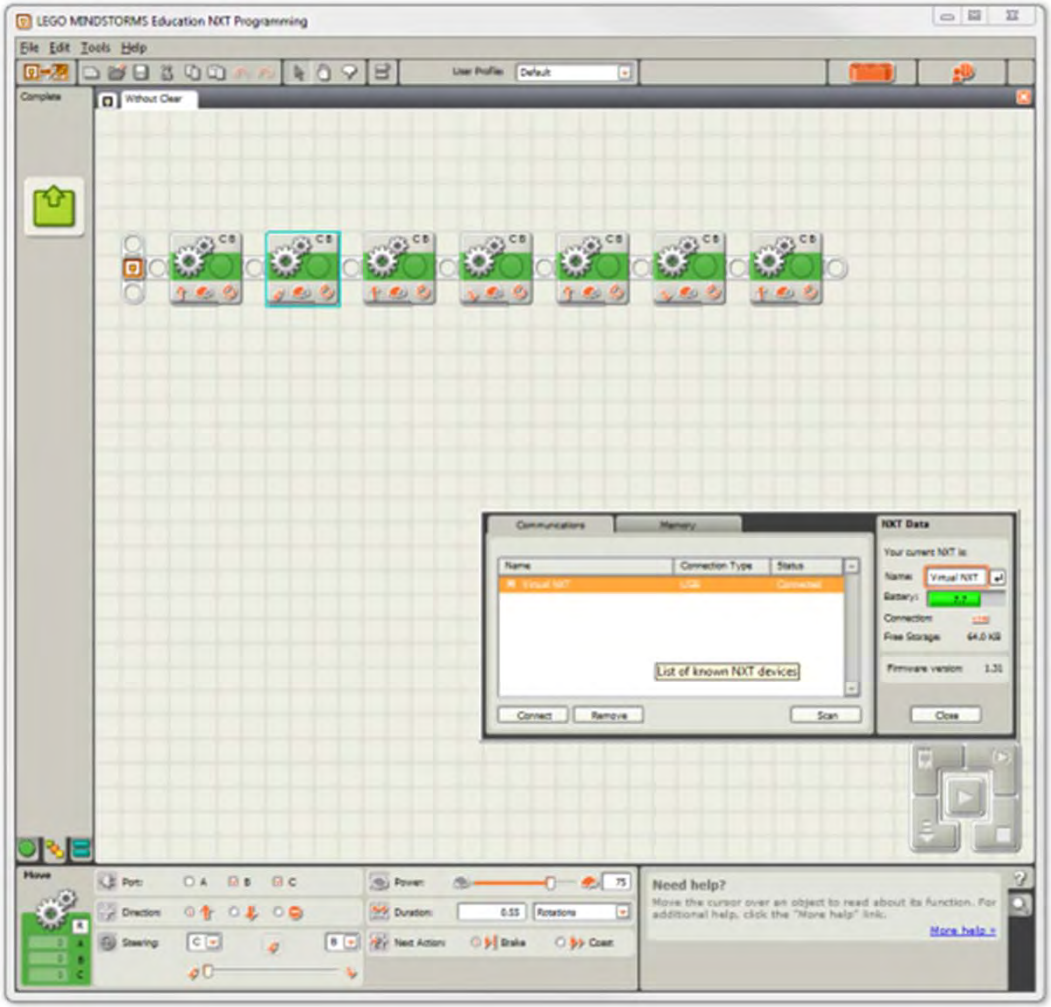
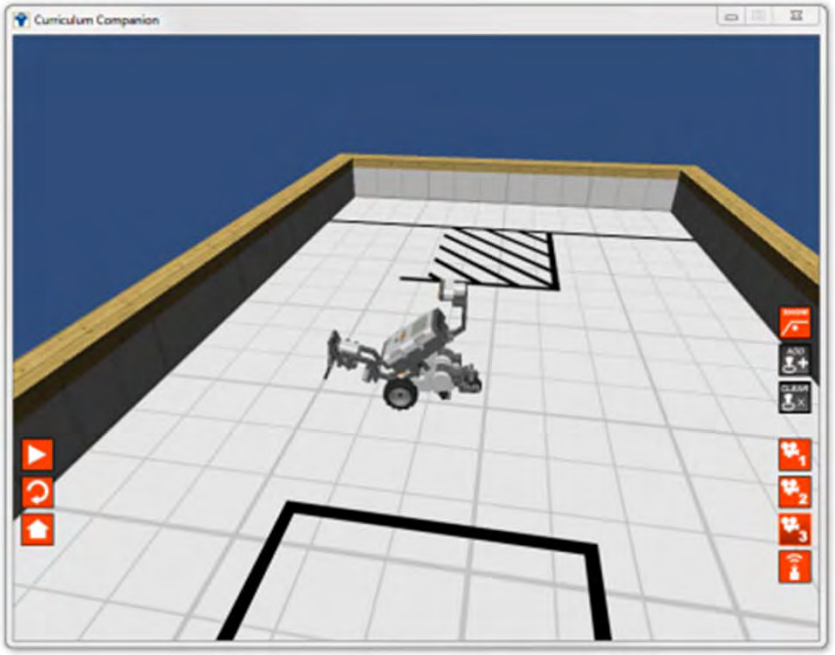
RVW NXT Software January 2014





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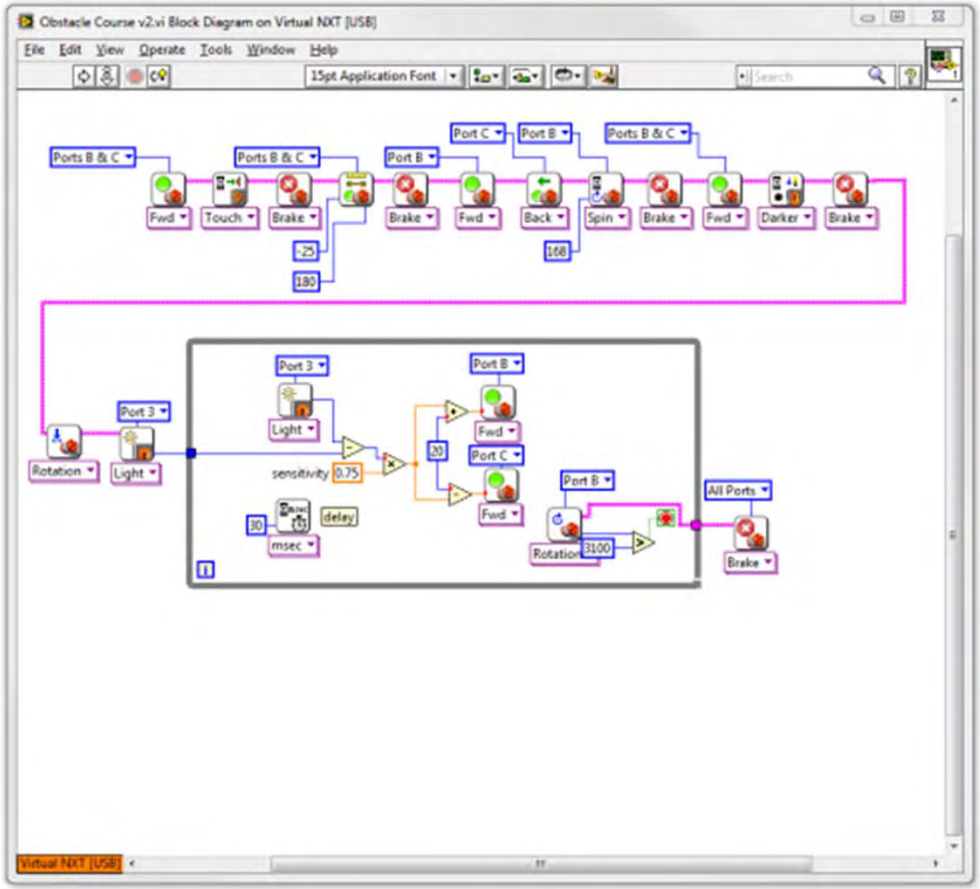
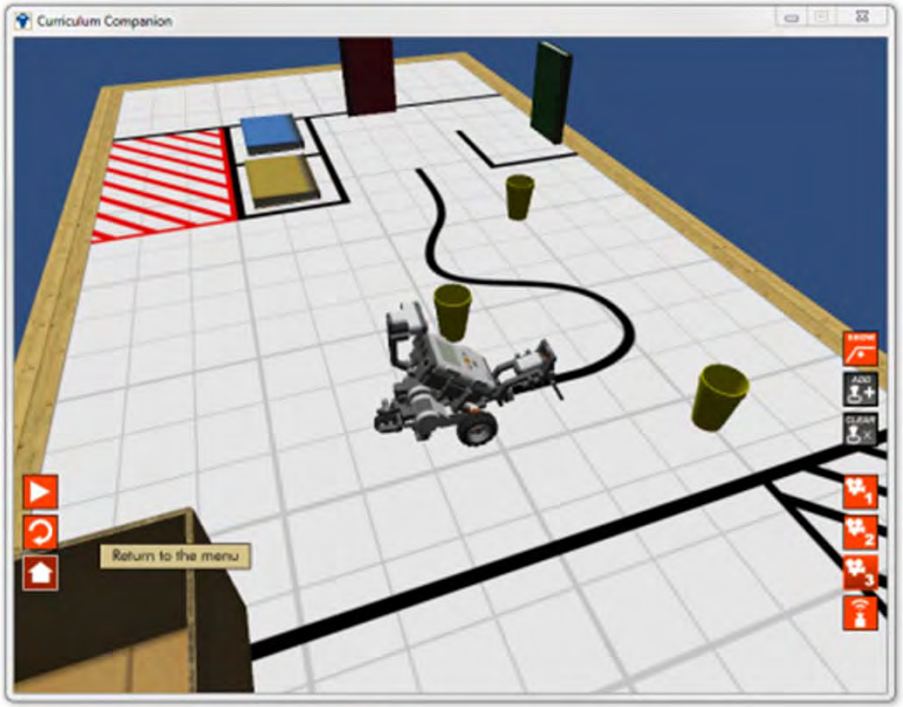
RVW LabVIEW Tools January 2014





Robomatter has been working with National Instruments and now has LabVIEW working with RVWs!

LabVIEW RVW Retail Pricing

Annual Single Seat - $49
Annual Team License - $149
Annual Classroom License - $299

Perpetual Single Seat - $79
Annual Team License - $299
Annual Classroom License - $599

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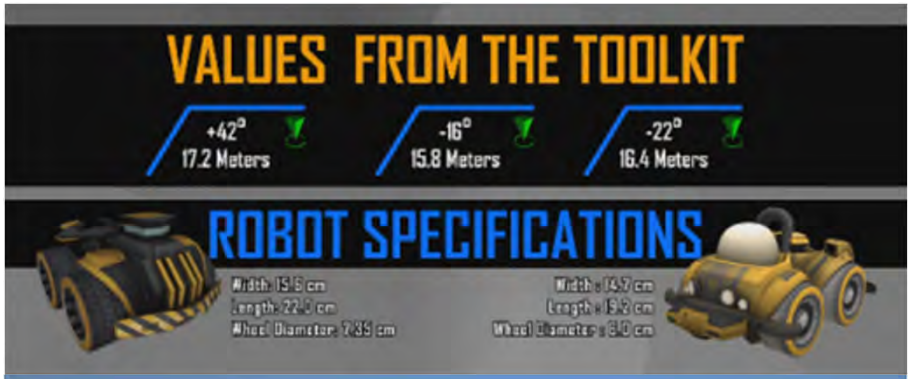
Additional Virtual Tools

RVW Measurement Tool Set

The measurement toolkit has been integrated into the curriculum companion and all robot programming games. This allows students to use virtual measurements allowing them to complete calculations BEFORE they program.

Picture taken from the Operation Reset Programming Game



Student have access to the Robot Specifications

The Expedition Atlantis game pictured at the right is specifically designed to use robotics to teach mathematics.

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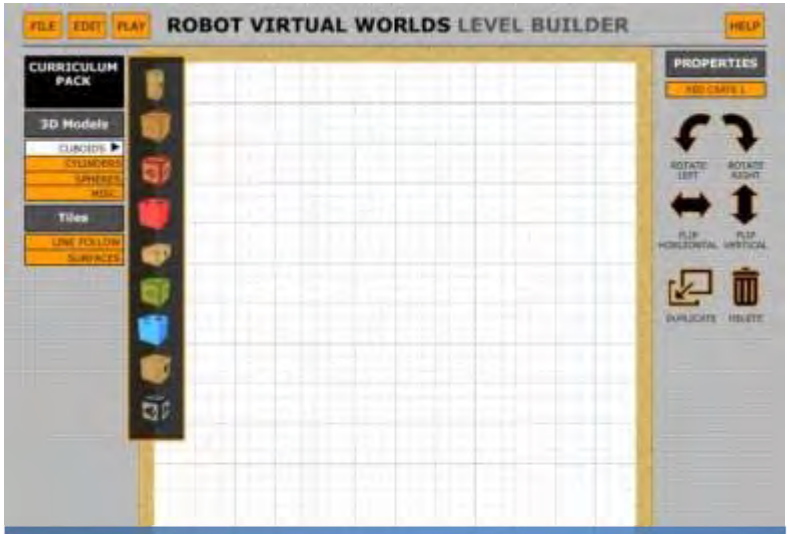
Additional Virtual Tools

RVW Level Builder/Robot Transformer

The Level Builder enables teachers and students to make their own challenges using models that already exist.

Pictured below is an example of the NEW Robot Transformer Technology. Students can swap out robot parts and use them in the game.

Picture above from the New Expedition Atlantis Game



The Level Builder Allows Students and Teachers to Create Programming Challenges

Examples of User-Created Worlds

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Additional Virtual Tools

RVW Model Importer

The Model Importer allows students to draw parts using a modeling software (i.e. PTC, Autodesk, Solidworks, or Google Sketchup) and save the part as an FBX file type and import that part into their custom Robot Virtual World.

Videos that show how this works can be found at: www.robotvirtualworlds.com

Create Your Own Parts and Import them into the world

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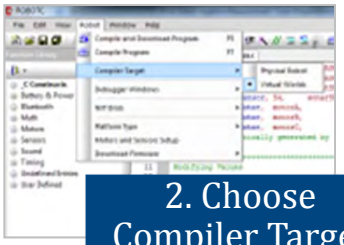
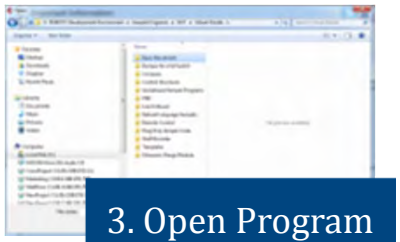
New Direct Launch File Type

Simplifies the user experience

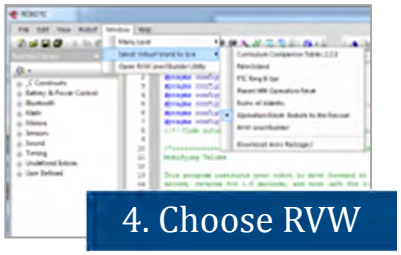
1. Open Software



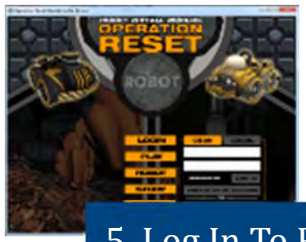
2. Choose Compiler Target



3. Open Program



4. Choose RVW



5. Log In To RVW

Older RVW software required the user to go through “six steps” to setup and play the game.

6. Play the Game

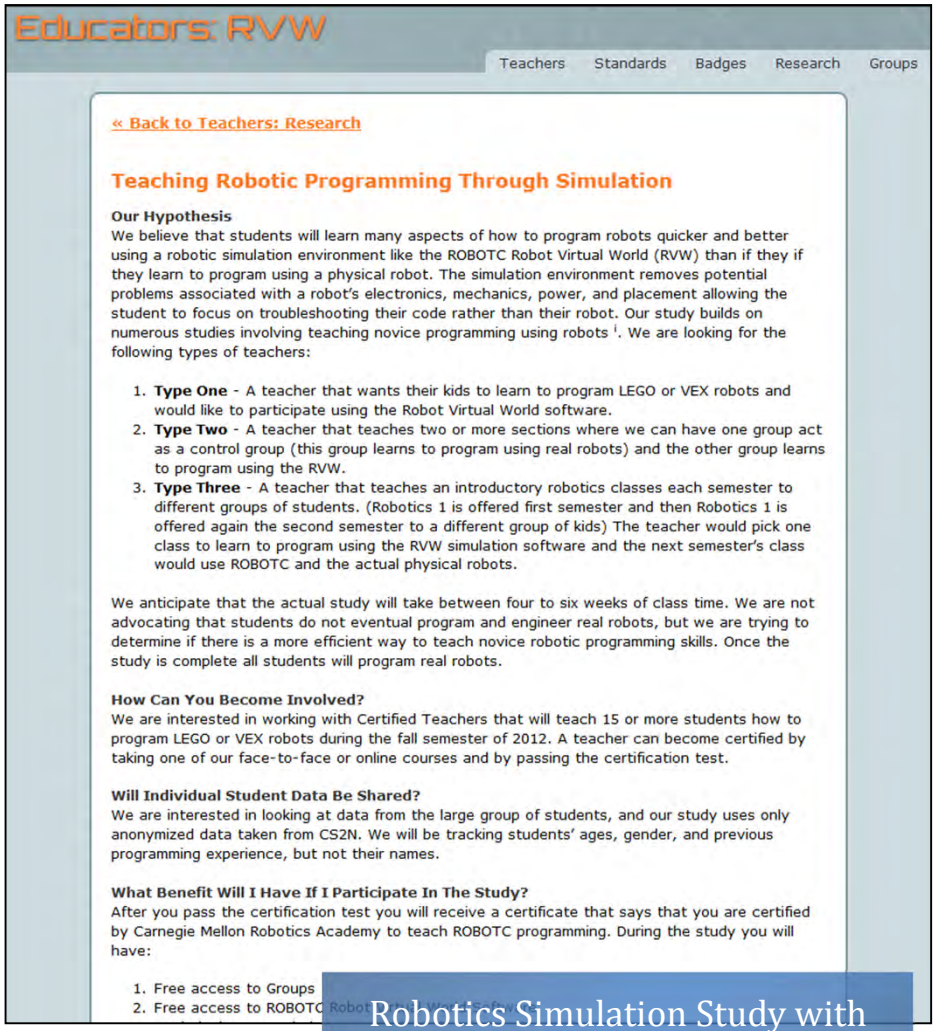
Select the File & Play the Game

The new “Direct Launch Type” that we are developing automatically:

1. Opens ROBOTC
2. Selects virtual robots
3. Opens the program
4. Selects the correct world
5. Selects the correct robot type
6. And places the robot in the world.

Using Groups for Research

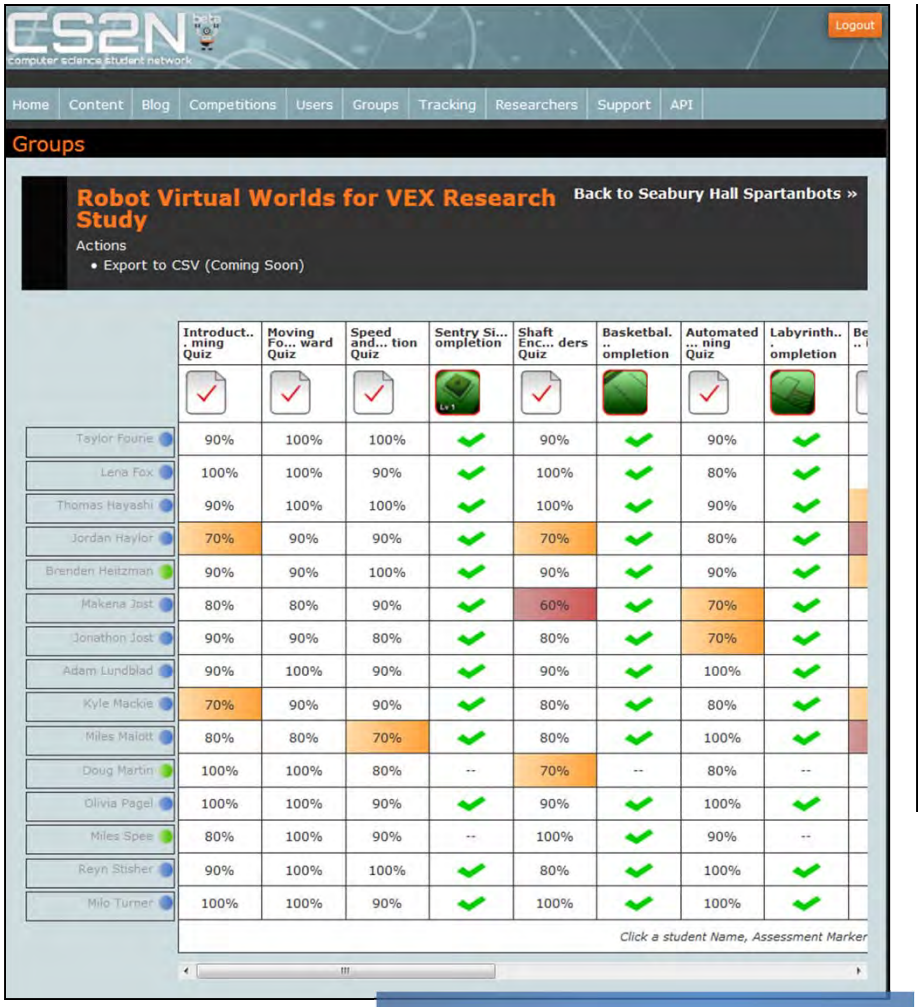
Published Research Can Be Found at:
http://www.cs2n.org/teachers/research



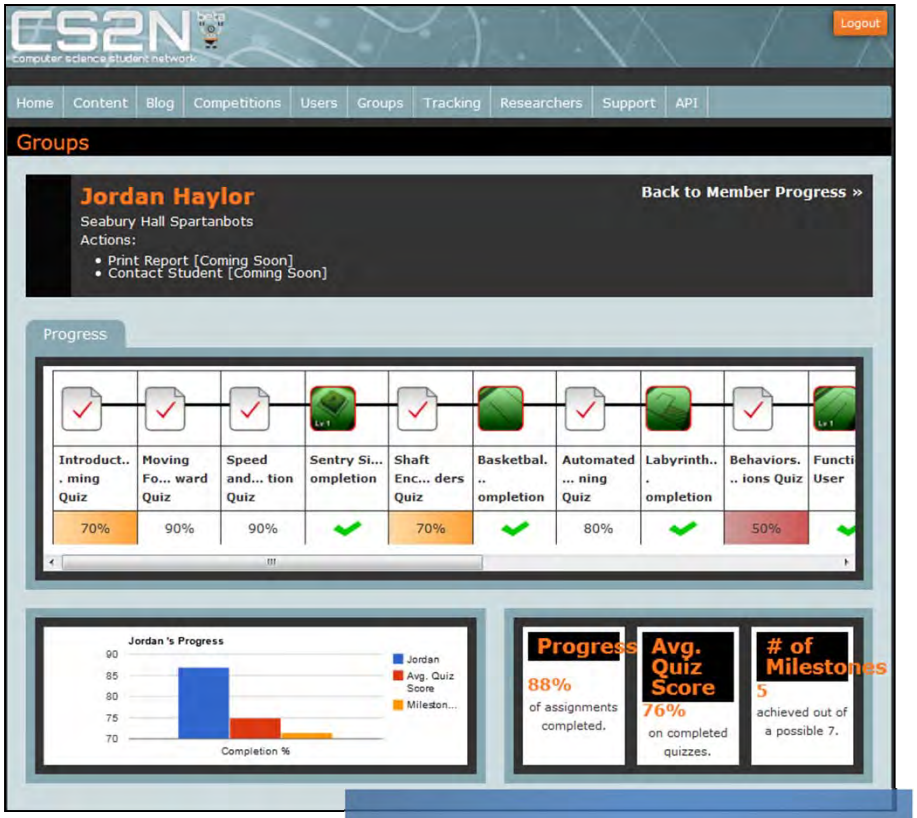
Robotics Simulation Study with Hundreds of Schools

Carnegie Mellon Robotics Academy

Teacher/Mentor Classroom View



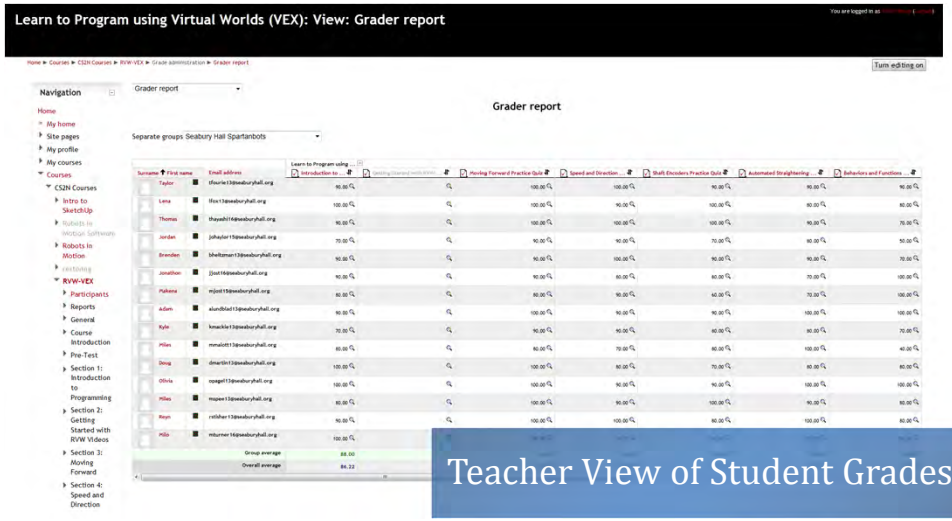
Member Progress Teacher View



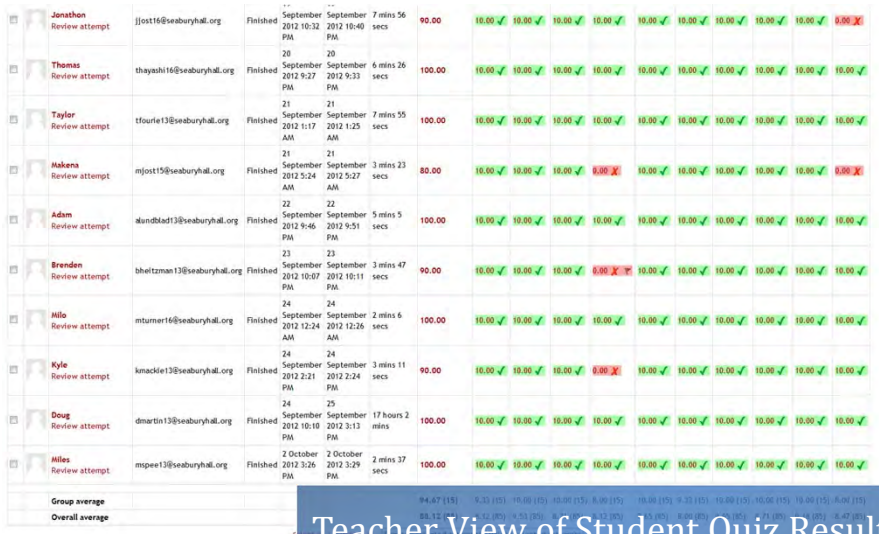
Individual Student Progress View

Carnegie Mellon Robotics Academy

Teacher Grade Book View



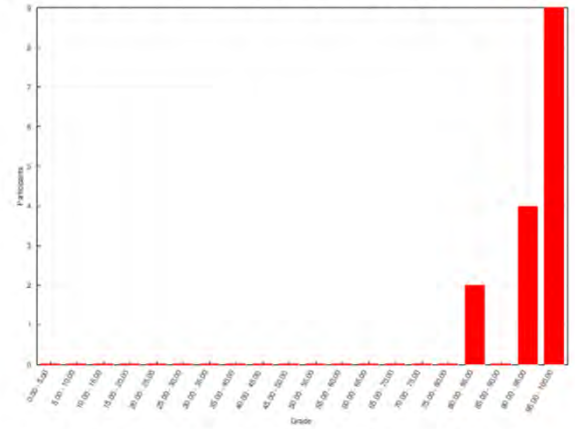
Teacher View of Student Grades



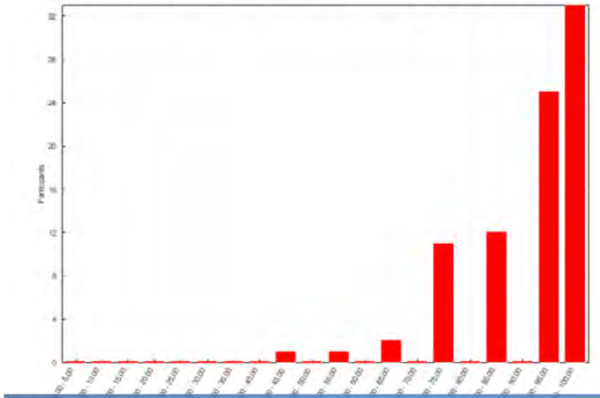
Teacher View of Student Quiz Results

Grade Distribution

Number of students in group achieving grade ranges



Overall number of students achieving grade ranges



Teacher View of Overall Results

Carnegie Mellon Robotics Academy

Computer Science Education Act – This Could Include Tech Ed

9/13/2013 – Referred to Subcommittee on Education

Future CS K-12STEM Offerings

CollegeBoard
inspiring minds

The College Board

Computer Science: Principles

Computational Thinking Practices

Big Ideas, Key Concepts, and Supporting Concepts

Computer Science: Principles is a pilot course under development. It is not an official Advanced Placement course currently being offered by the College Board.

This document is based upon work supported by the National Science Foundation, grant CNS-0938336. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The National Science Foundation Provides $5.2 Million Grant to Create New Advanced Placement® Computer Science Course and Exam

Innovative College-Level AP® Course Created To Increase Interest In Computing Degrees And Careers, Particularly Among Female And Minority Students

CollegeBoard

New Course and Exam — AP® Computer Science: Principles to Launch in Academic Year 2016–17

- Overview
- Development
- Higher Education Acceptance
- Curriculum and Assessment

The College Board plans to launch a new course, AP Computer Science Principles (CSP), in fall 2016, with the first AP CSP Exam scheduled to be administered in May 2017.

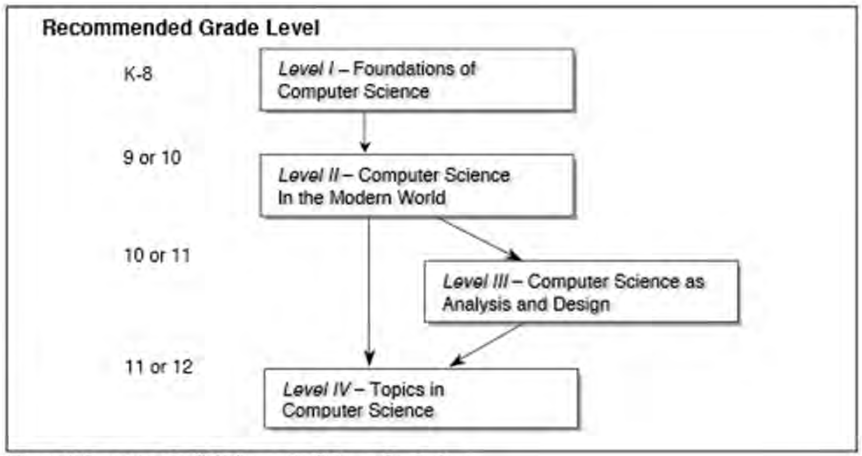
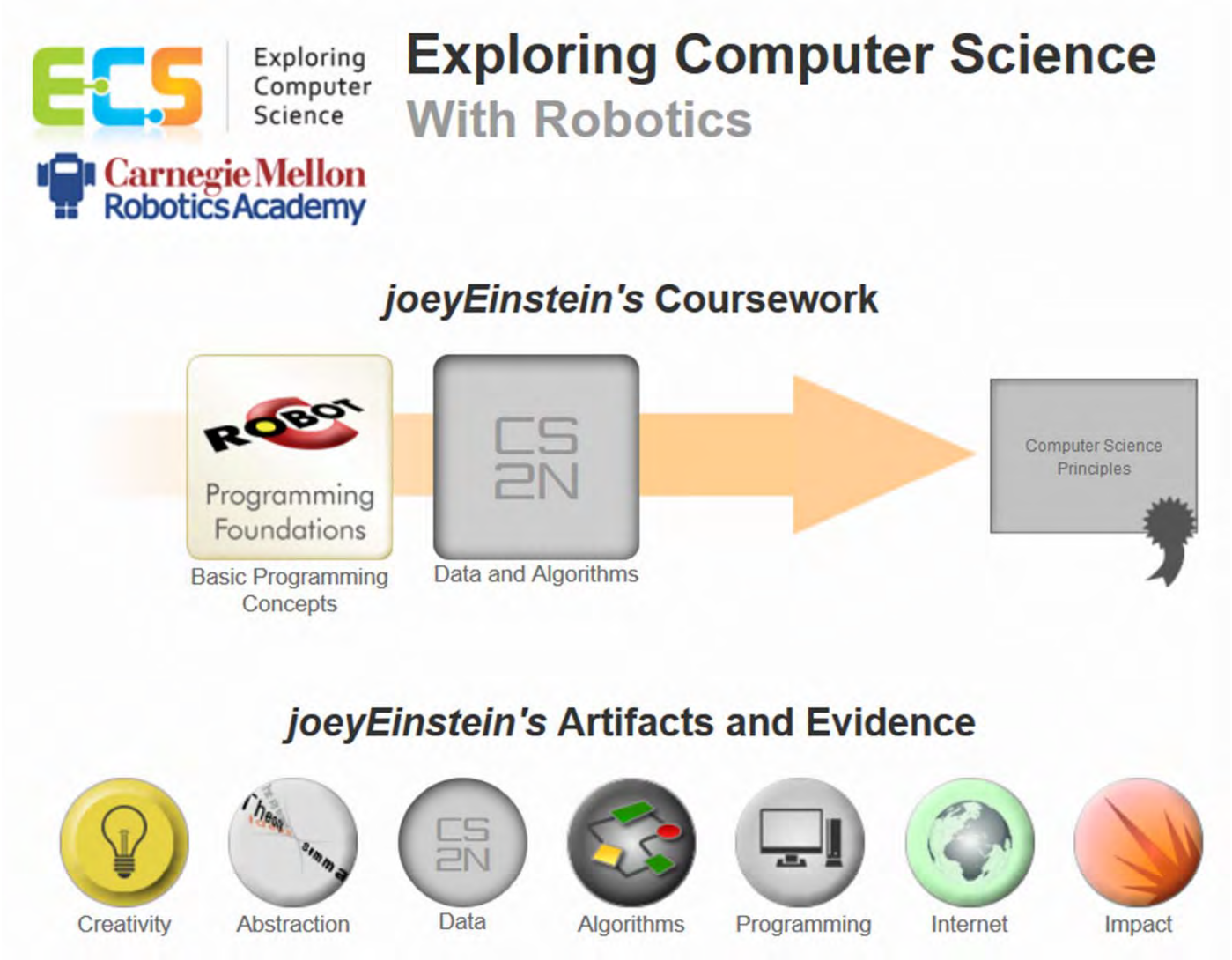


Figure 1. Structure of a K-12 Computer Science Curriculum

Carnegie Mellon Robotics Academy

This Could Be Us



Recruiting Partner Schools

To prepare over 1,000 Highly Competent robotics instructors able to *teach students how to use robotics as an organizer to teach students engineering process and introduce students to the CS Principles Computational Thinking* Practices identified as important for all students to understand (Astrachan, et al., 2009-2013); and to do so through their existing robotics classes.

Recruiting Partner Schools

Using Robotics to Teach Big Ideas of CS

The CS computational artifact for:

- Creativity could be: a robot, a webpage, a logo for their team;
- Abstraction: pseudocode, variables, or a map;
- Data: the human genome, statistics on global warming, or collecting feedback from sensors via data logging;
- Algorithms: a flowchart, an algebraic expression, or an algorithm they developed to calculate a threshold value.
- Programming: robots that complete a variety of tasks
- Internet and Impact: Robotics competitions also involve team organization, fundraising, marketing, and team promotion, providing additional opportunities for students to create computational artifacts.

What's in it for you?

- A Certification that could lead to Job Security
- Free training
- Free software
- An opportunity to be part of a research project

Certifying Coaches and Mentors

Online Training Tools

Online LMS

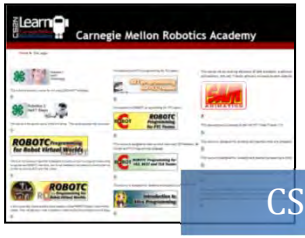
Extensive Resources

Competition Specific Tools

Automated Assessment Tools

RVW Curriculum Companion

CS2N Groups



CS2N Learns

RVW CS2N Login

The Certification

Computer Science and Robotics Certification

- Algorithmic Thinking
- Syntax, Statements, and Structures
- Robot Mathematics
- Control and Feedback of Motors and Sensors
- Boolean Algebra/Conditional Statements
- Variables/Functions/Parameters
- Pedagogy
- Programming User Interfaces
  - Buttons
  - Joystick
- Troubleshooting/Debugging Code
- Arrays
- Case Statements
- Multi-Tasking
- Multi-Robot Communications
- Pointers
- Recursion

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