stelar
STEM LEARNING AND RESEARCH CENTER

May 15, 2018
12:45-2pm

Preparing the Skilled Technical Workforce of the Future: How ITEST Projects Approach Dispositions and Skills

EDC Learning transforms lives.

Agenda

- Introductions
- 5-minute presentations
- Discussion
- Next Steps

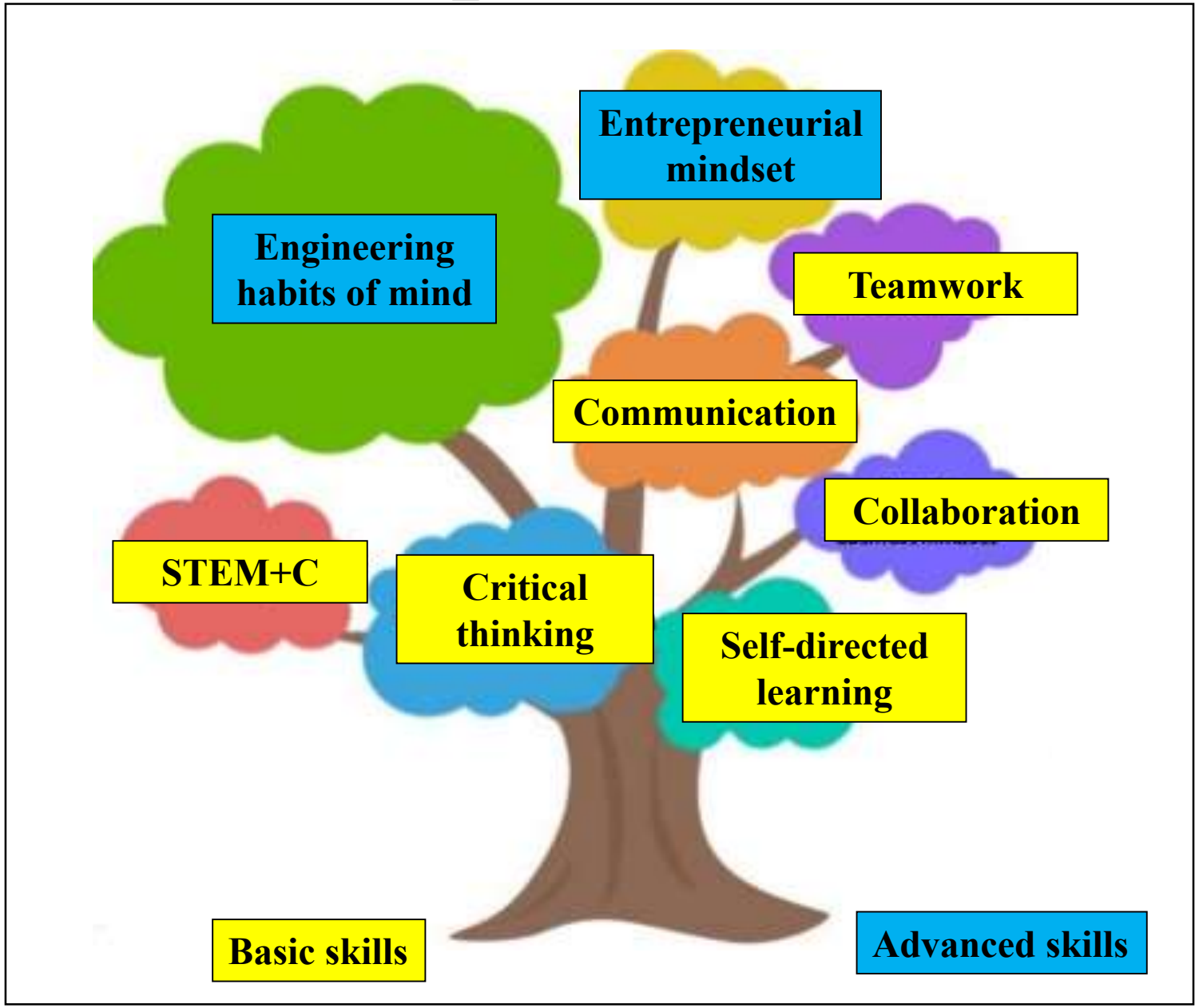
Vikram Kapila
New York University

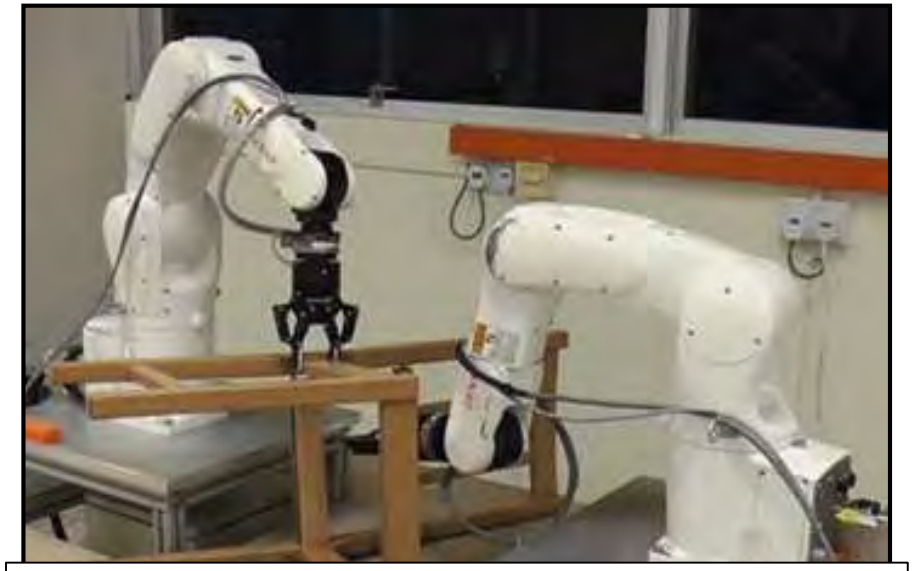
Human-Technology Frontier: Skills and Dispositions for Success

Vikram Kapila

DRL: 1614085

Skills & Dispositions for HTF





IKEA furniture

Hirebotics

Lawncare

AI and law

AI on beat

Online immersion vs. brick-and-mortar

The New York Times

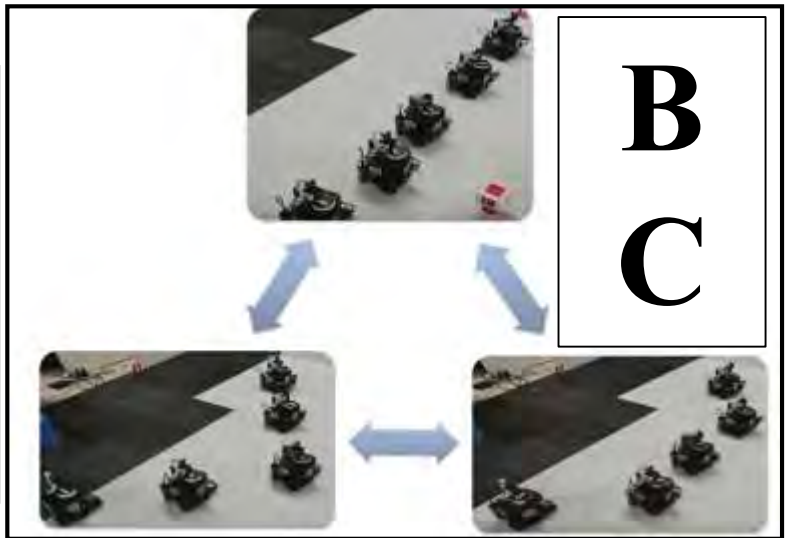
Cryptocurrencies Come to Campus

By NATHANIEL POPPER FEB. 8, 2018

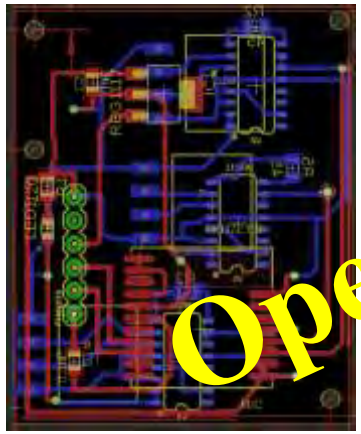
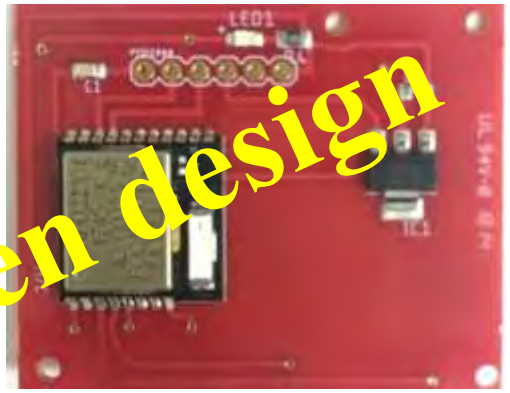
New York University students in a cryptocurrency course taught by David Yermack, a business and law professor. He had to find a bigger lecture hall for the 225 who signed up.

Blockchain: secure contracts, social networks, …

Tech Convergence @ NYU MCRL



Drivers of Disrupting Tech.



Open design



Com., low-cost

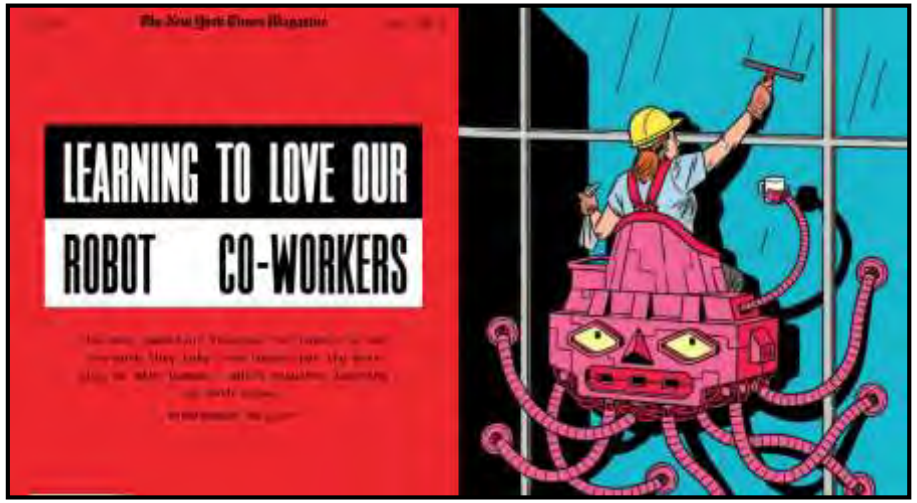

Making


Open source

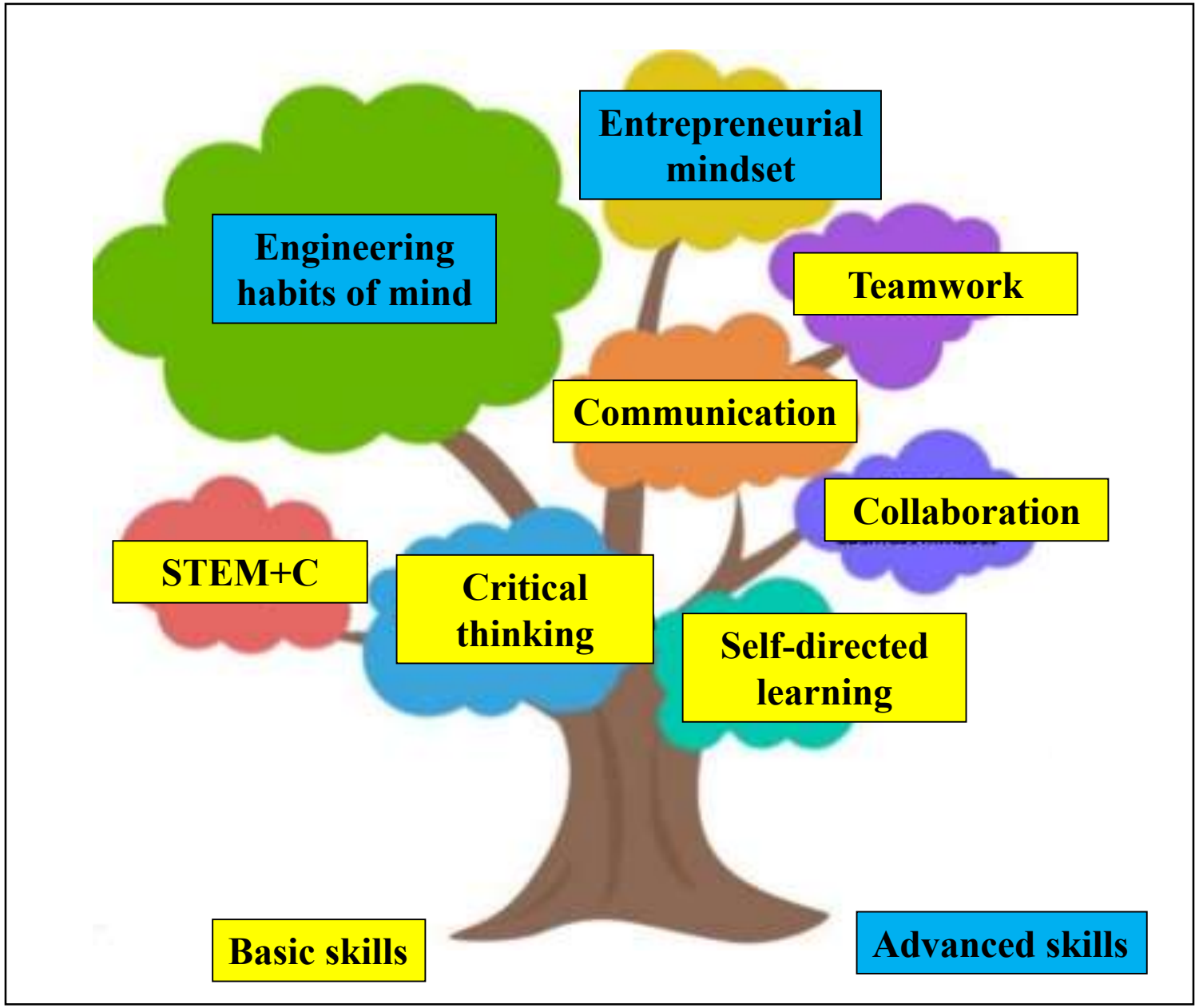
KHAN ACADEMY
coursera
edX
LEARN ZILLION

Adafruit, Thingiverse

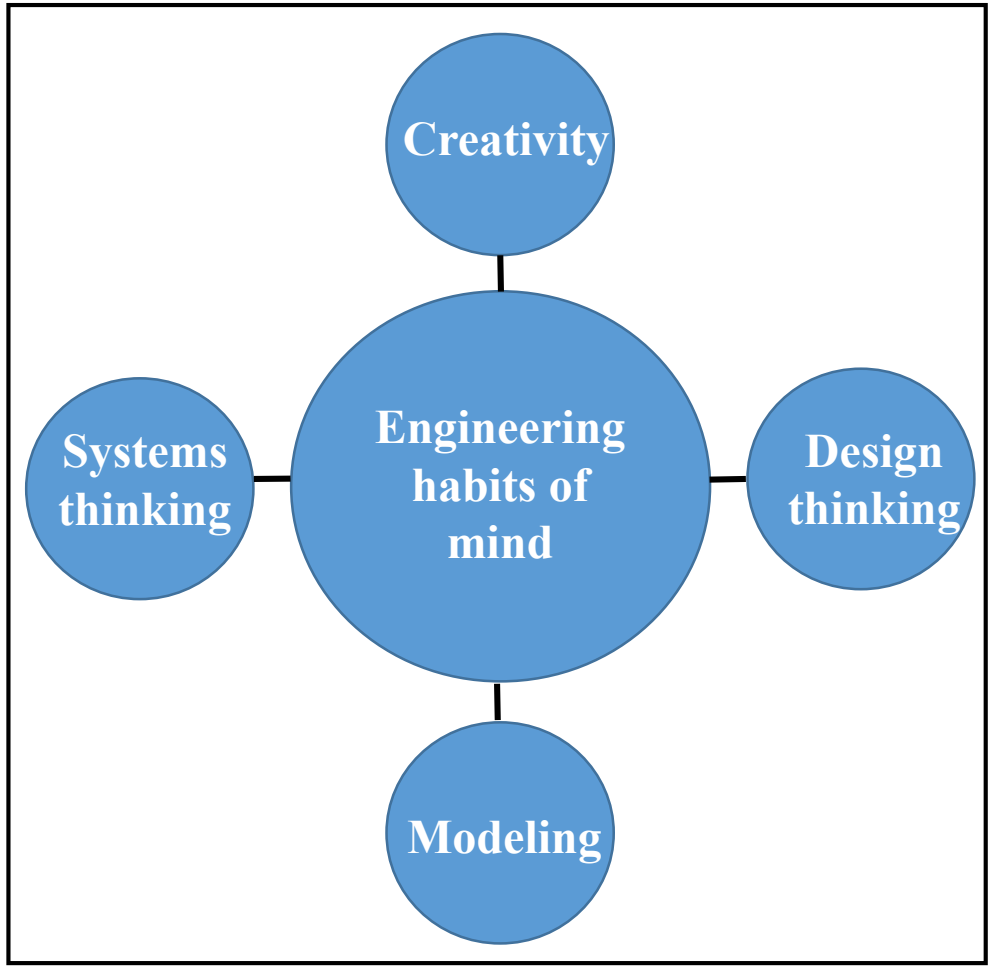
Humans @ Tech Frontier?

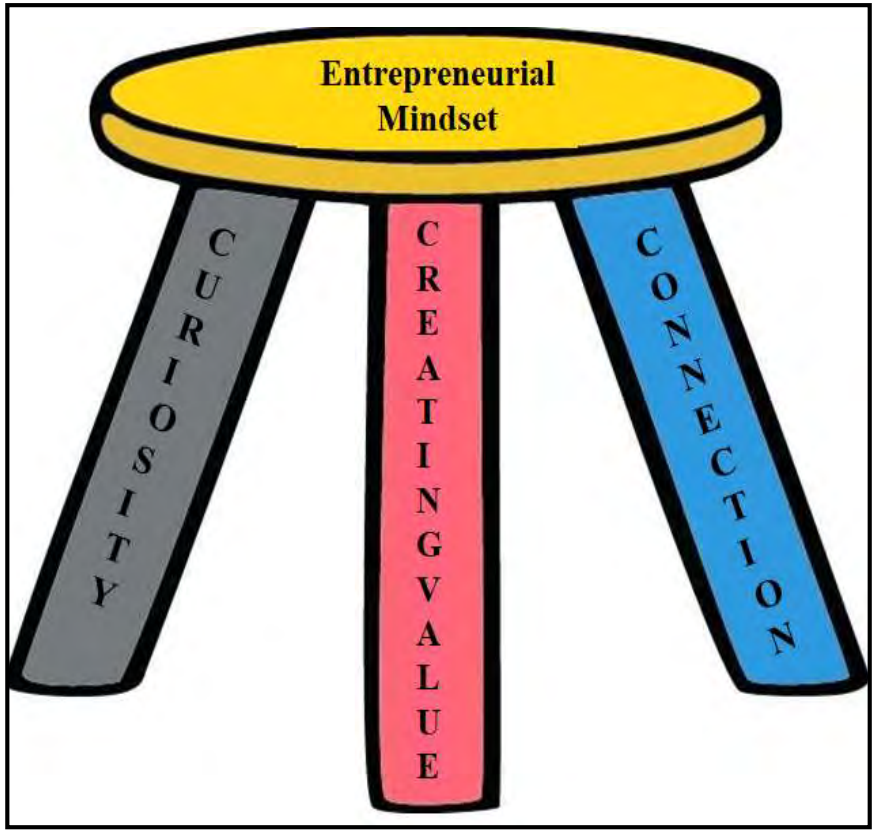


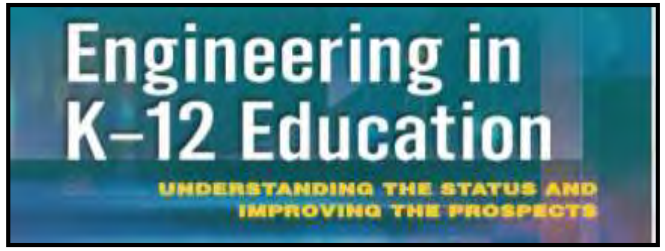
Skills & Dispositions for HTF



Advanced Skills & Dispositions

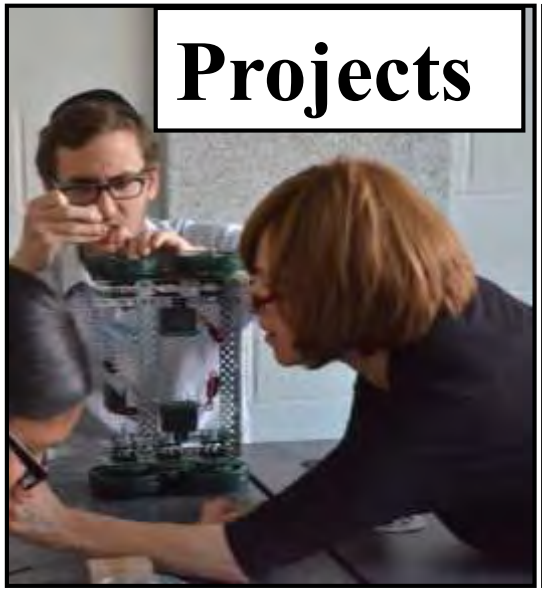




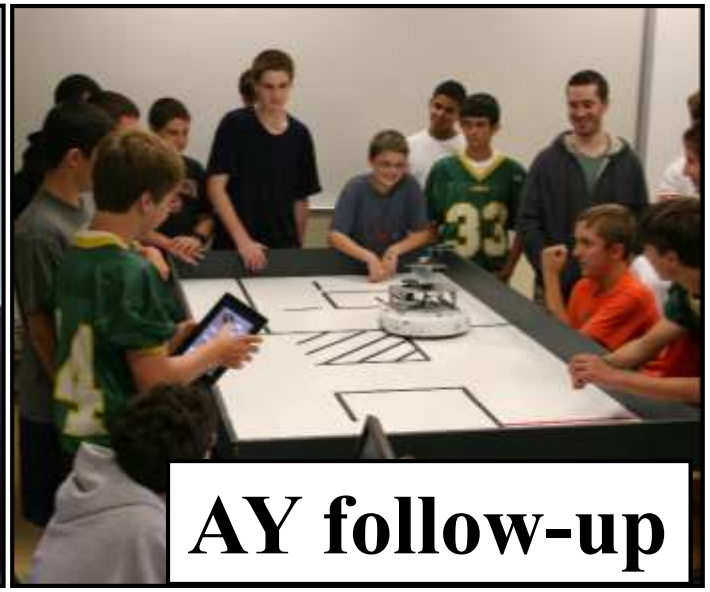


ITEST @ NYU Tandon

Guided learning

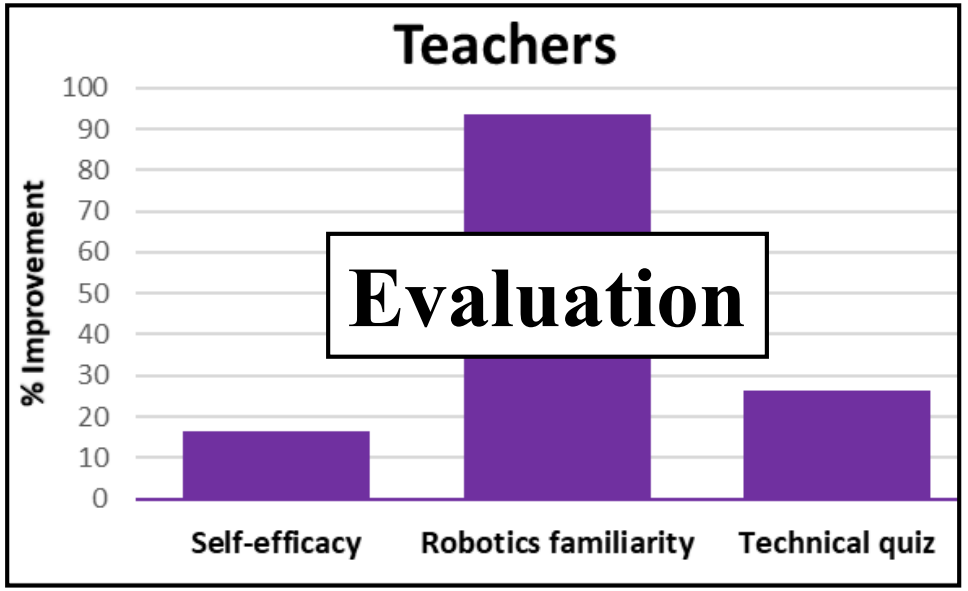


Projects



AY follow-up

Contest



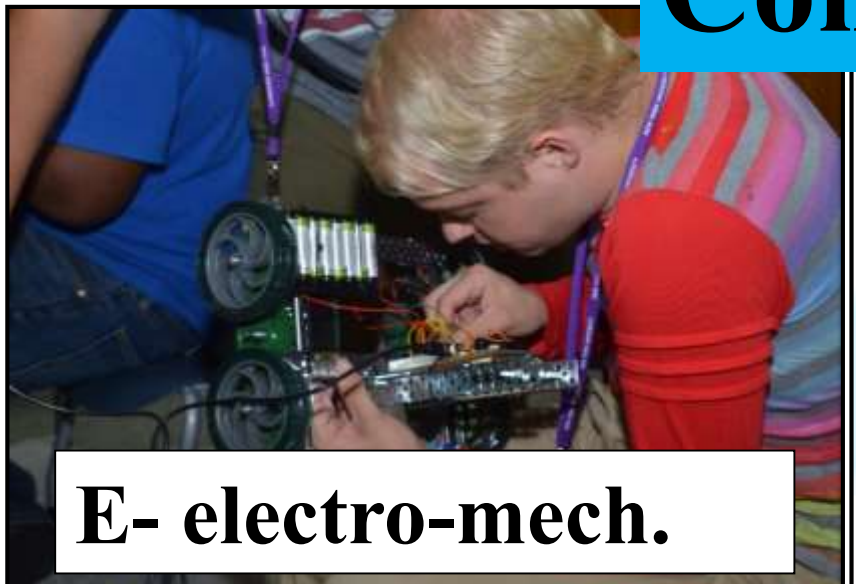
Evaluation

STEM Interest and Computational Thinking

S- operating principle

T,C- µC programming

Connection



E- electro-mech.

M- echo time to distance

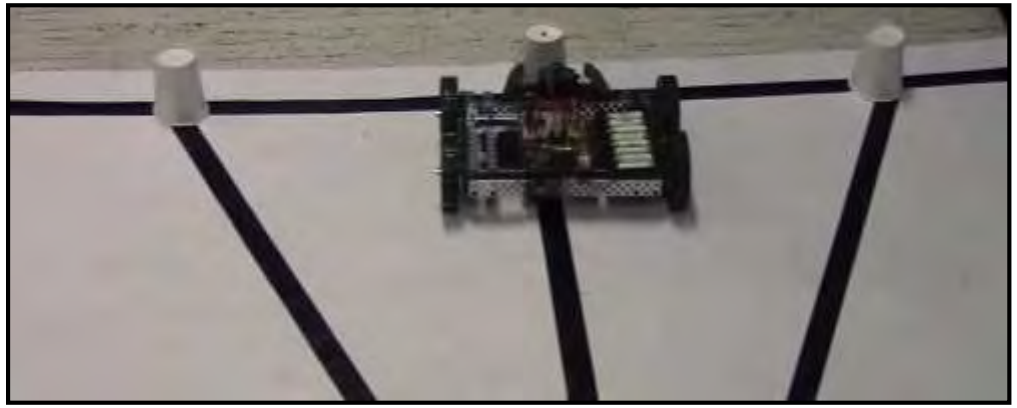
Communication

Collaborative planning

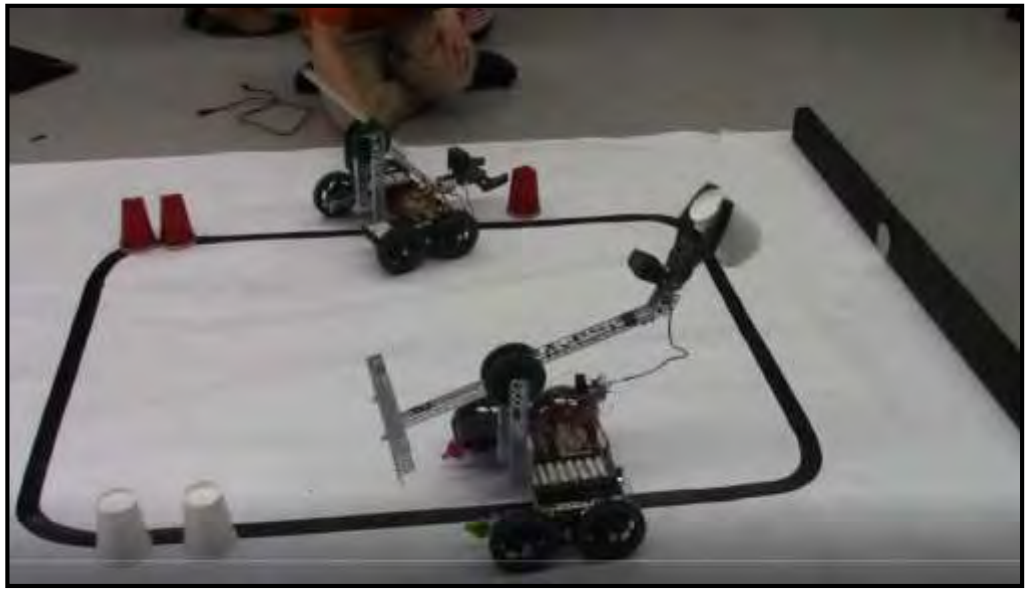
Collaborative learning

Collaborative design

Teamwork



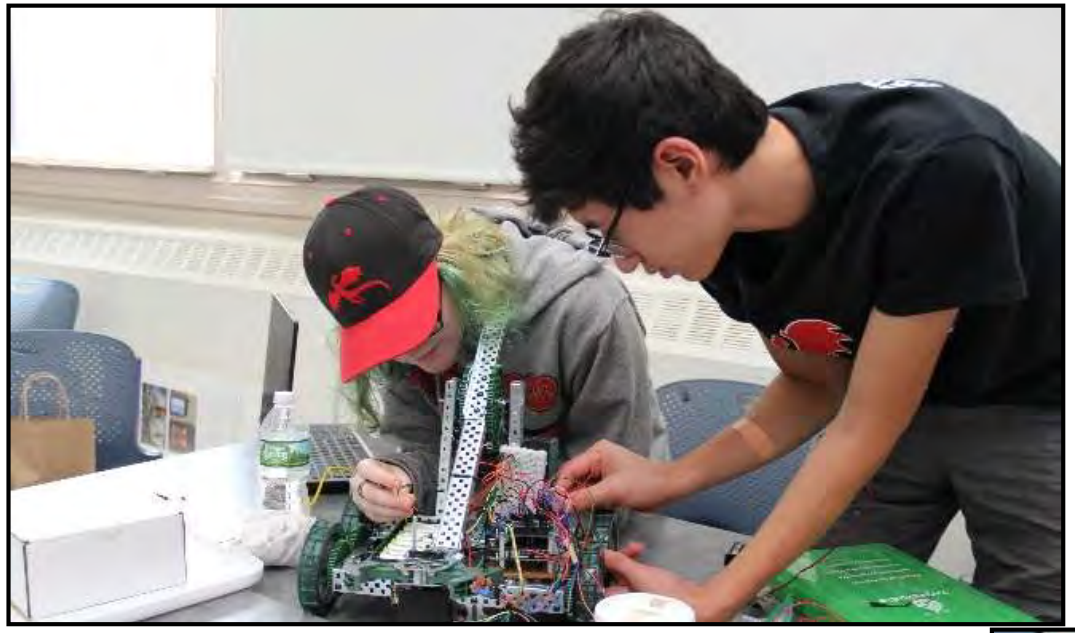
Projects promote critical thinking, computational thinking, and self-directed learning - Picking objects, except forbidden object



Projects promote engineering habits of mind
- Nursery bot to move plants

Inspiration
Harvest
Automation

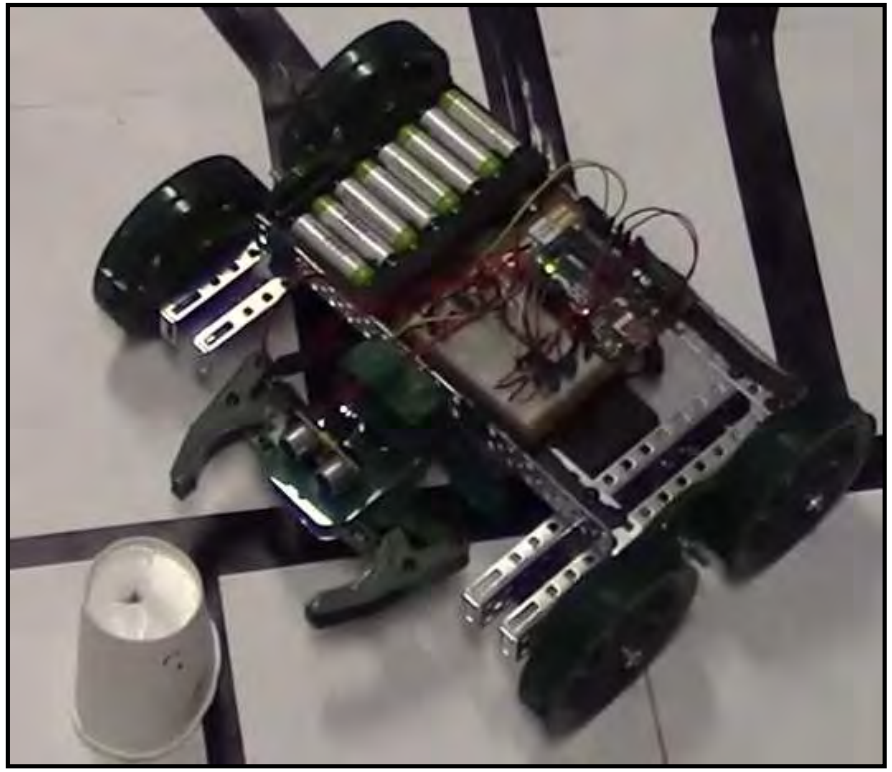
Systems Thinking



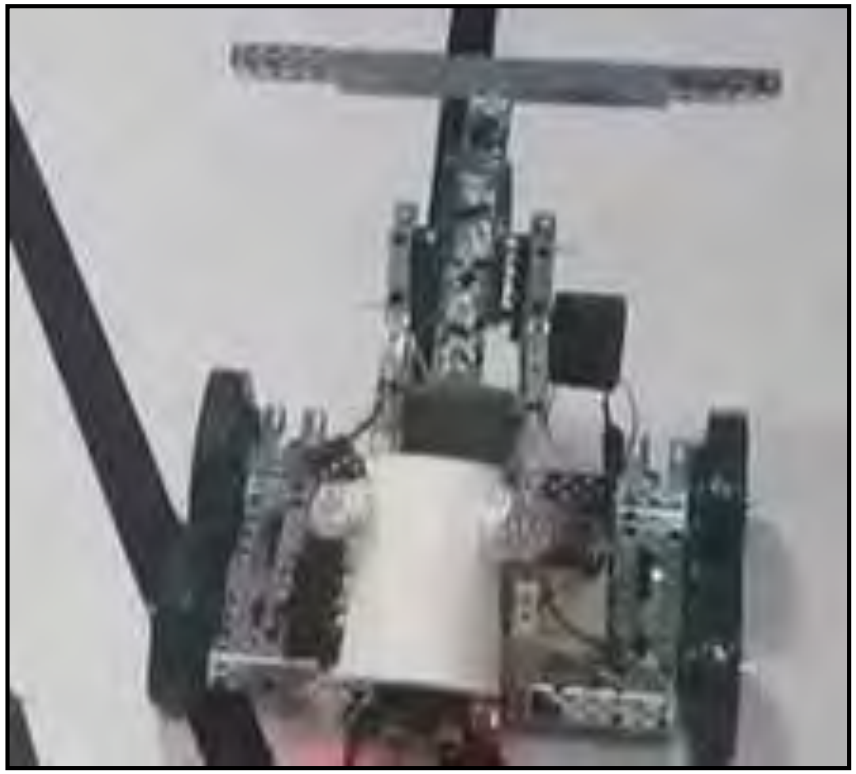
Integrating robot subsystems

Testing, measuring, and refining

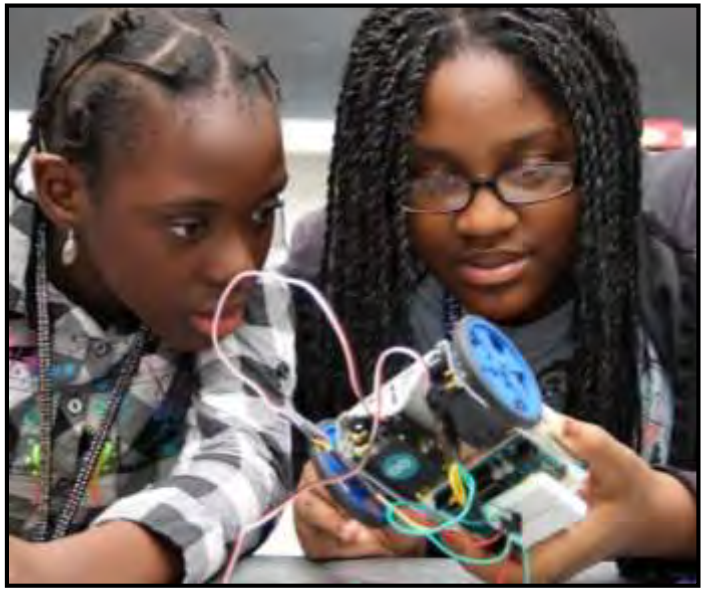
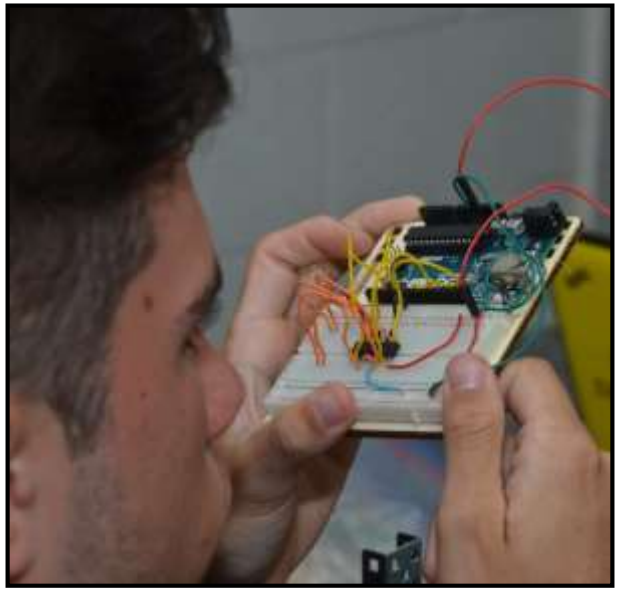
Design Thinking and Creativity



Varied clawbot designs



Varied detectors for forbidden object

Curiosity: the what, why, how, when …?


Explain to one-another

Entrepreneurship

20

NYU ITEST InnoVention Competition
Robotics Challenge for Household

- *Identify* a problem in your household that can be addressed using a robot
- *Build* a robot using your VEX robotics kits to solve this problem
- *Market* your robotic solution to potential investors

Identify: As you survey around your house, carefully analyze and examine opportunities for a robot to make a significant impact in your life. How can a robot simplify your life? Develop a *Problem Statement* and *Solution*

Illustrative examples:

1. Robo-Trash Can: A robot that roams around in a room where you may be holding your party, it may follow a designated person for collecting trash from your guests
2. Robo-Tray: A robot that follows you around with a tray full of beverages/food so that you have room to offer your guests at one time.
3. Robo-Mail: A robot that pick up your mail while you are on vacation so that potential thieves don't realize you are not home.
4. Robi-Pets: A robot that performs surveillance on your pets when you are not home.
5. Handy-Robo: Painting/spraying/pest control robot.

Research Survey: Survey your household and/or ask questions to people you encounter. Develop a brief survey with 5 questions (it will help with the entrepreneurship aspect)
Possible Questions:

1. What would ease your time at home?
2. What chores do you wish you had help with?
3. What chores would you trust a robot to do?
4. Give some examples as mentioned above.
5. How much are you willing to pay for a robotic solution to handle household chores?

Full example: Based on the survey results, select a problem statement and come up with a solution for the problem. For example, **Robo-Tray Problem Statement**: Whenever I host parties I can only bring one tray at a time to offer snacks to my guests. It would be great if I had someone to bring another tray to help me. *Solution*: build a robot that will follow me around with a tray to serve my guests.

Build: Design and build a mobile platform/robot to counter the pains and problems that you identified to be most feasible, needed, and innovative. It can be an (1) improvement in already existing solution, (2) an integration of different technologies, and/or (3) coming up with something new. You need to finish the robot with a working demo and a video within the specified time limit. It should be a mechanically stable solution with a practical application in current households and people are interested to use them in their daily lives.

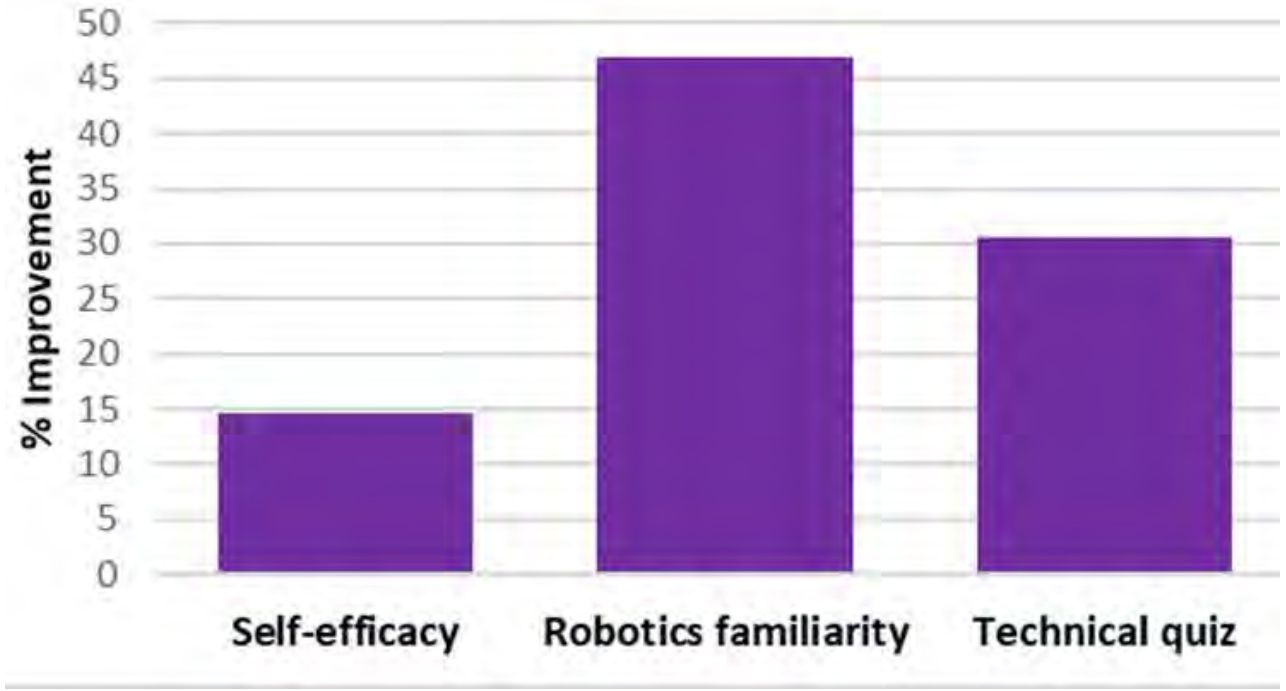
Market: Now you have identified the problem and built a prototype. How can you now market your "product"? Who are your customers? What is your price point? Identify your budget(s), materials, advertisement (i.e., social media, ads, etc.). Most importantly, develop a great pitch to persuade people to buy it. **Robot name:** Give your robot a name, this name will become your team name and is part of your marketing technique.

Date of Competition: May 22, 2018
Time: 9am-12pm
Location: To be determined (NYC area)

INTERNSHIP WINNERS: Each team will choose 3-5 students to represent the class in the final competition. Each student team will compete for a chance to win bragging rights for their school and team. Judges will have a rubric to select team winners. Paid Internship awardees will be selected by your respective teachers and NYU instructors through a mutual agreed upon process.
There will be 4 student winners that will receive a paid internship based on the following categories:

1) NYU ITEST Winner
2) Best Robotic Engineering
3) Best Innovation
4) Best Entrepreneurship

Student Outcomes from Summer



- Familiarity with robotics: s.s. improvement
  - Effect size: medium
- Technical knowledge: s.s. improvement
  - Effect size: large

Chengcheng Li
University of Cincinnati

Design Based Information Technology Learning Experiences DITLE Project

The missing “T” in STEM education

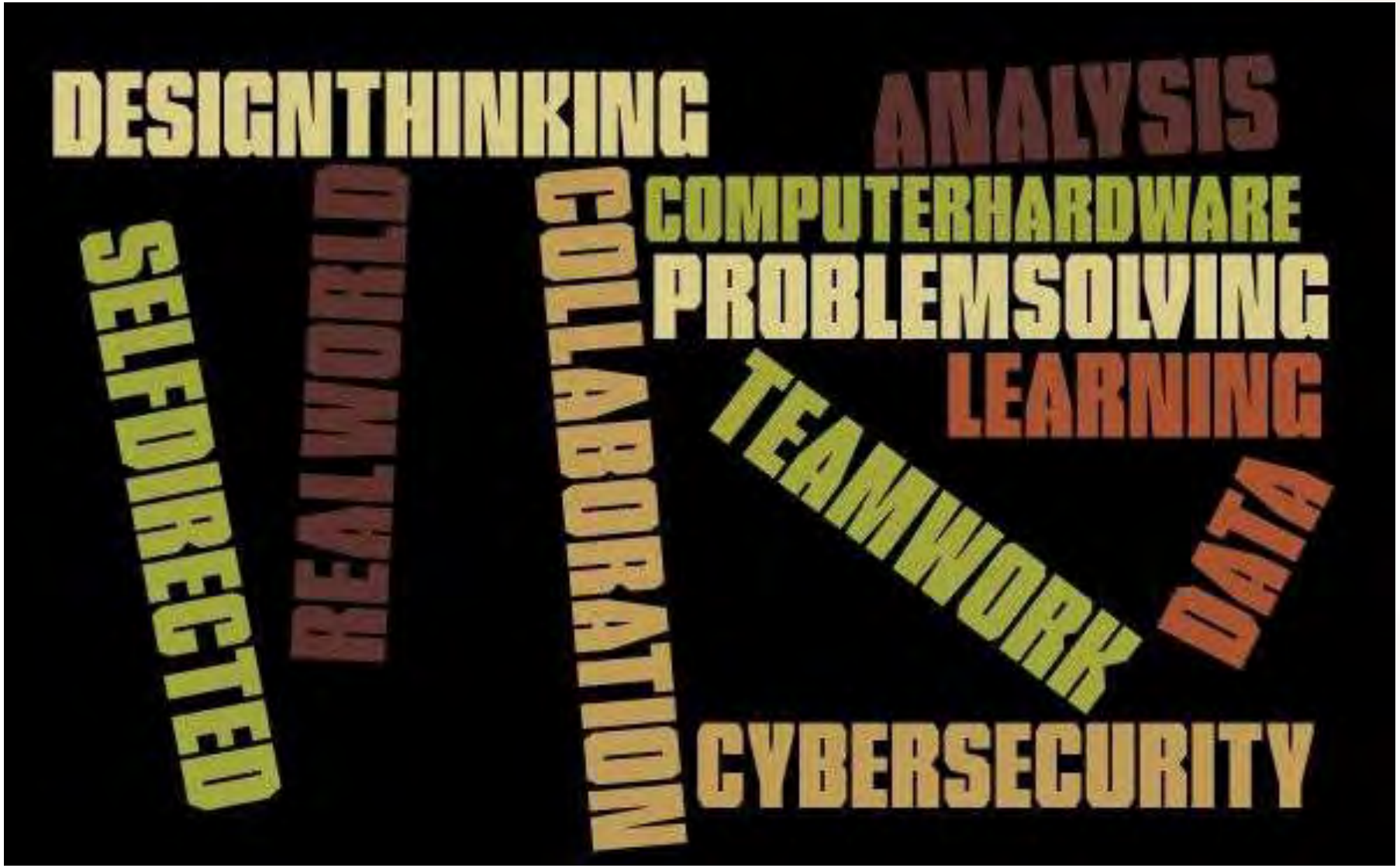
National Science Foundation

School of Information Technology
&
School of Education
University of Cincinnati

DITLE Project Goals

- Increase Secondary Students' Interest, Awareness, and Knowledge of IT
- Prepare a Cadre of STEM Educators Who are Prepared to Teach IT Topics and Integrate IT into Other STEM Education
- Expand and Strengthen Existing Regional Technology Infrastructure by Harnessing and Sharing Essential IT Resources

Human-Technology Frontier Dispositions

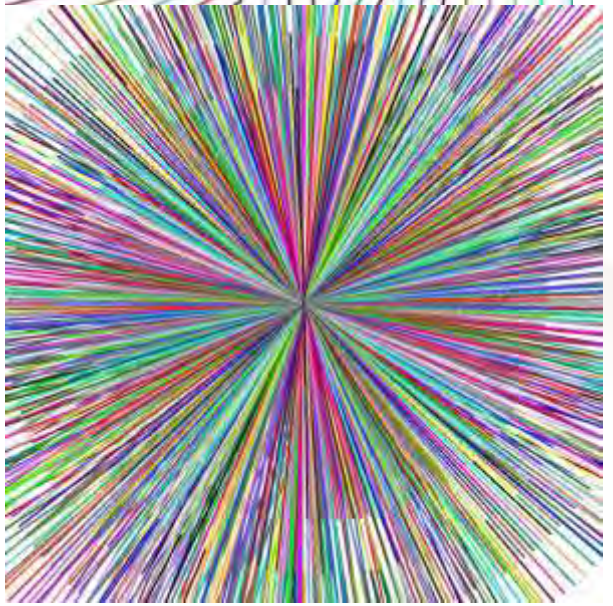


Interdisciplinary Teamwork/Collaboration

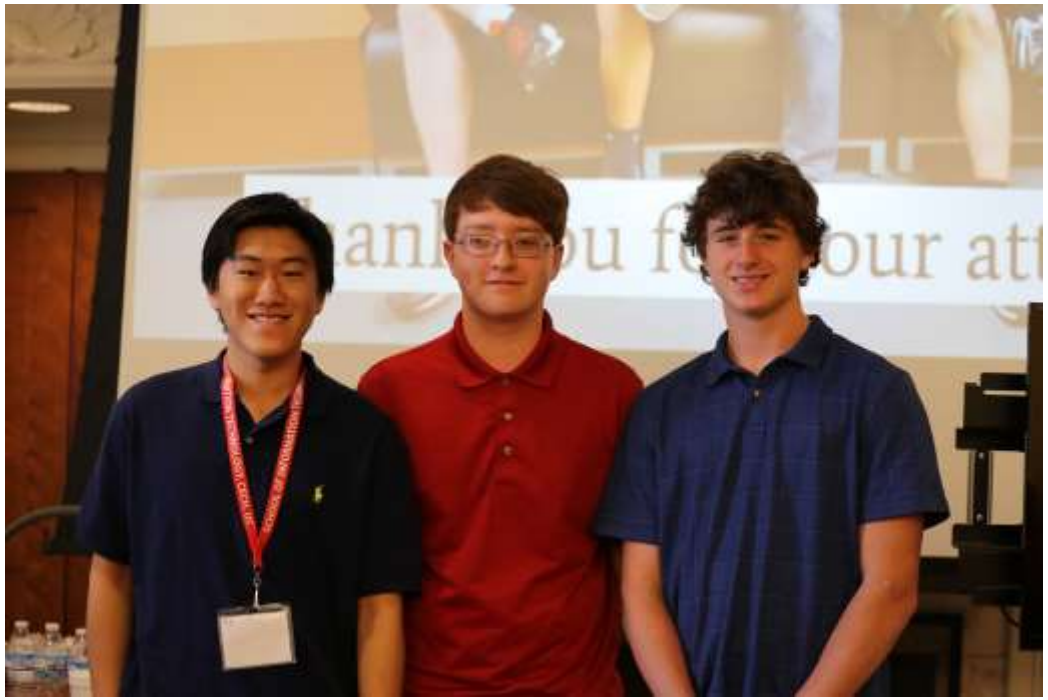
Interdisciplinary Teamwork/Collaboration

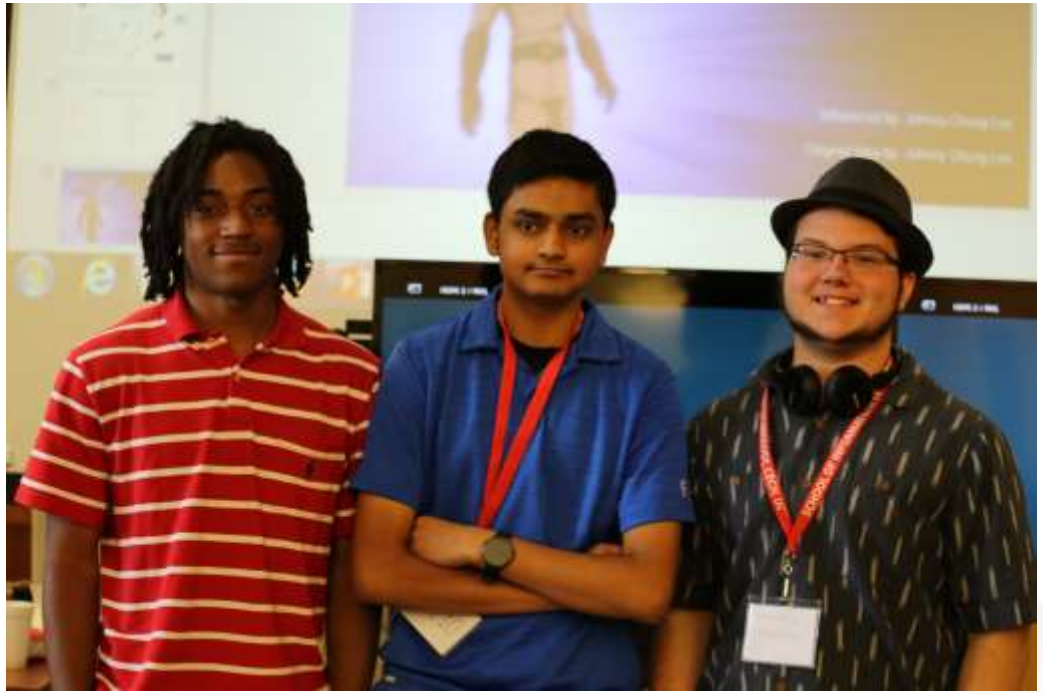
Interaction and teamwork with others was among the most engaging and interesting aspects of the summer workshop.

Computational and Design Thinking



Project-based Learning through Solving Real-world Problems





Formal Learning

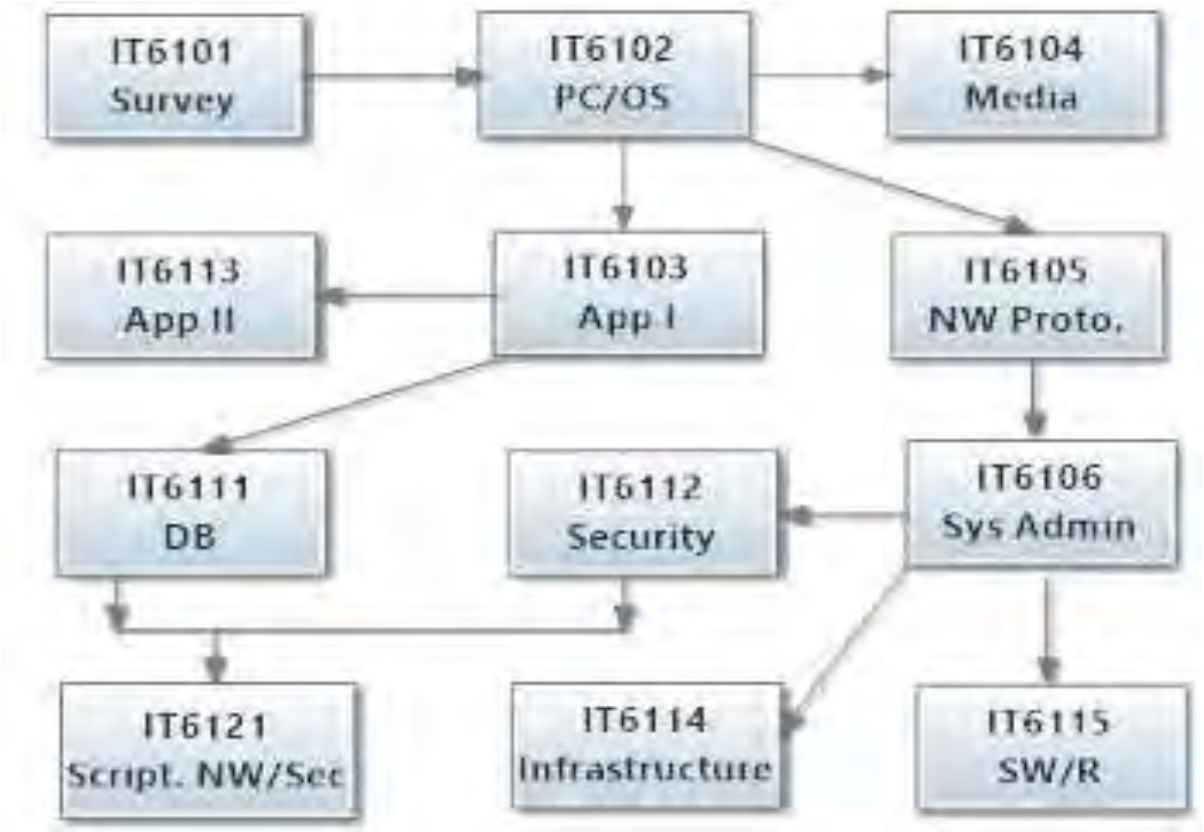
Lecture-based Learning in the 1st Year

Self-directed Formal Learning

Design-Based
Active
Hands-on
Learning

Self-directed Learning in the 2nd Year

Self-directed Formal Learning for Teachers



Short one-credit graduate courses for teacher

Computer and System Hardware

Cybersecurity

Cybersecurity

Data Collection and Analysis

ICT Future Workforce

Occupational Title	2012 Median Pay		2012 Employed	Change, 2012-2022	
	Per Year	Per Hour		Percent	Numeric
Information Security Analysts	**$86,170**	$41.43	75,100	37%	+27,400
Software Developers	**$93,350**	$44.88	1,018,000	18%	+222,600
Web Developers	**$62,500**	$30.05	141,400	20%	+28,500
Computer Network Architects	**$91,000**	$43.75	143,400	15%	+20,900
Network/Systems Administrators	**$72,560**	$34.88	366,400	12%	+42,900
Computer Systems Analysts	**$79,680**	$38.31	520,600	25%	+127,700
Database Administrators	**$73,080**	$37.06	118,700	15%	+17,900

Computer and Information Technology Occupation Outlook 2012-2022 by the U.S. Bureau of Labor Statistics, Published on Wednesday, January 8, 2014.

ICT Skills

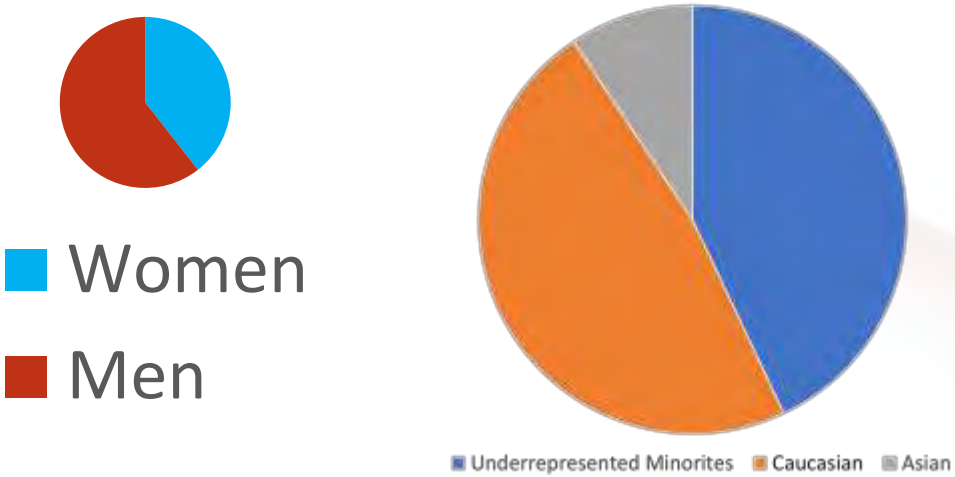
- Prior math scores don’t correlate with the ICT camp performance
- ICT is a highly applied discipline that requires hands-on experience, teamwork, and problem solving skills

Career Advising and Ethics

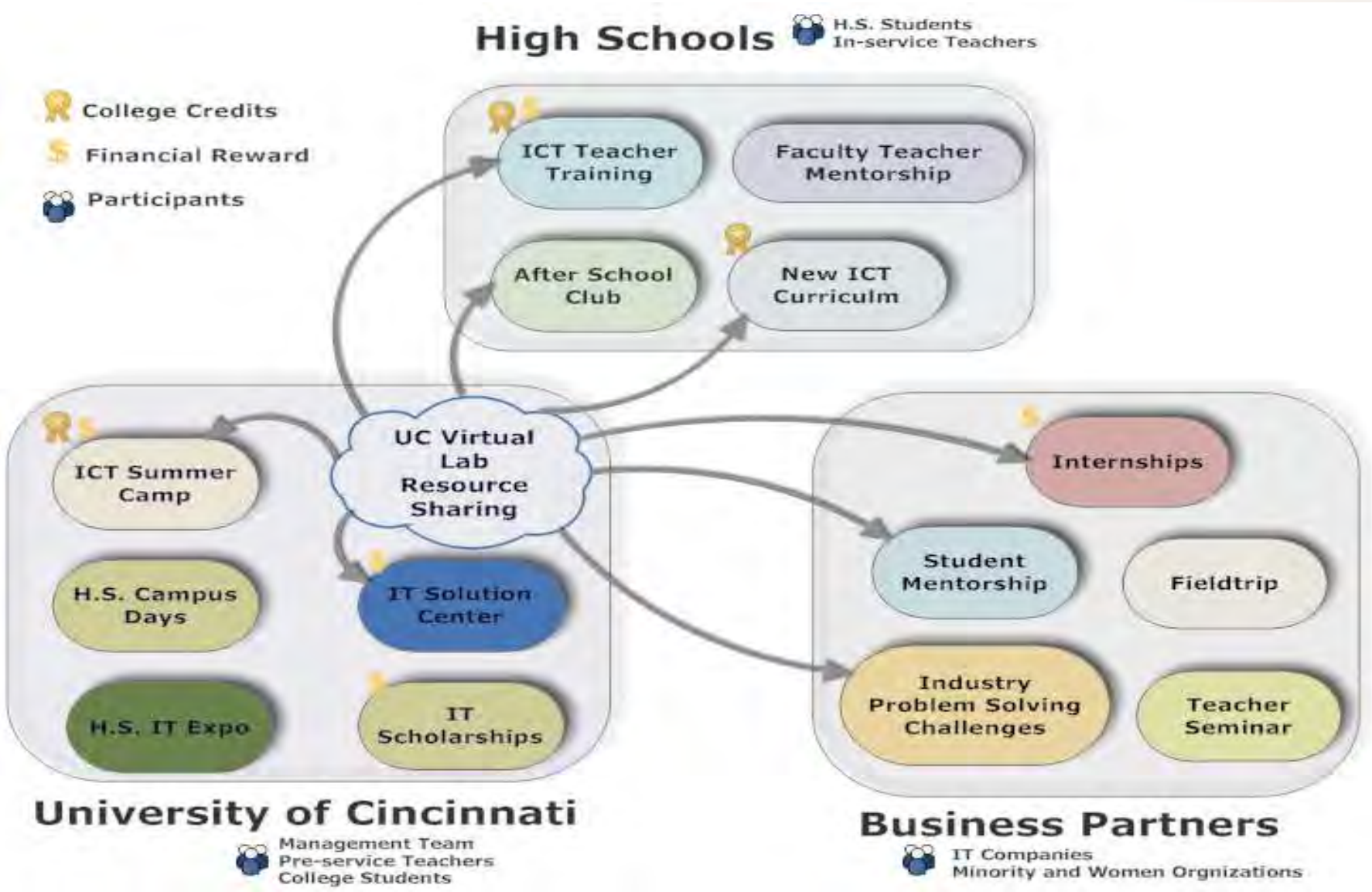
- More than 30 Guest Speakers @ the summer camp

Broad Participants

- 140 High School Students, 10-12th grade
- 6 School Liaisons
- 20 Pre-service Teachers
- 30 Teaching Assistants and Faculty
- Parents and 30 Guest Speakers
- >700 students in @school coding events



Rich Activities



Certificates and Awards

Q/A

Chengcheng Li, PhD

School of Information Technology

University of Cincinnati

Chengcheng.li@uc.edu

(513)556-5920

Eric Greenwald
University of California - Berkeley

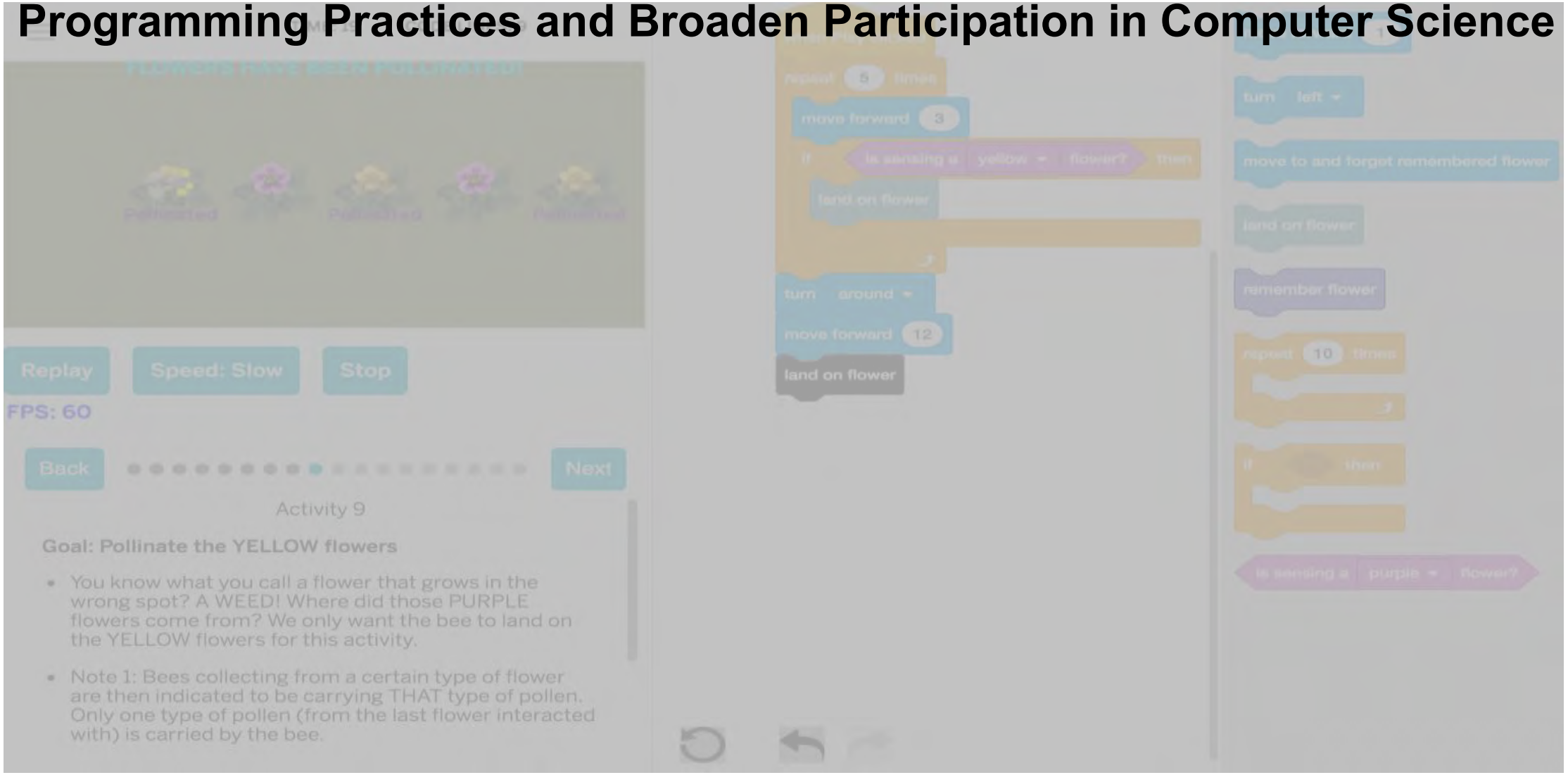
Integrating Computer Science in Science

Activating new players and changing the game

Eric Greenwald & Ari Krakowski
University of California, Berkeley

Coding Science Internships:

Authentic Learning Experiences to Support Students' Science and Programming Practices and Broaden Participation in Computer Science



Coding Science Internships:

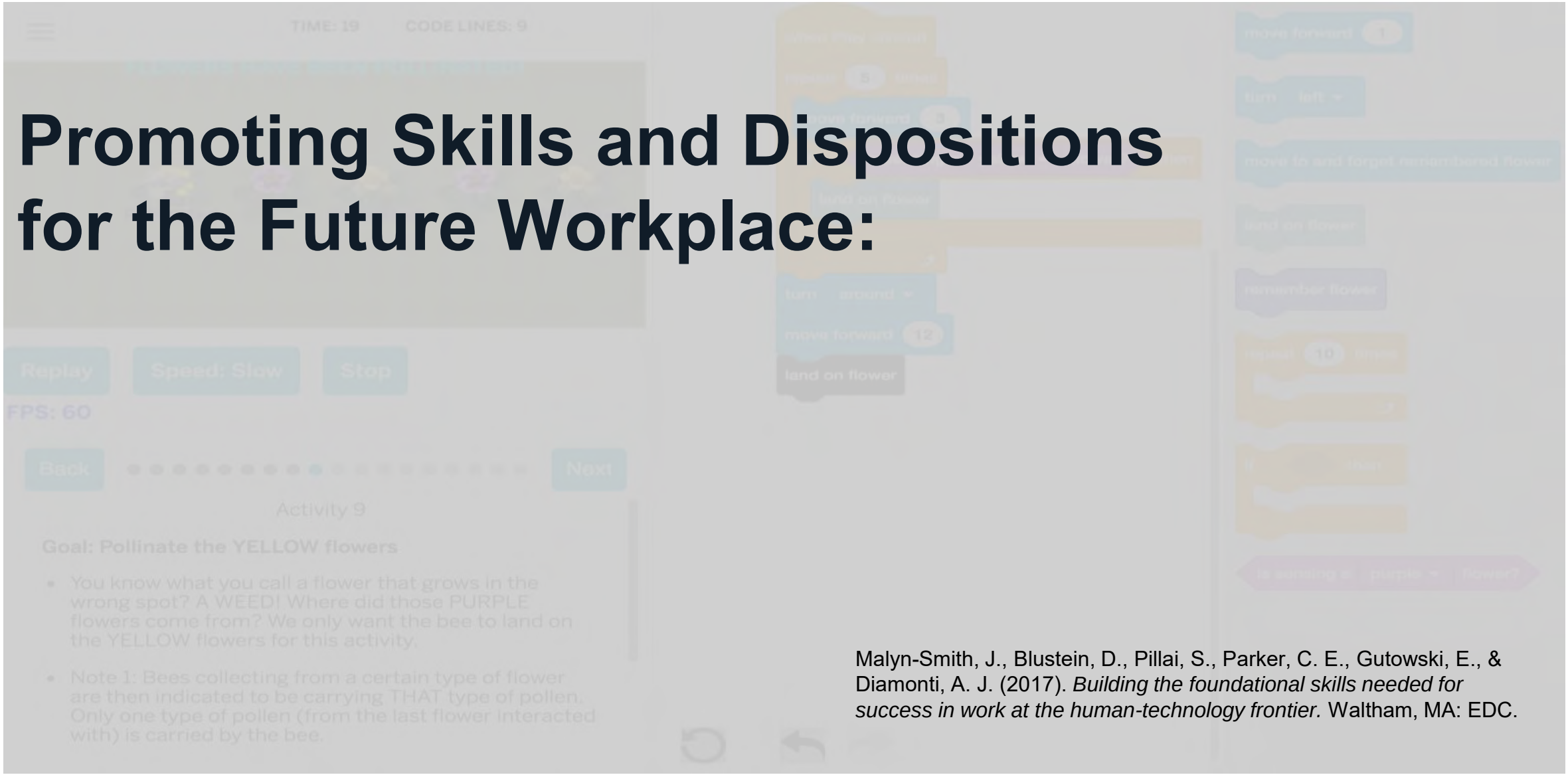
Authentic Learning Experiences to Support Students' Science and Programming Practices and Broaden Participation in Computer Science

Our Task

Create student learning experiences that expand opportunity and capacity, shift student perceptions of CS, and provide a path to sustainable implementation at scale.

Our Task

Promoting Skills and Dispositions for the Future Workplace:



Malyn-Smith, J., Blustein, D., Pillai, S., Parker, C. E., Gutowski, E., & Diamonti, A. J. (2017). *Building the foundational skills needed for success in work at the human-technology frontier.* Waltham, MA: EDC.

Our Task

Promoting Skills and Dispositions for the Future Workplace:

- Interdisciplinary at the core
- Learning through real-world problem solving
- Engineering & design thinking to guide student work
- Highlighting the role of CS/CT in the life sciences

Malyn-Smith, J., Blustein, D., Pillai, S., Parker, C. E., Gutowski, E., & Diamonti, A. J. (2017). *Building the foundational skills needed for success in work at the human-technology frontier.* Waltham, MA: EDC.

Coding Science Internships:
the problem and our approach

Barriers to broader participation

negative perceptions of CS / CT

limited opportunities & exposure

Coding Science Internships:
the problem and our approach

Barriers to broader participation	Coding Science Internships
negative perceptions of CS / CT	→ positive counter-experiences
limited opportunities & exposure	→ expanded opportunities & capacity

Project Timeline

We are here.

Launch → Design, Pilot, and Develop CS Internship 1 → Conduct Research Trials on CS Internship 1

Years 1 & 2

Design, Pilot, and Develop CS Internship 2 → Conduct Research Trials on CS Internship 2

Years 2 & 3

What is a Coding Science Internship?

What is a Coding Science Internship?

DAY 1

Welcome to Futura!

Welcome to your coding internship, and welcome to Hawaii! I'm Kai Alana, your Project Director.

All of us here at Futura are excited that you are joining our team. We will be working on a project for the Coral Reef Restoration Association (CRRA). They plan to design and implement a restoration plan to help the coral reef populations here in Hawaii become healthy again.

They've asked for our help to code two models that will be an important part of their restoration plan. You will be coding two types of models:

1. A model that shows how the coral reef ecosystem is affected by harmful environmental factors. This model will help the Coral Ree
community members how human activity c
community to participate in decisions abou
2. A model that shows how different kinds of
of tasks to help corals grow and thrive.

Soon, you'll receive your Futura Dossier that will p
about coral reef ecosystems and coral restoration
Dossier (DAW-see-ay) is a term professional engi
related to a certain project.

I will be meeting with the Coral Reef Restoration A
like you to work on these tasks and provide me wi
why they will be useful for the restoration plan. I w
talking points for my conversation with the Coral R

I am looking forward to seeing the programs you c

Kai

Kai Alana, Project Director
Futura | Software Engineering Division

FUTURA

FUTURA SOFTWARE ENGINEER'S DOSSIER

What is a Coding Science Internship?

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Kai

Kai Alana, Project Director
Futura | Software Engineering Division

FUTURA

FUTURA SOFTWARE ENGINEER'S DO

Hawaii Coral Reef Restoration Plan

Table of Contents

Introduction: How Humans Affec

Often, people do not realize that many of the
daily basis—like driving cars, running appliance
affecting other organisms on Earth. Cars, planes,
transportation release carbon dioxide into the atmo
electricity we use to turn on our lights and run appli
homes and businesses comes from burning fuels that
and other gases into the atmosphere. Farming activities
and animals for food—release other gases into the atmos

Communicating to the Public

[Futura's help needed here]

Comment [CRRA]: 1 day ago

Futura, We need your help here. We would like to present the community with a tool that shows how factors associated with climate change (such as water temperature increases and ocean acidification) and nutrient runoff affect the reefs. We think that if people have an interactive tool, they will better understand why these factors are harmful to the reef ecosystems. When you submit your interactive tool, please include an explanation of what your tool shows and why it is a useful way to communicate how environmental factors affect the coral reef ecosystem.

Strategies for Improving Coral Reef Ecosystem Health

Addressing Climate Change

to decrease human impact on climate change by changing
eas in our Hawaii community: (1) energy production, (2)

Using Robots to Support Coral Reef Growth

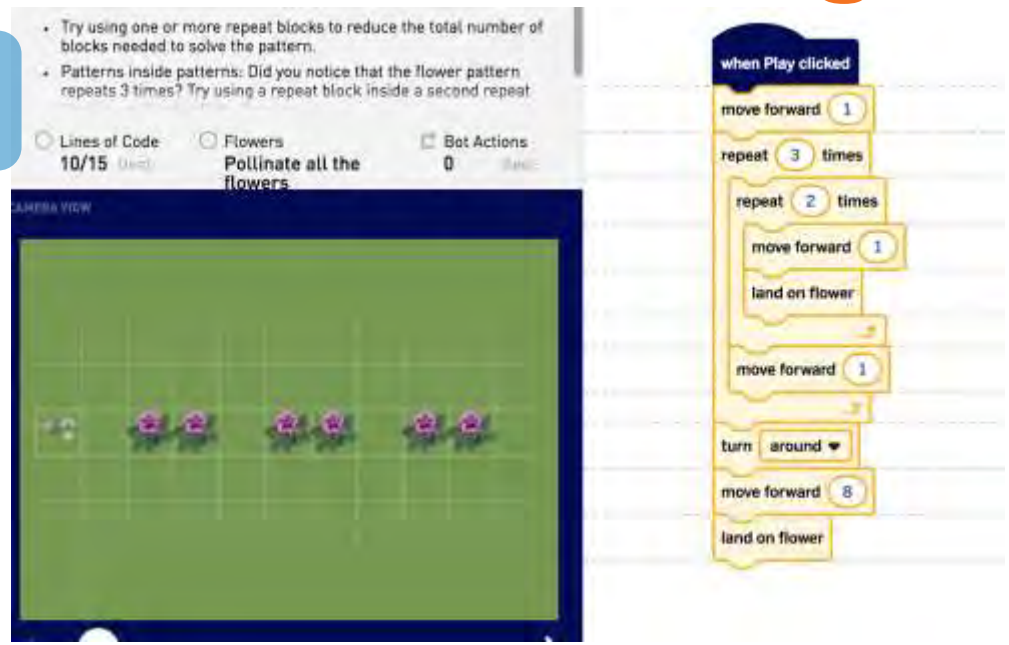
[Futura's help needed here]

Comment [CRRA]: 1 day ago

Futura: We need your help here also. We would like to use the robots and the code you write to program other robots in the future. After you have programmed your robots to support coral reef growth, please include an explanation of how your robots work and why you think your coded solutions are strong.

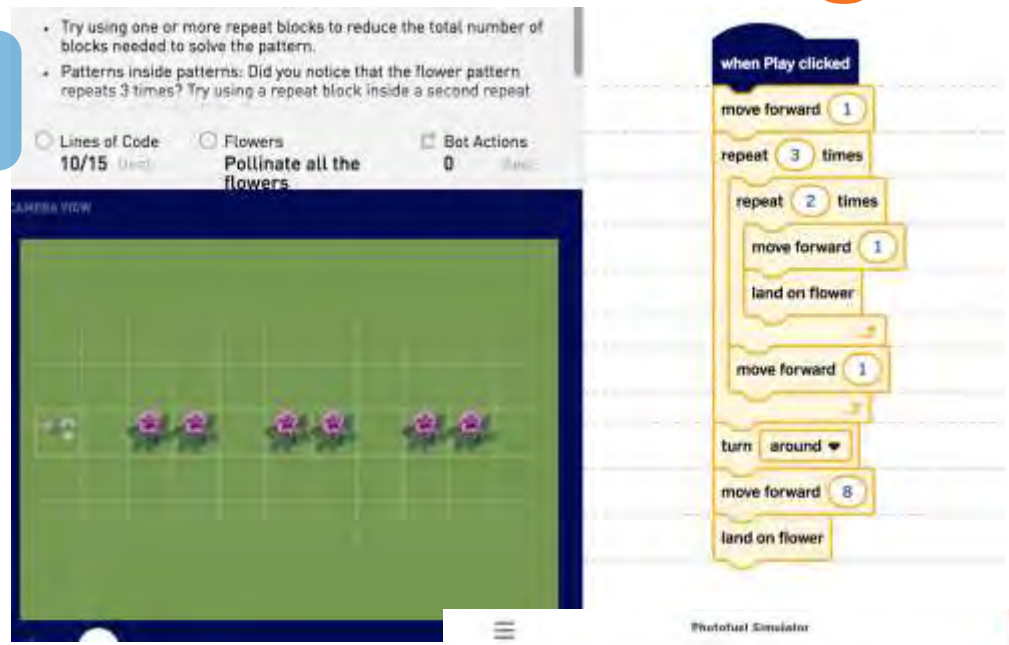
What is a Coding Science Internship?

pattern
efficiency

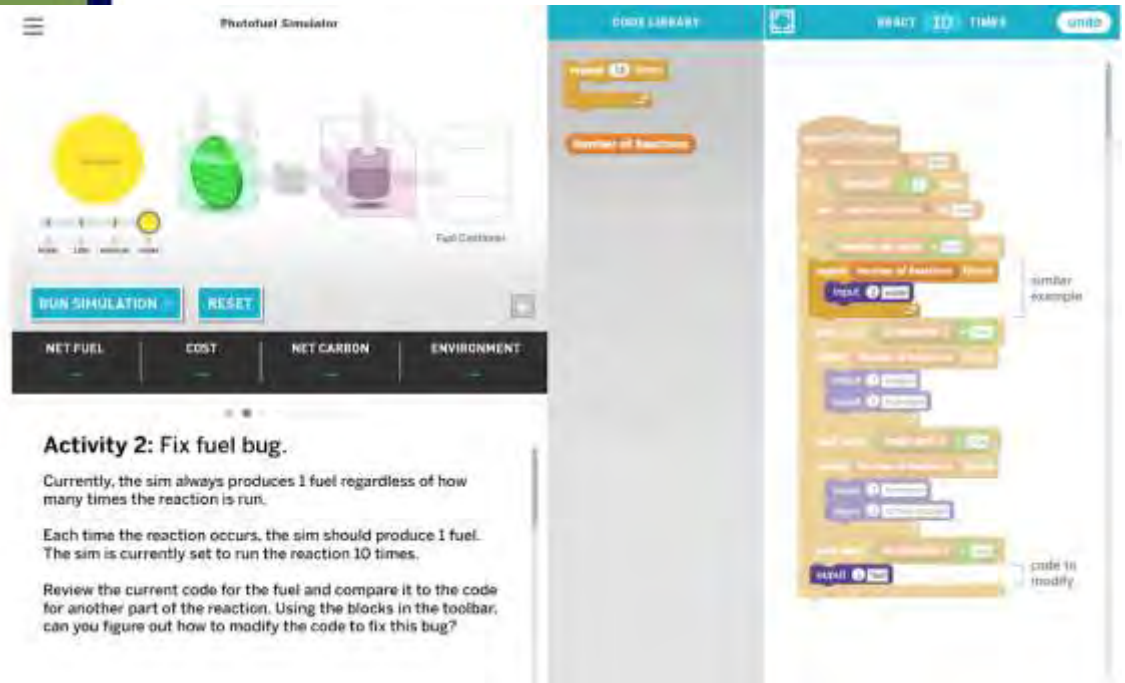


What is a Coding Science Internship?

pattern efficiency

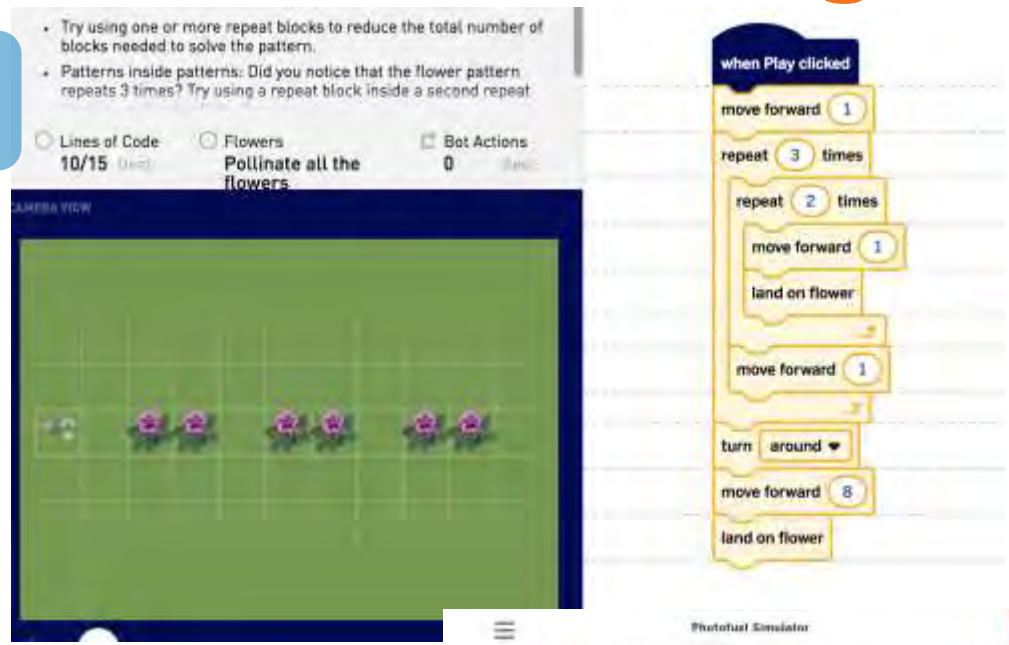


system modeling



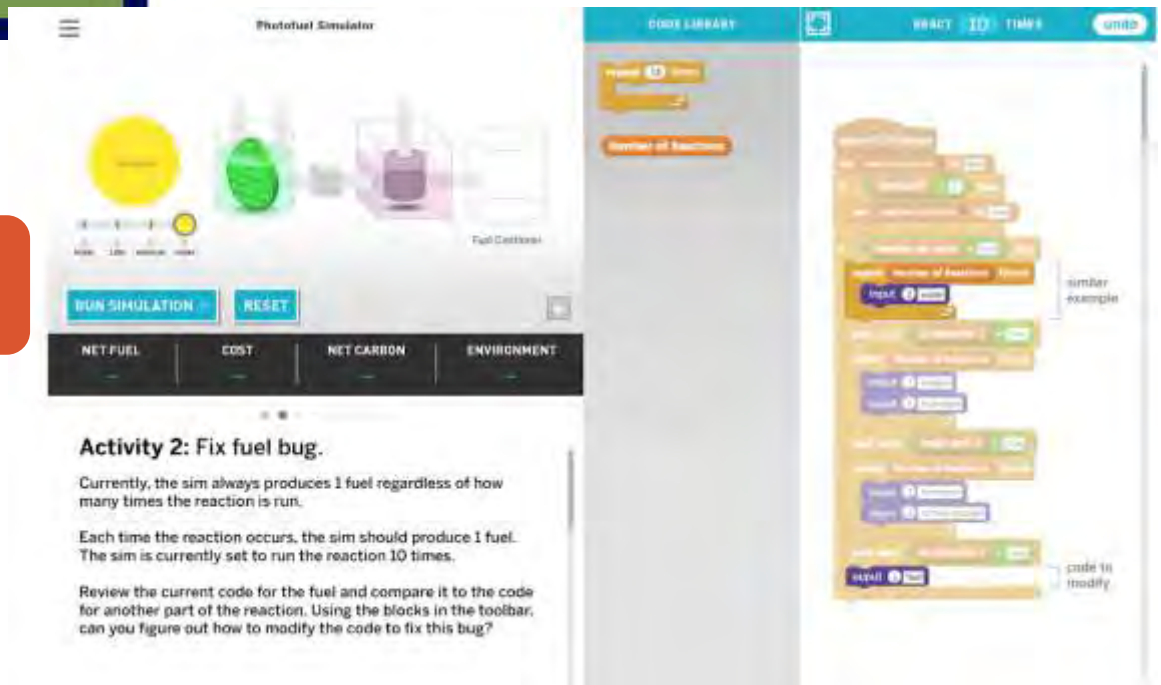
What is a Coding Science Internship?

pattern efficiency



data visualizatio n

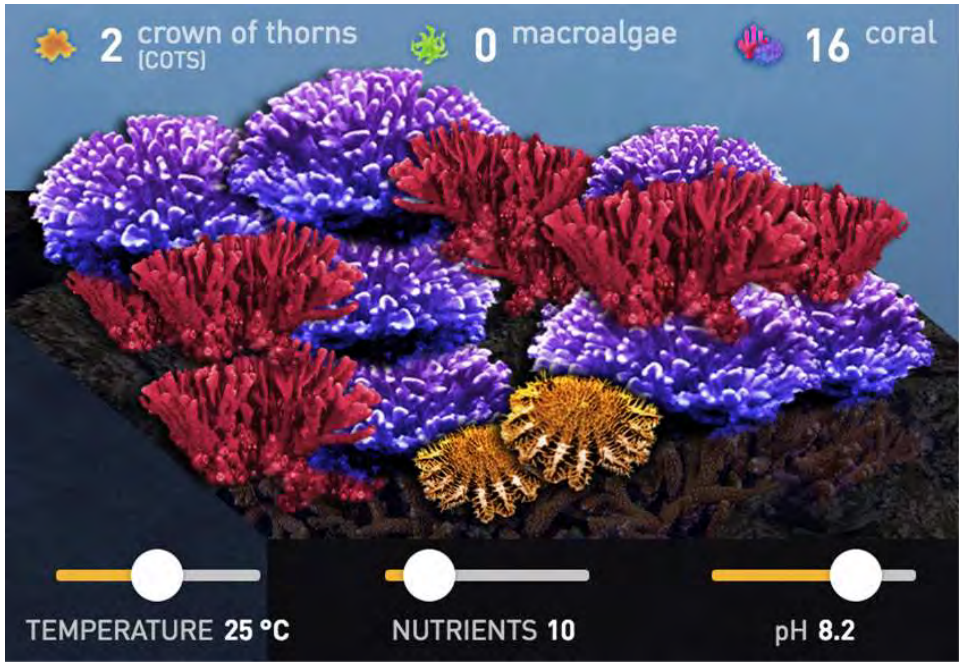
system modeling



Coral Restoration CS Internship:

putting CS/CT to work to solve real-world problems

Coral Sim Environment



Transplant Bots

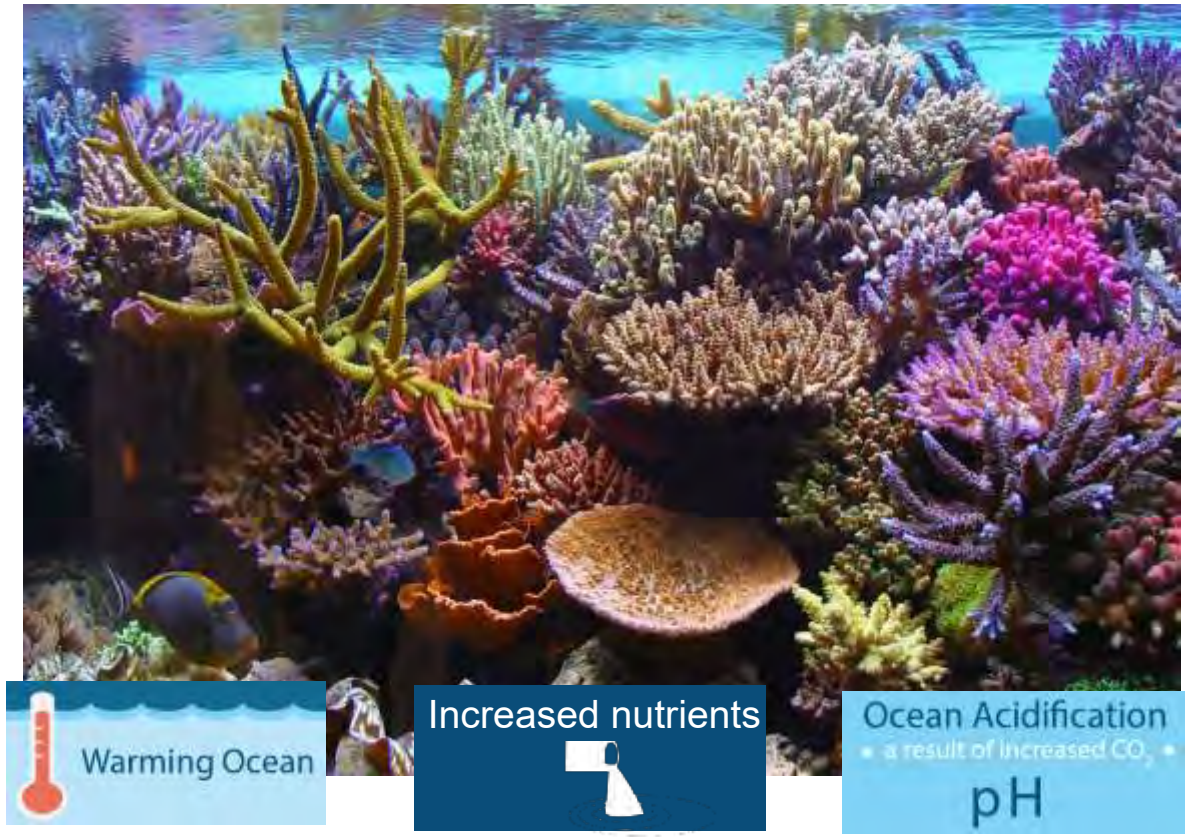
transplant young coral polyps to appropriate transplant location

Reef Cleaning Bots

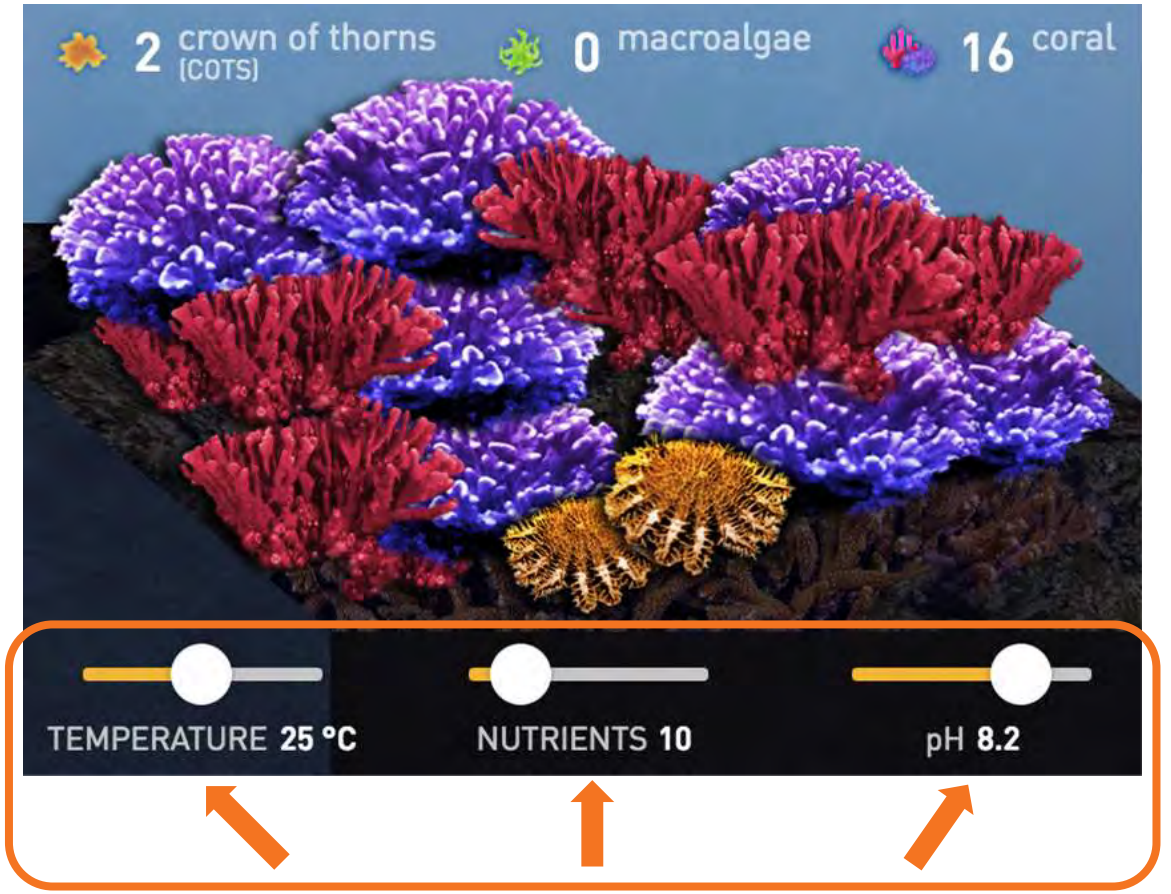
remove macroalgae and crown-of-thorns starfish threats to the reef

Coral Restoration CS Internship:

computational thinking for the life sciences



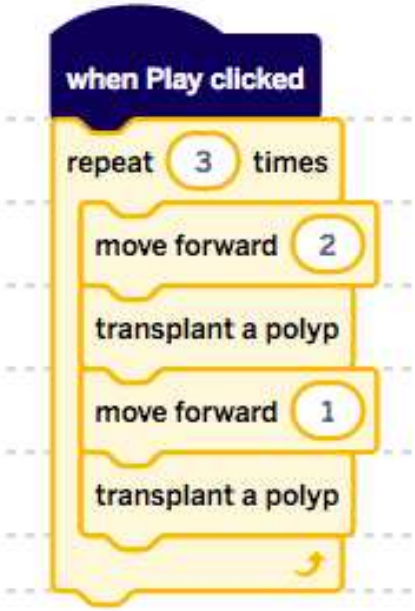
Environmental factors that threaten the health of the Hawaiian coral reef ecosystem



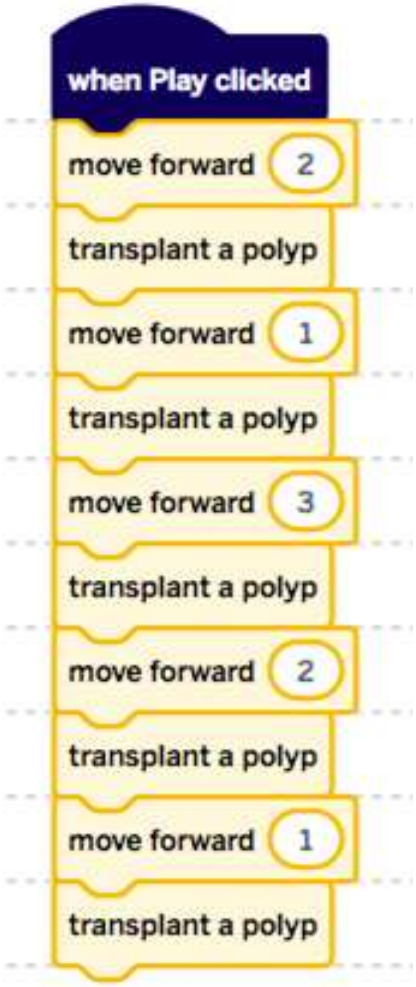
Students code a model that shows how coral reef ecosystem is affected by 3 environmental factors

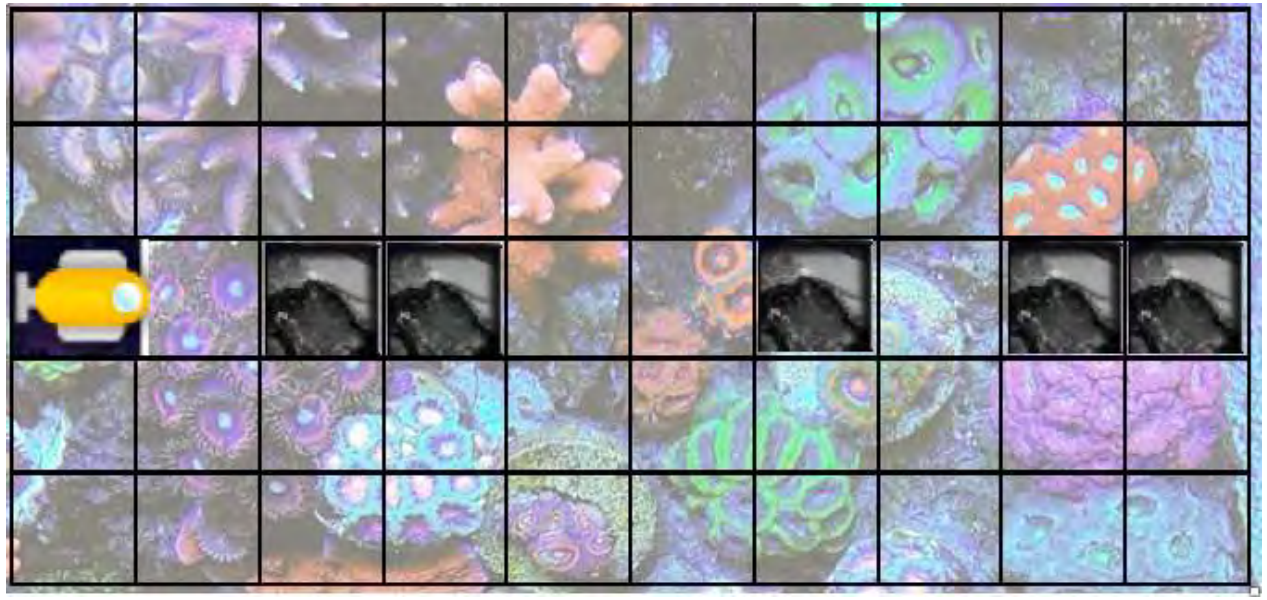
Comparing Coded Solutions:
an interdisciplinary lens for coding tasks

Solution 1



Solution 2





Solution 1: Use a repeat

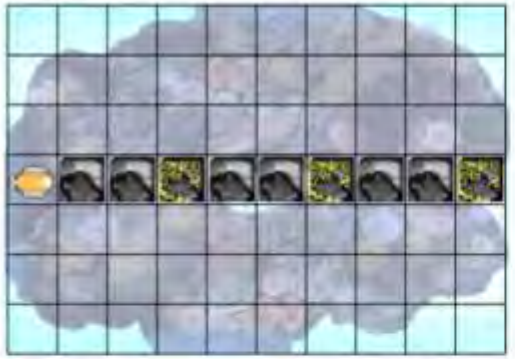
- 5 successfully transplanted polyps
- 1 wasted polyp
- 1 coral(s) damaged
- 6 lines of code
- 15 bot actions

Solution 2: Hard code

- 5 successfully transplanted polyps
- 0 wasted polyps
- 0 coral(s) damaged
- 11 lines of code
- 14 bot actions

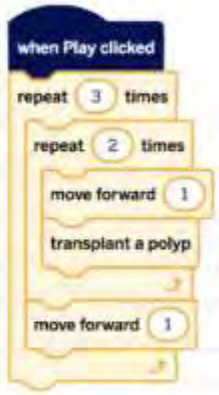
Criteria for Evaluating Code:
applying design thinking to iterate on solutions

Assignment Goal: Transplant 6 coral polyps

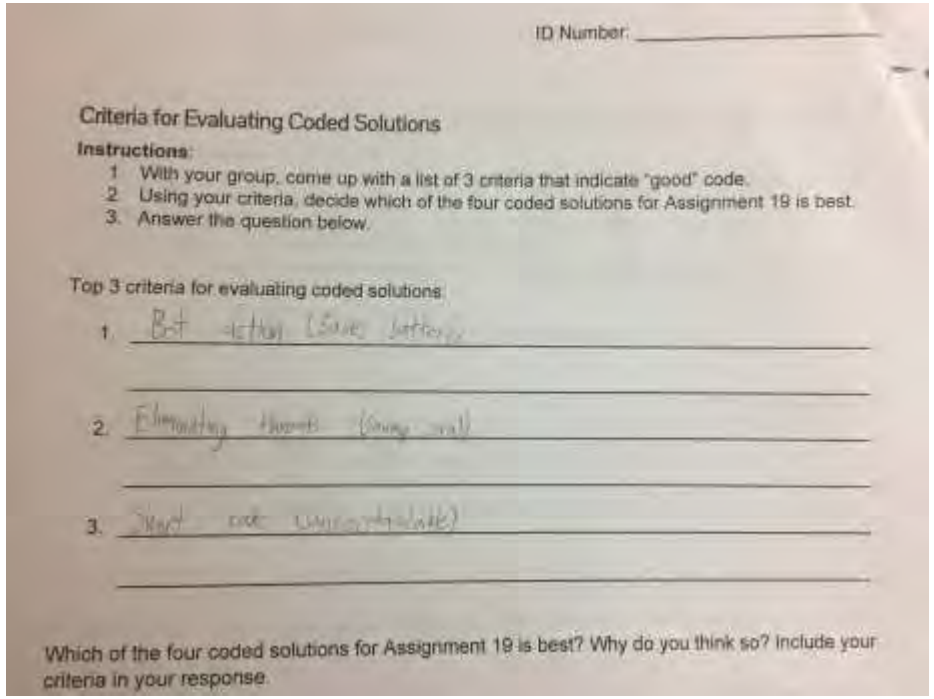


Coding solution A
12 lines of code
14 bot actions

Coding solution B
6 lines of code
15 bot actions



Comparing Coding Strategies



ID Number: _____

Criteria for Evaluating Coded Solutions

Instructions:
1. With your group, come up with a list of 3 criteria that indicate "good" code.
2. Using your criteria, decide which of the four coded solutions for Assignment 19 is best.
3. Answer the question below.

Top 3 criteria for evaluating coded solutions:

1. Bot actions (Save batteries)
2. Eliminating [illegible] (Easy to read)
3. [illegible]

Which of the four coded solutions for Assignment 19 is best? Why do you think so? Include your criteria in your response.

What is a Coding Science Internship?

solving real-world problems

CS/CT in the life sciences

engineering & design thinking

interdisciplinary

Thank you!

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fin.

Victor Minces
University of California – San Diego

stelar
STEM LEARNING AND RESEARCH CENTER

David Reider
Education Design

Learning transforms lives.

Four ITEST Projects inform thoughts on Equity and Access at the Human-Technology Frontier

David Reider, Education Design, INC

eDUCATIONDESIGN

Human-Frontier Dispositions

- Deep knowledge in science and technology
- Keep data safe, interpret data, and tell their story
- Solid grounding in computational thinking
- Comfortable sharing work tasks with machines
- Curious, self-directed, resilient
- Lifelong learners
- Innovative, disruptive and willing to fail
- Cooperative, interpersonally competent
- Think outside the box
- Insightful, diligent, persistent

CompuGirls (SPreaD)

Arizona State University, Phoenix & Denver Sites

CompuGirls

Girls from underserved and underrepresented communities gain access to technology through socially-based and culturally relevant practices.

CompuGirls

Technologies: Scratch, Virtual worlds, iMovie, PodCasts

Dispositions: Predominance of dynamic interdisciplinary teams, Ubiquitous CT, Continuous Learning

GRACE (SPreaD)

Eastern Michigan University, State of Michigan

GRACE

Applying GIS, mapping, and visualization technologies to solve community-relevant and place-based problems in multiple cities and towns throughout the state of Michigan.

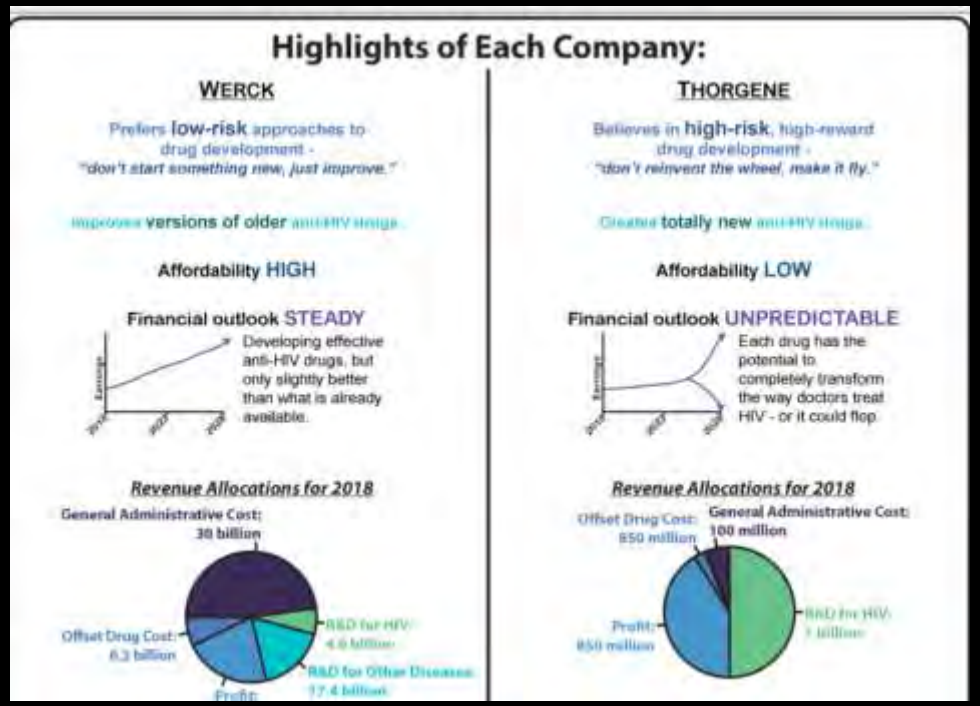
GRACE

Technologies: ARCGIS, online GIS databases.

Dispositions: Focus on Data, Ubiquitous CT, Engineering Design/ Design Thinking, Education on PBL

BioScann

Tufts University, Boston



BioScann

Collaborative team-based drug development through deliberations of medical, financial, ethical, and marketing data.

BioScann

Technologies: Data analysis, online modeling environment

Dispositions: Predominance of dynamic interdisciplinary teams, Focus on Data, Education on PBL, Continuous Learning

STEMulate

University of Hawaii, Maui, Hilo, Oahu

STEMulate

Increase capacity and motivation for native island population to pursue STEM related careers

STEMulate

Technologies: sensing and imaging, GIS, navigation, data analysis

Dispositions: Ubiquitous CT, Education on PBL,
Continuous Lifelong Learning

Commonalities

Emphasis of project work is on social change, often community-based, reflecting a change in ITEST program since its beginning:

Innovative Technology Experiences emphasis from new technologies to new uses or contexts for ubiquitous technologies

Dispositions

- CompuGirls: Social change and possible selves through tech-based storytelling and role-playing
- GRACE: Community improvement projects through GIS
- BioScann: Collaboration on product design
- STEMulate: Problem-based learning solutions to local issues

Dispositional shifts not how users feel about technologies but how they place themselves as participants in STEM literate citizenry, not necessarily on STEM career trajectory

Equity

- Girls striving for parity with boys with tech
- Urban and rural youth of poverty left out of tech and under
- Inner city youth don’t use tech to collaborate, design, construct, and argue
- Island youth don’t conceptualize a place for tech in their work futures

Access

Urban and rural youth of poverty, minority girls, and island youth share a lack of or otherwise compromised access to technology that may enable them to participate in the STEM-literate life— and workforce

Social Human-Technology Frontier

STEM literacy developed using technology to address community-based social problems intersects with many identified dispositions on the Human-Technology Frontier.

We need to concepuatlize this frontier more broadly than technology skill acquisition and application.

Human-Frontier Dispositions

- Predominance of dynamic interdisciplinary teams (BioScann, CompuGirls)
- Focus on Data (GRACE, BioScann)
- Ubiquitous CT (CG, GRACE)
- Engineering Design/Design Thinking (GRACE, BioScann)
- Blurred Boundaries between Human and Machines (CG)
- Education on PBL (GRACE, BioScann, STEMulate)
- Continuous Lifelong Learning (All)

Next Gen STEMforce

- Typical technology skillsets include learning how to use and apply specific tools
- Many projects demonstrate the application of technology to empower social and community change
- Many communities do not have access to or knowledge about existing, ubiquitous technologies, which can be used effectively to address local and critical issues.
- STEM-ready, STEM-pipeline, STEM-workforce must be defined more broadly than nurturing STEM careers, including increasing STEM literacy for non-STEM careers