Dr. Ethan Danahy

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Tufts University School of Engineering

Leveraging Educational Technologies to Capture, Share, and Interact with Students' Ideas

HGSE T561, Fall 2016

October 17th, 2016

Tufts UNIVERSITY | Center for Engineering Education and Outreach

http://www.sayresd.org

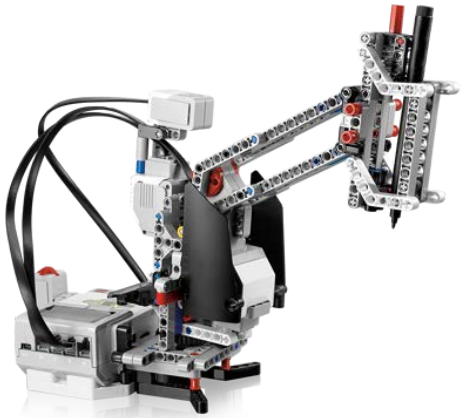
http://www.edudemic.com

Research Interest

Developing and analyzing educational technologies and environments for supporting STEM learning

http://en.community.dell.com

http://web.uri.edu



http://education.lego.com

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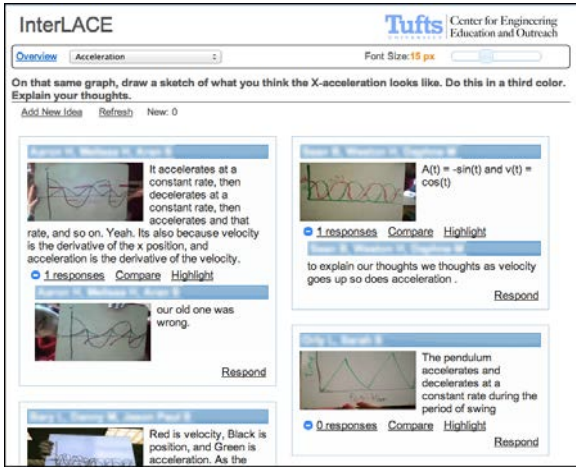
Research Area

- Educational Technologies: new hardware, software, interfaces for teaching and learning

- Focus on STEM (science, technology, engineering, and math) subjects, from K to primary to secondary through university
- Special emphasis on **creativity** in engineering, on **documentation** of student work (the process), and on **collaboration**



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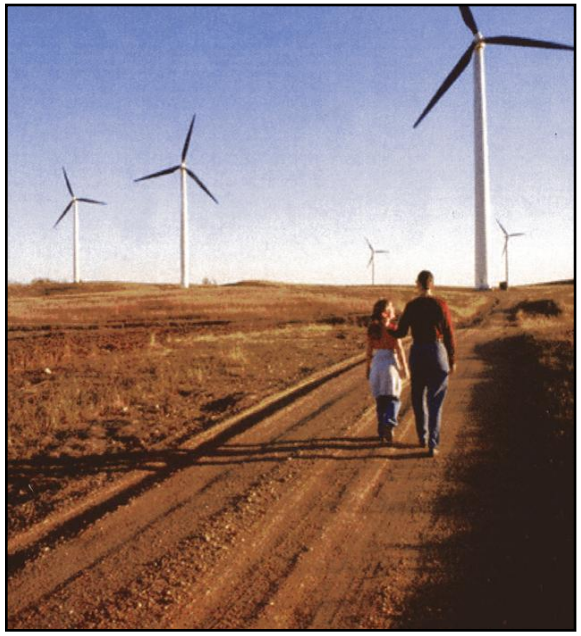
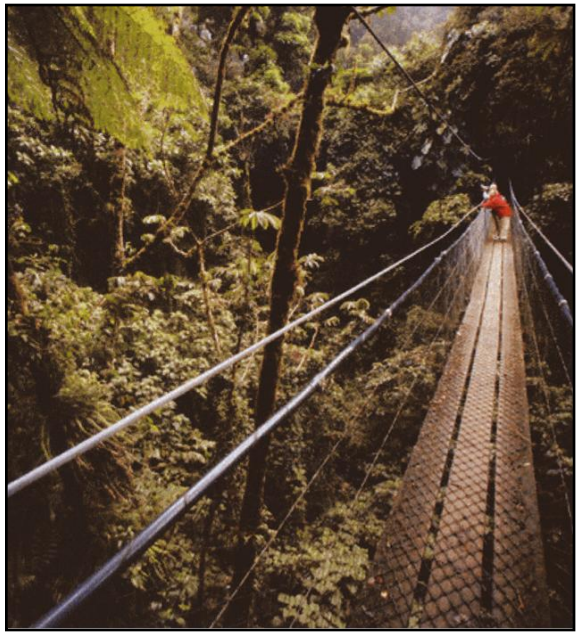


TEACHING PRACTICES:

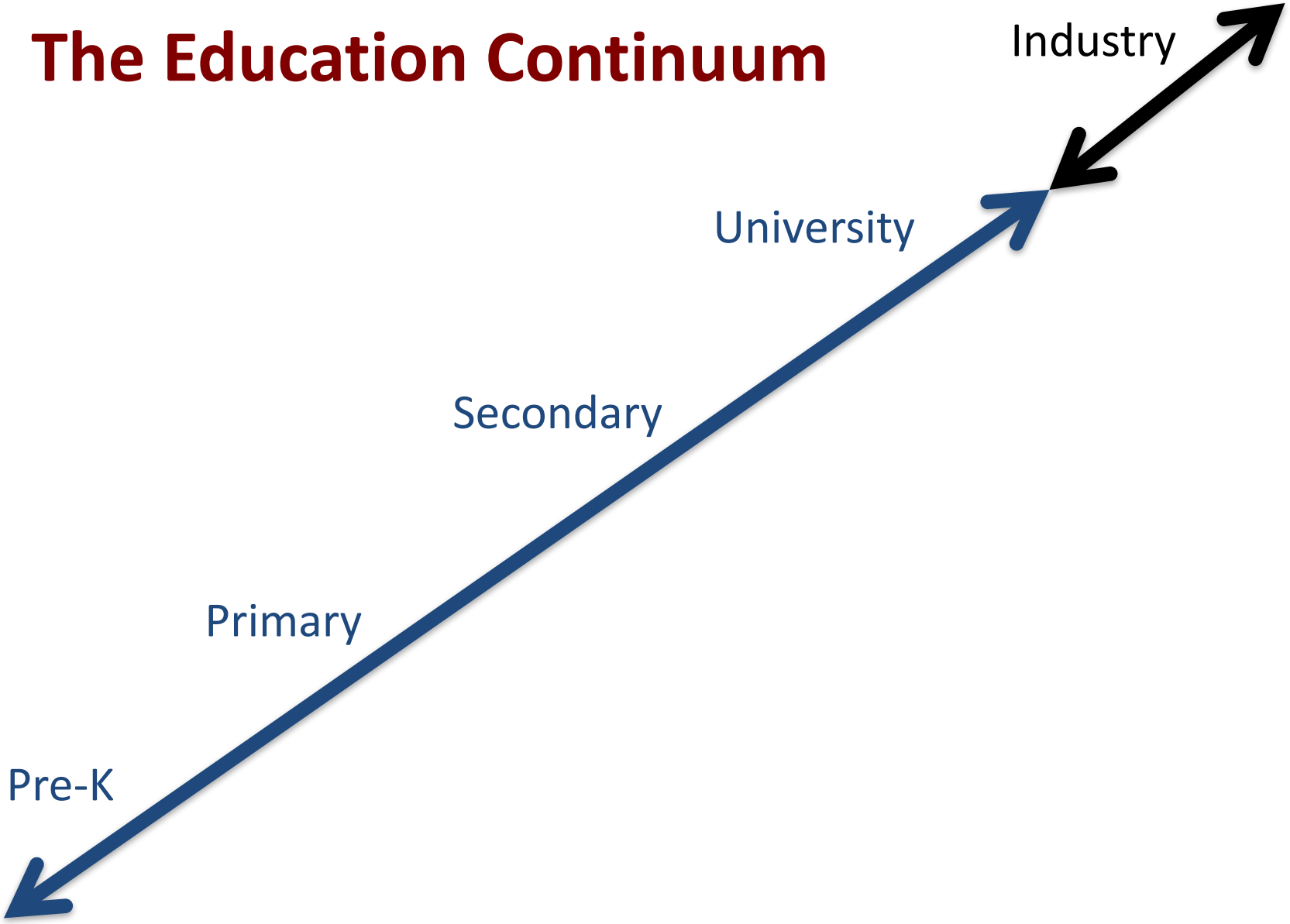
- Science, Technology, Engineering, Math (STEM)
- Hands-on activities
- Project Based Learning
- Engineering Design Process
- "Real-World" Applications

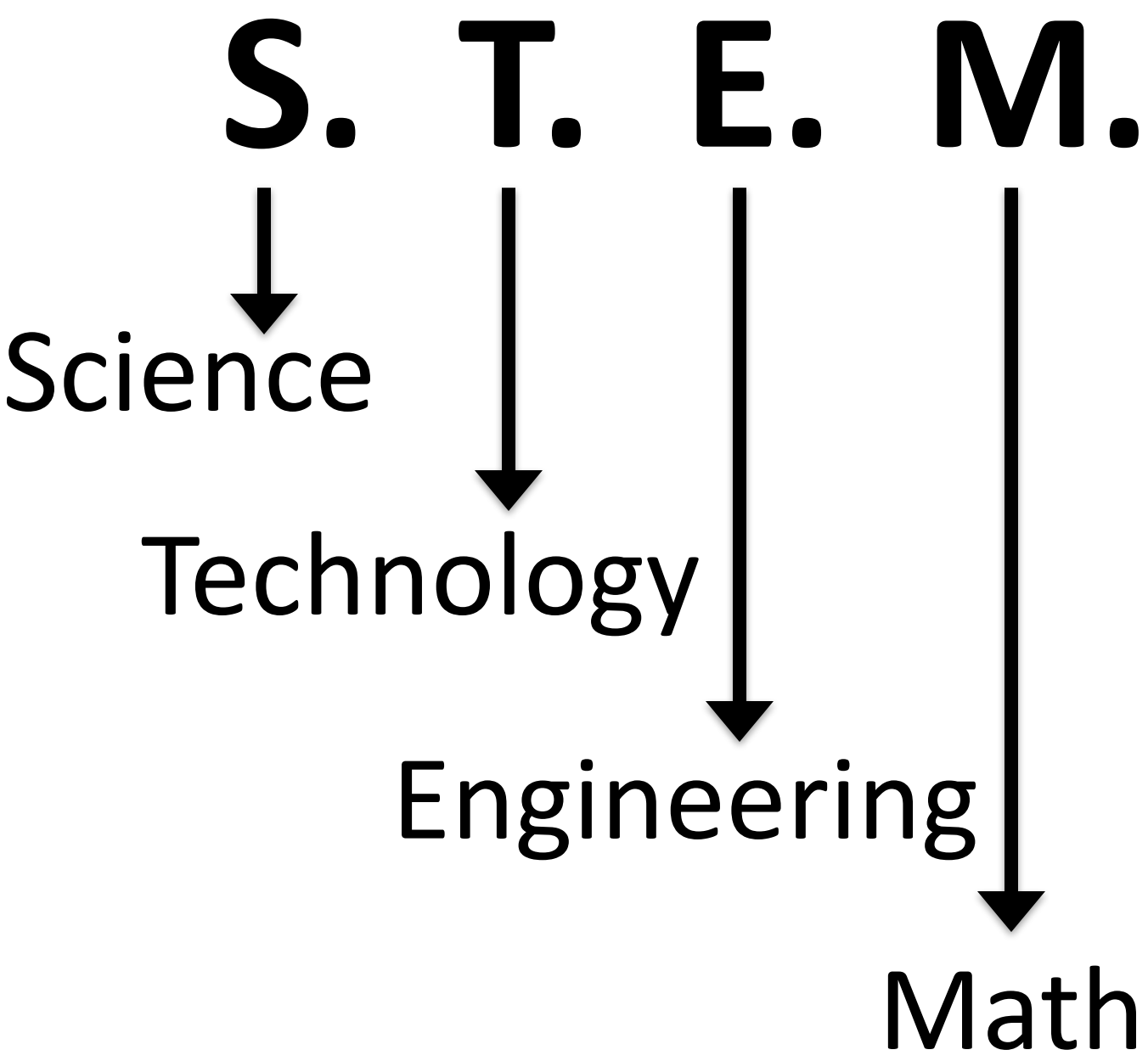


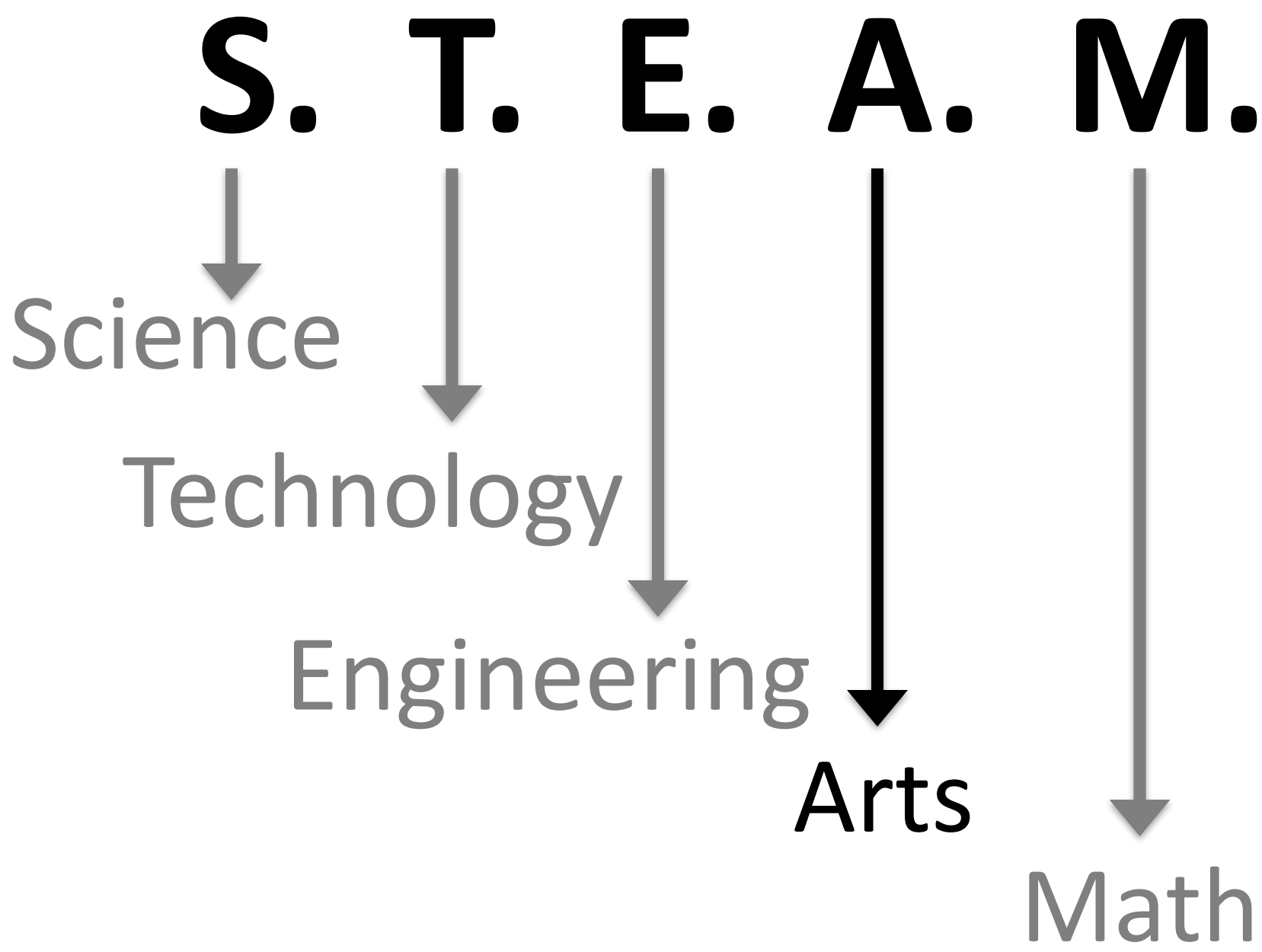
RESULTS:

- Increase technological literacy
- Peak curiosity
- Stimulate creativity
- Build self-confidence
- Instill passion for learning

The Education Continuum




S. T. E. M.
Science
Technology
Engineering
Math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IMPERVIOUS AREA = 100,000 SF + 50,000 SF = 150,000 SF

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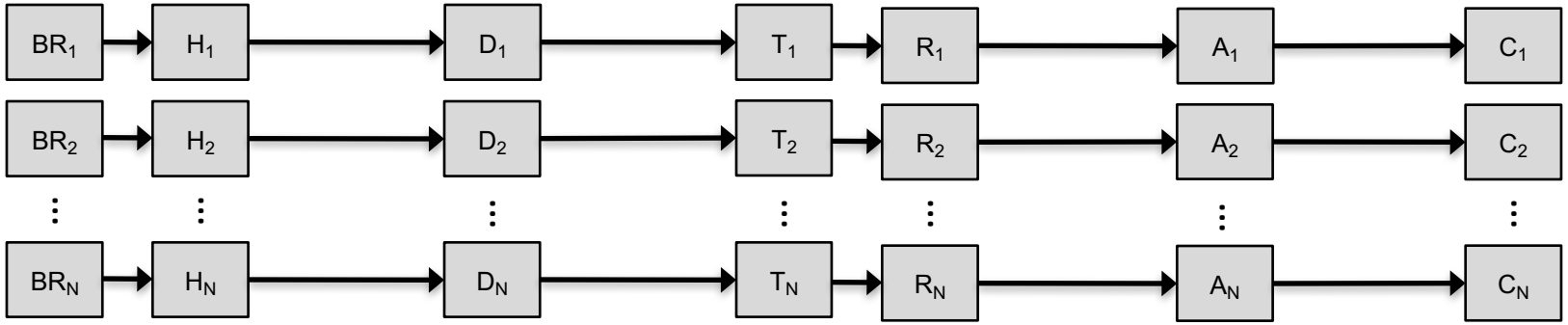
Individual Groups Working Independently



Background Research (BR) → Hypothesis (H) → Design (D) → Test (T) → Results (R) → Analysis (A) → Conclusion (C)

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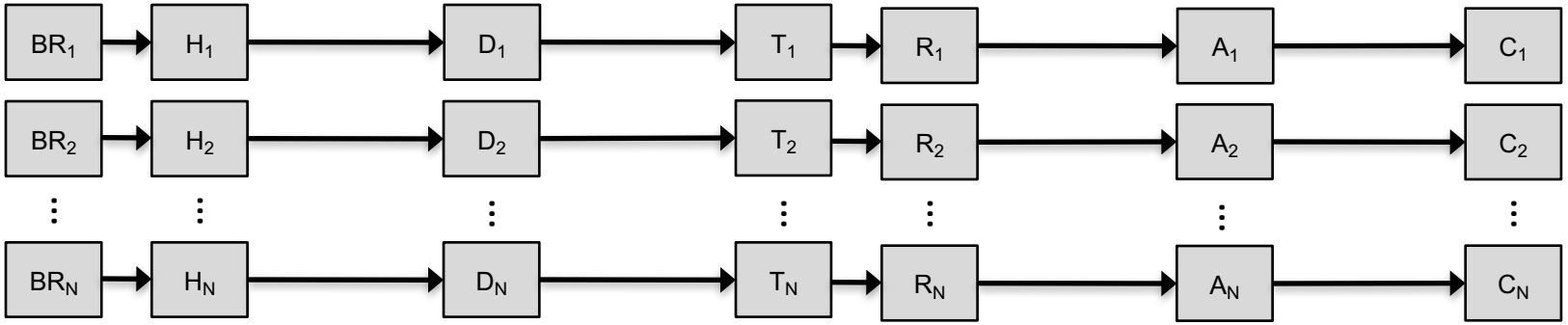

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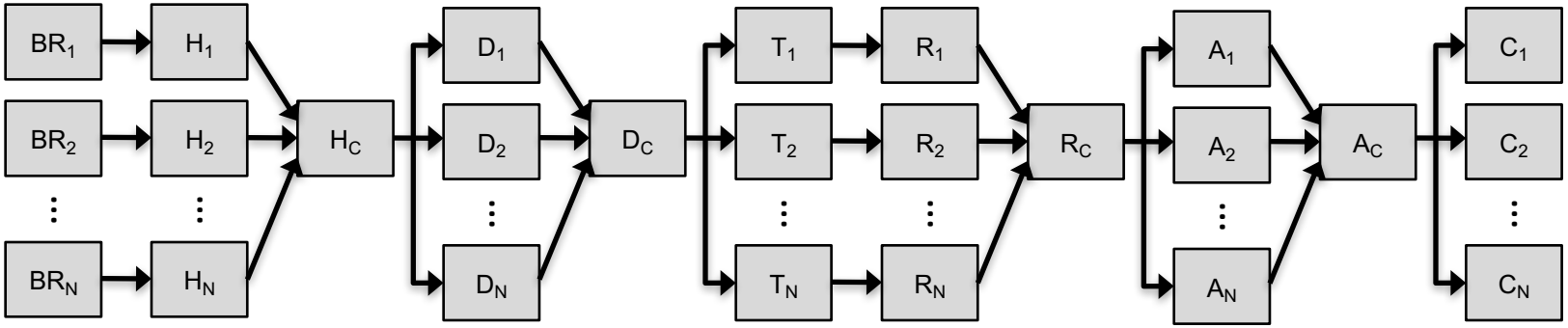

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Periodic Cross-Group Sharing Resulting in Collaboration

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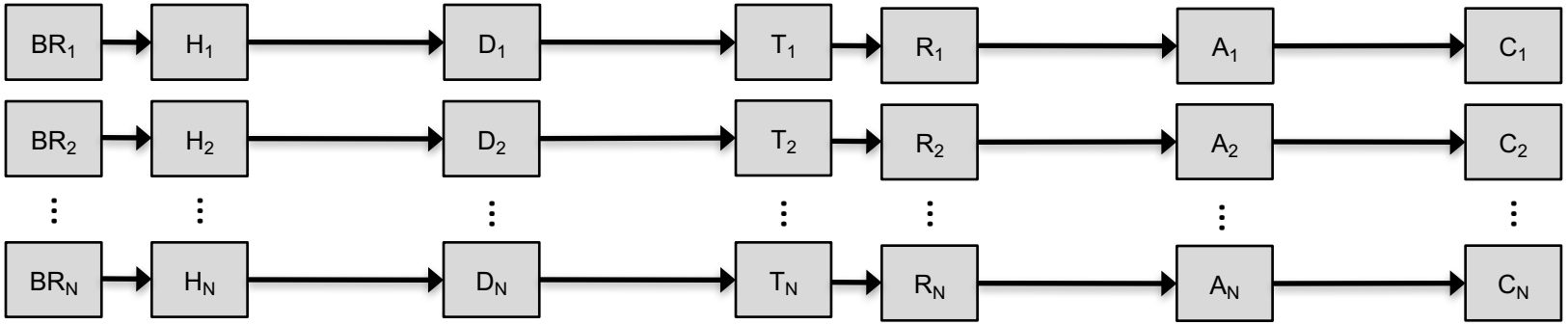

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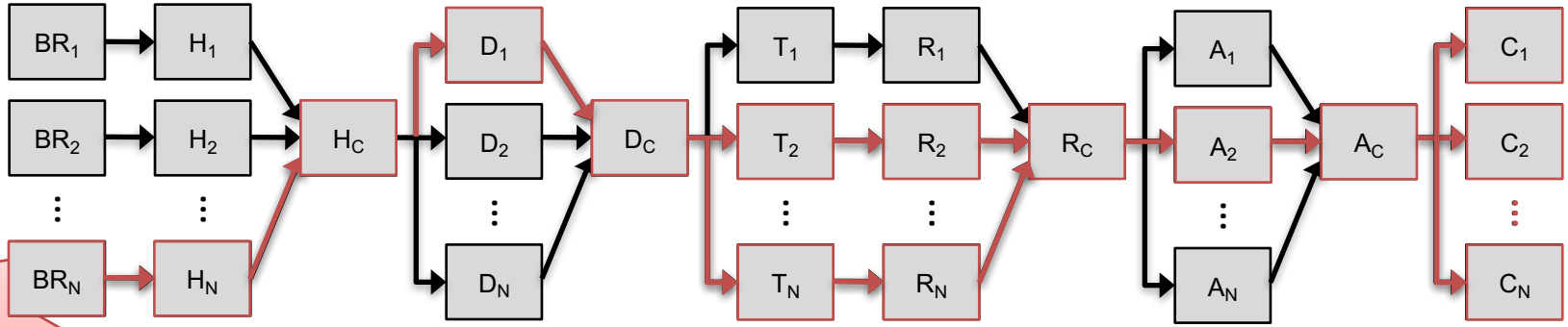


New Idea

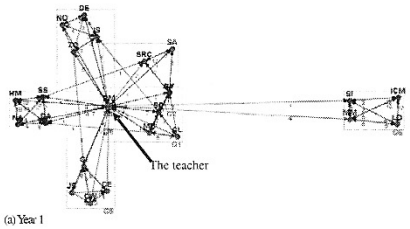
Background Research (BR) → Hypothesis (H) → Design (D) → Test (T) → Results (R) → Analysis (A) → Conclusion (C)

Periodic Cross-Group Sharing Resulting in Collaboration

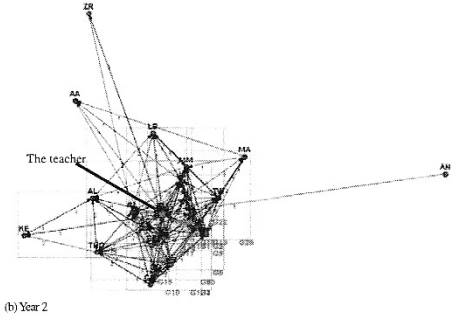
Social Network Analysis (SNA)

SNA Diagrams from Zhang et. al. (2009)

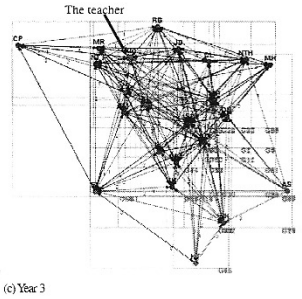
Teacher-centric class with small fixed-groups



Interacting groups

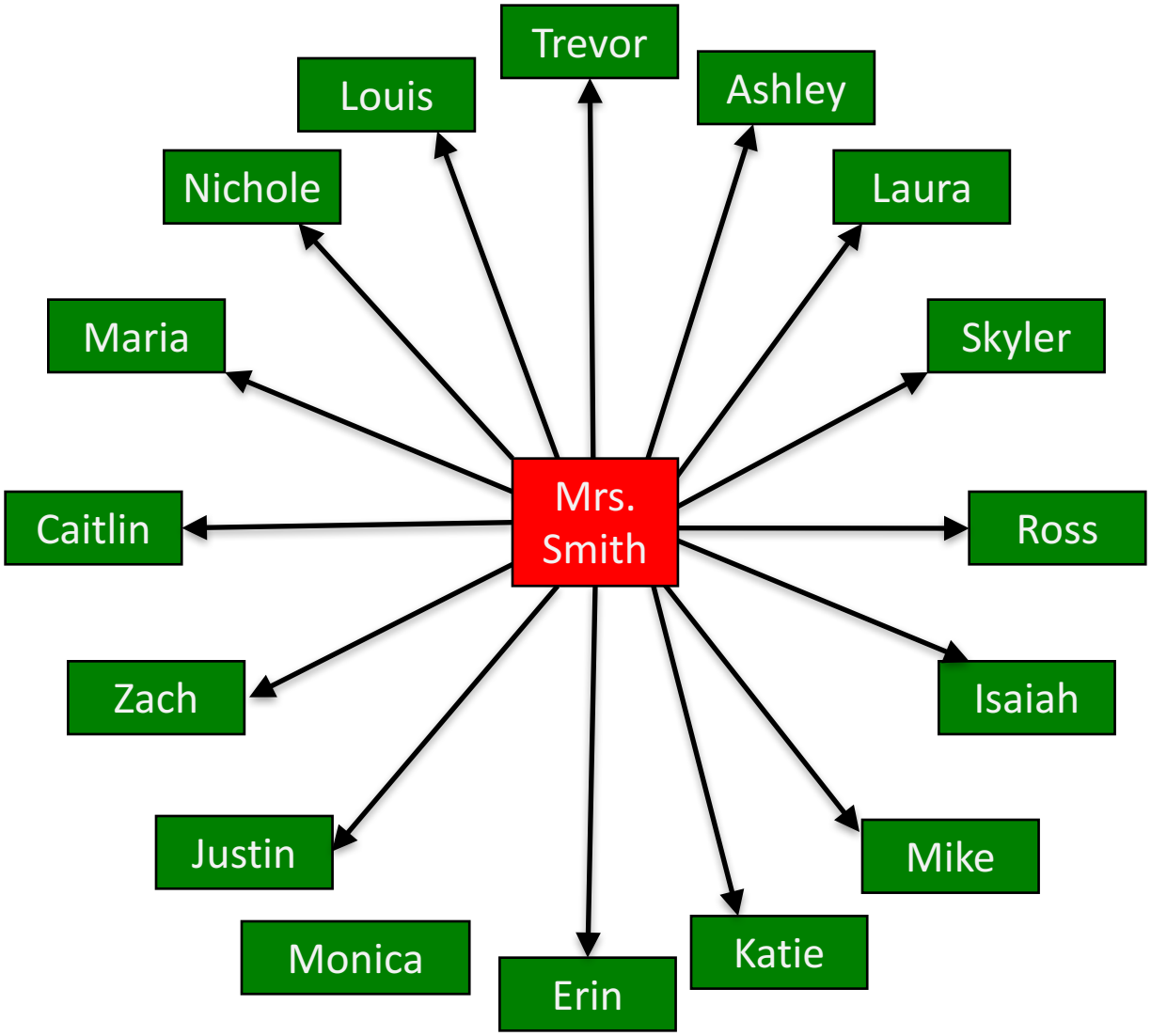


Opportunistic collaboration

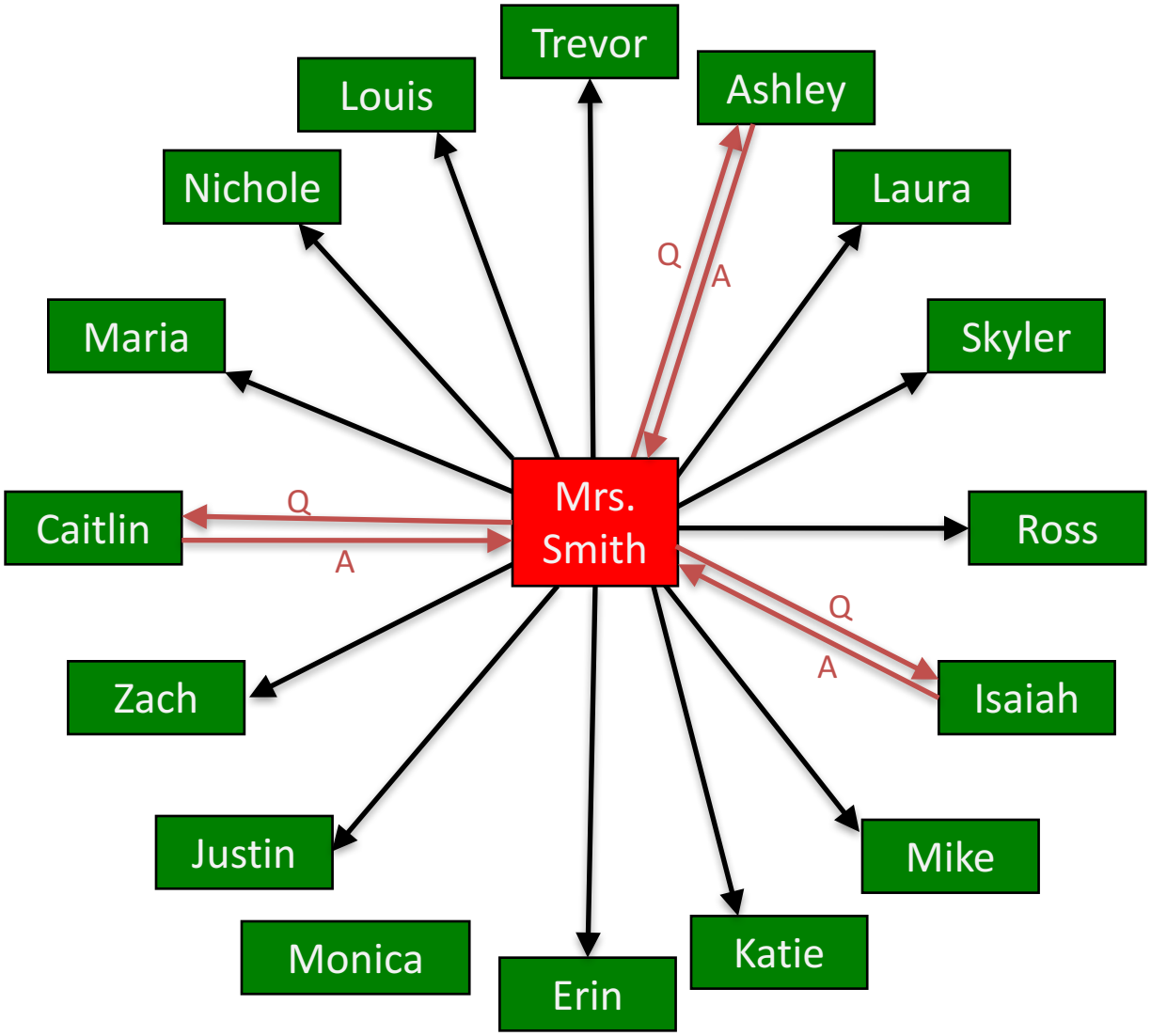


Zhang, Scardamalia, Reeve & Messina (2009). Designs for Collective Cognitive Responsibility in Knowledge-Building Communities. Journal of the Learning Sciences, 18:1, 7-44.

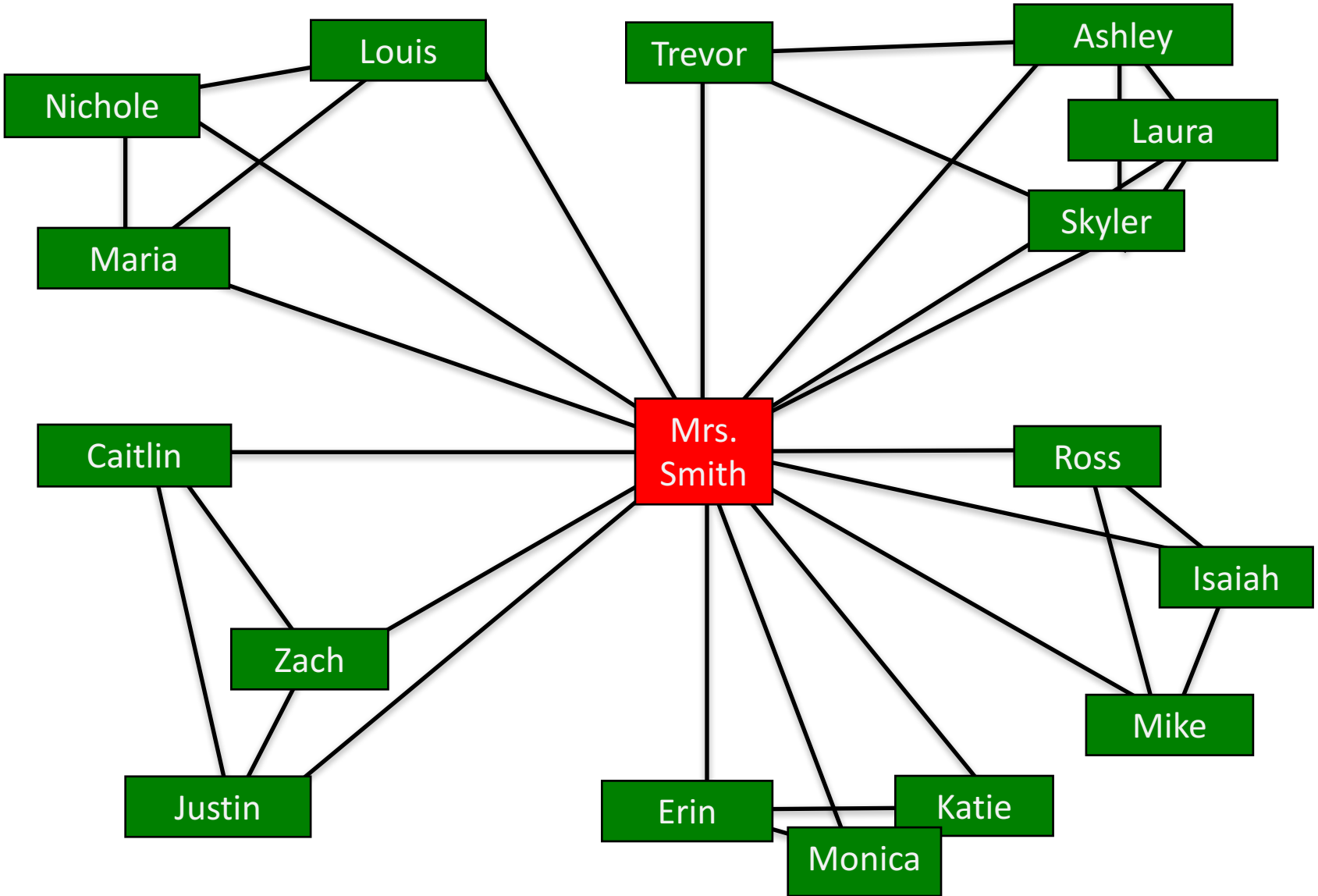
SNA: Lecture Style



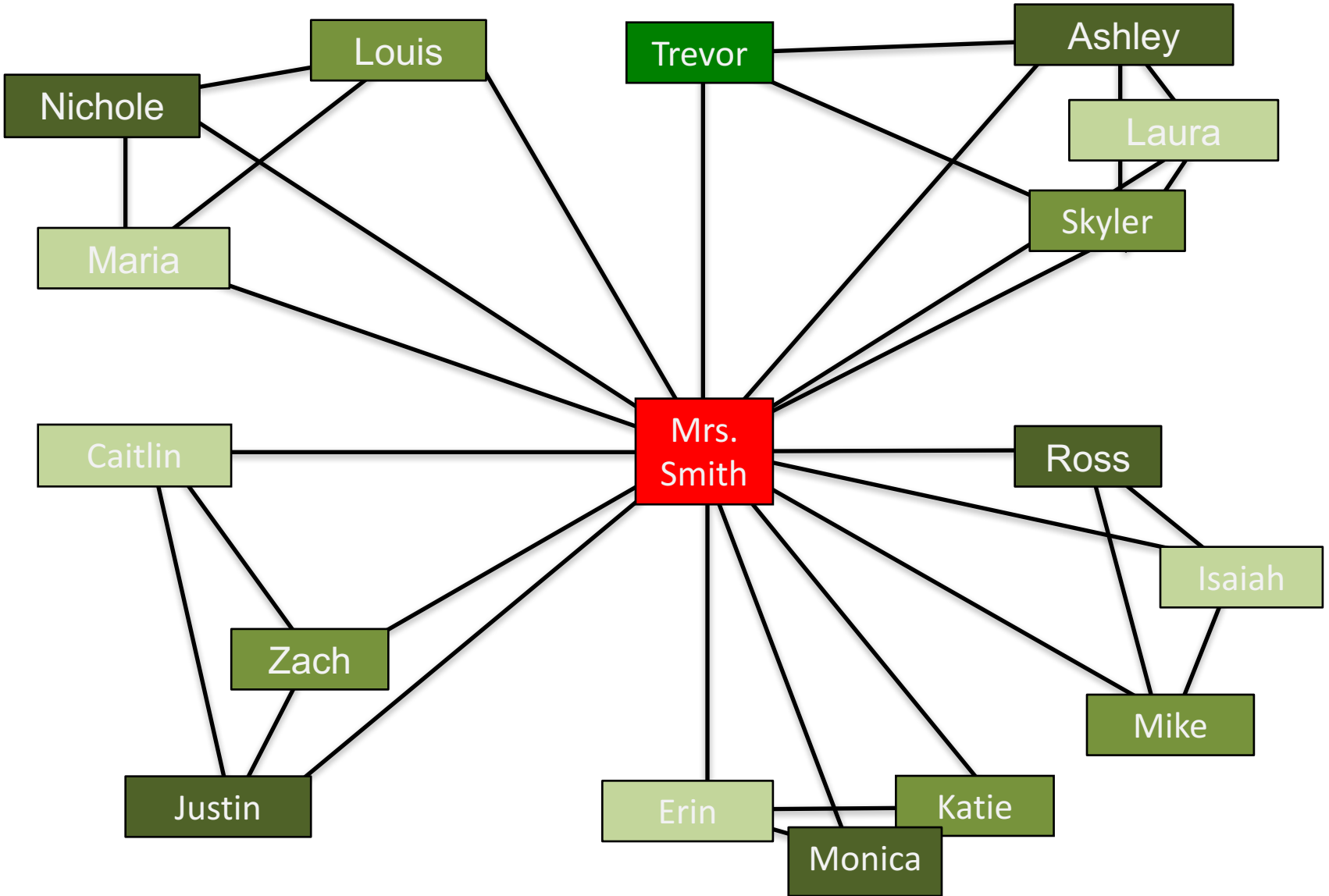
SNA: Lecture Style + Q&A



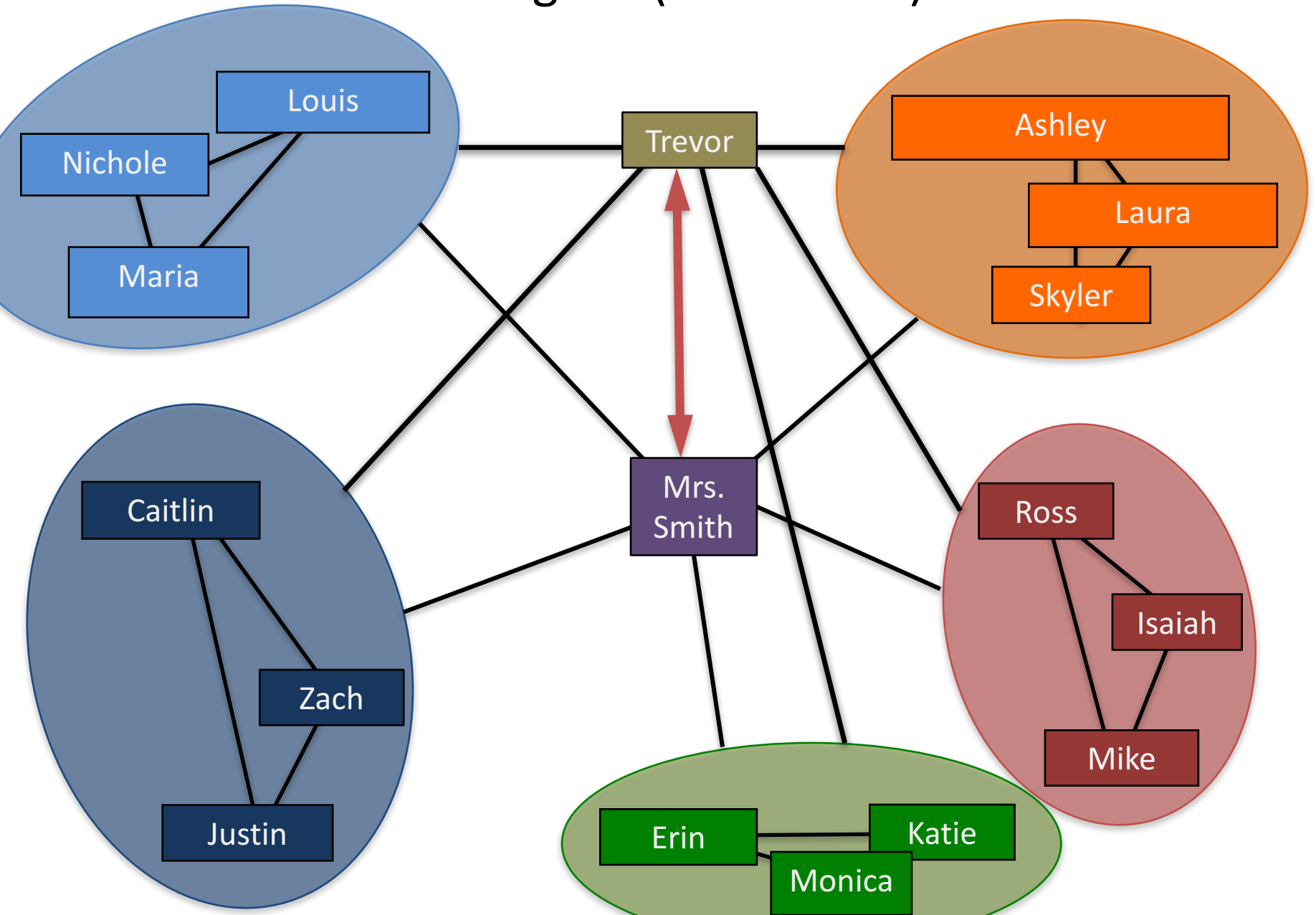
Idealized Small Group Social Network



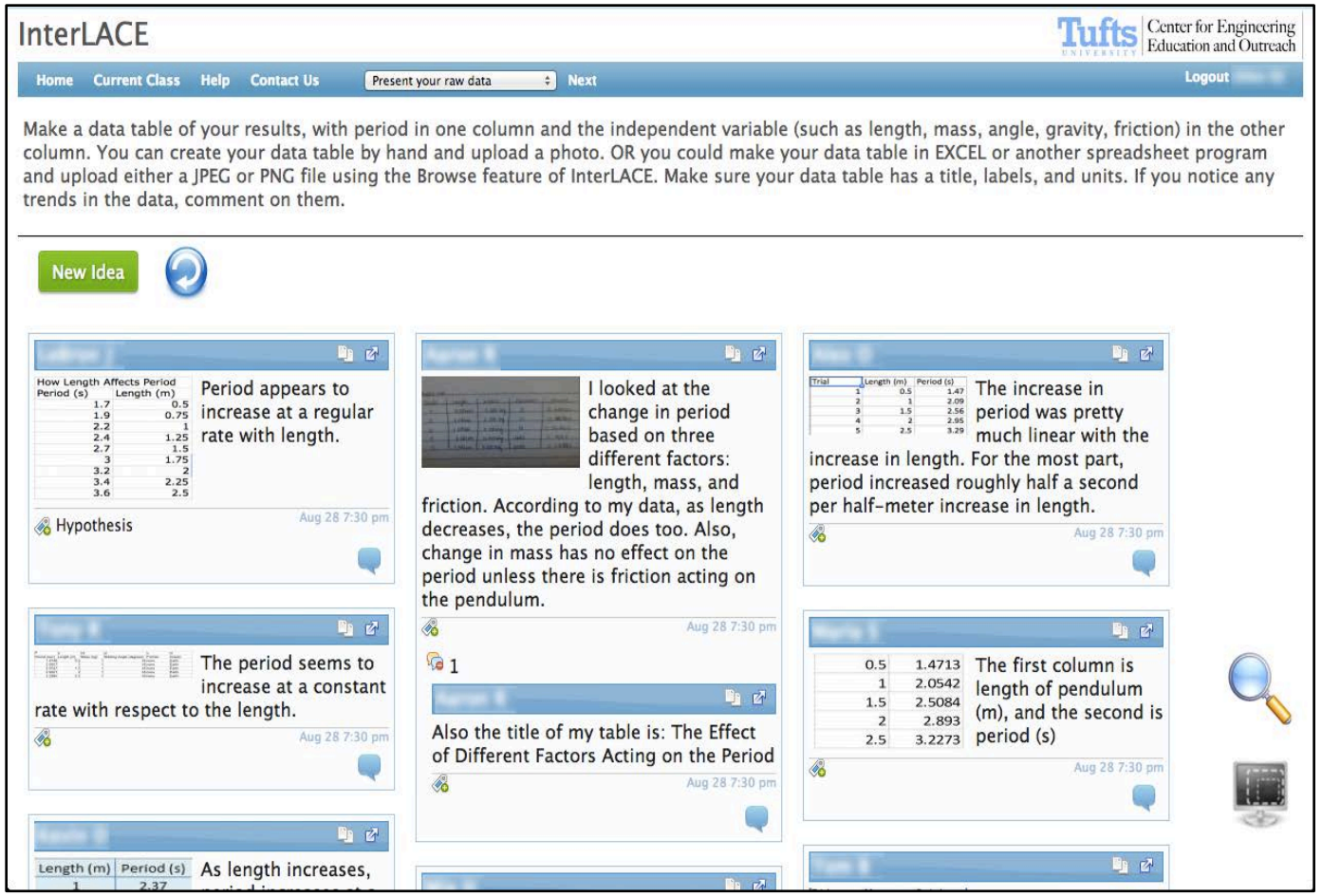
Idealized Small Group Social Network with Individualized Roles within Groups



Idealized Small/Individualized Group Social Network with "Rogue" (moderator)



InterLACE: Interactive Learning and Collaboration Environment

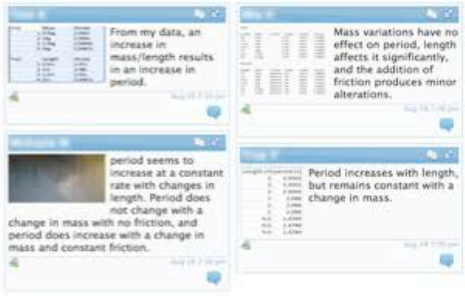


Work supported in part by NSF grant #1119321

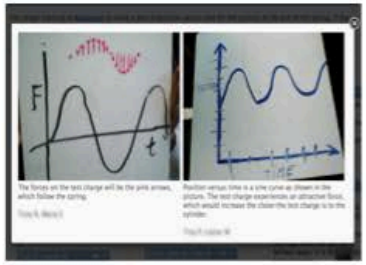
Design Principles

- Facilitate student discussion, argumentation, and negotiation to empower students to share, develop, and build ideas, theories, and designs collectively.
- Promote collaboration among individual students, student groups, and the teacher.
- Enable the teacher to act as a facilitator of the above two principles, as well as to allow them to focus on student thinking.
- Flexible environment that can be customized to fit the culture of the classroom.

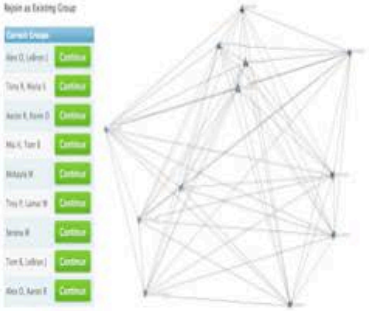
InterLACE Functionality



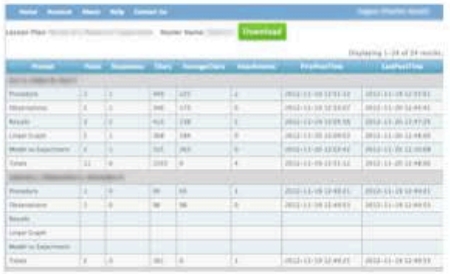
Persistent shared workspace for gathering and displaying student contributions



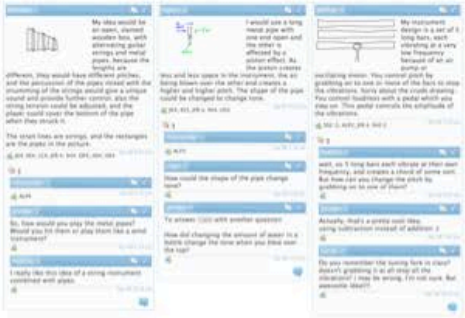
Ability to highlight and compare student work



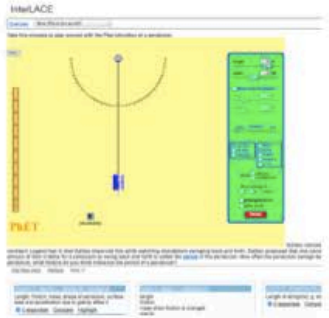
Real-time progress tracking and formative assessment information



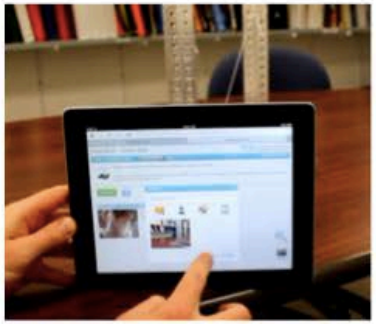
Automated analyses and user interface functions for facilitating summative grading



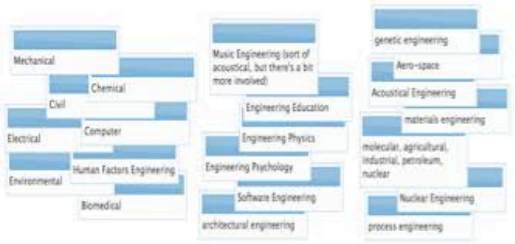
Commenting feature for enabling discussions and tagging for peer evaluation



Teachers can use existing content and embed third-party simulations

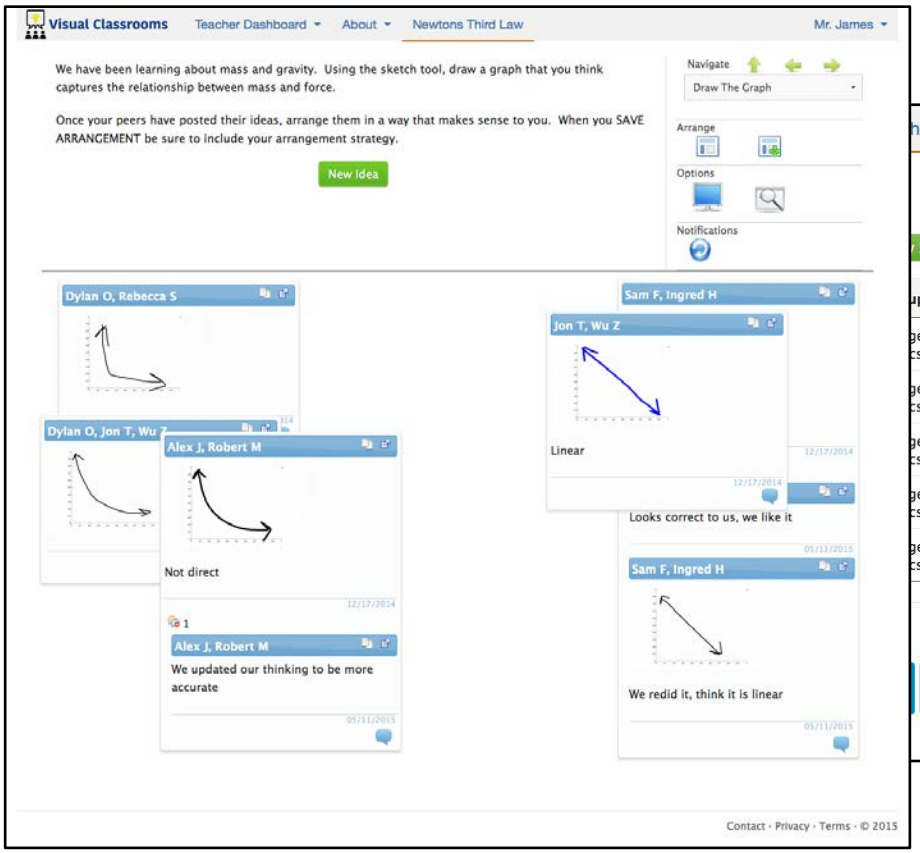


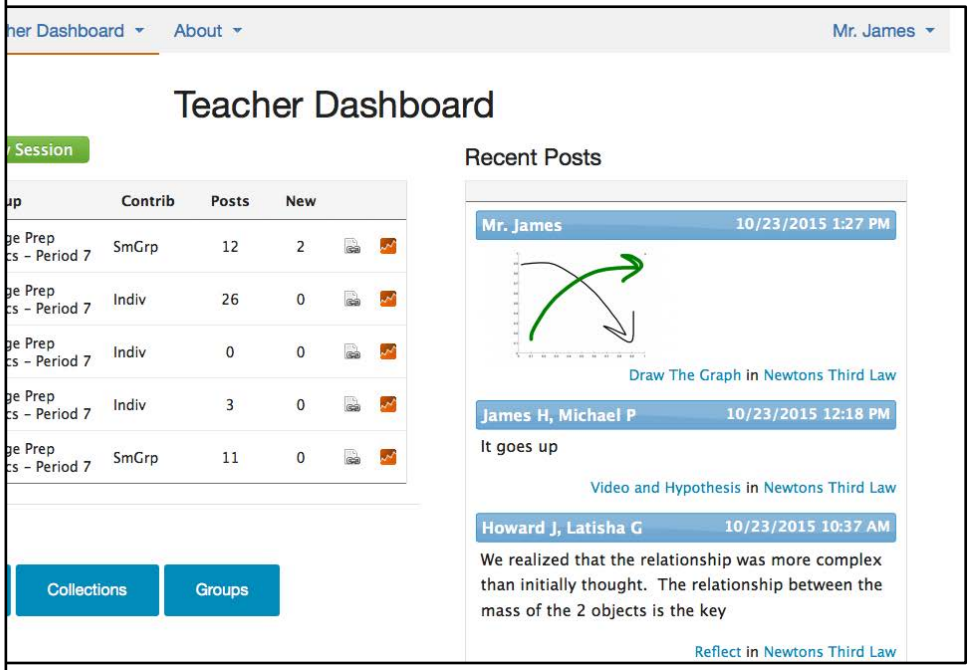
Variety of input devices for capturing student ideas, discussions, and class work



Grouping and saving individual arrangements for expressing spatial orientation of ideas

Visual Classrooms





http://VisualClassrooms.com

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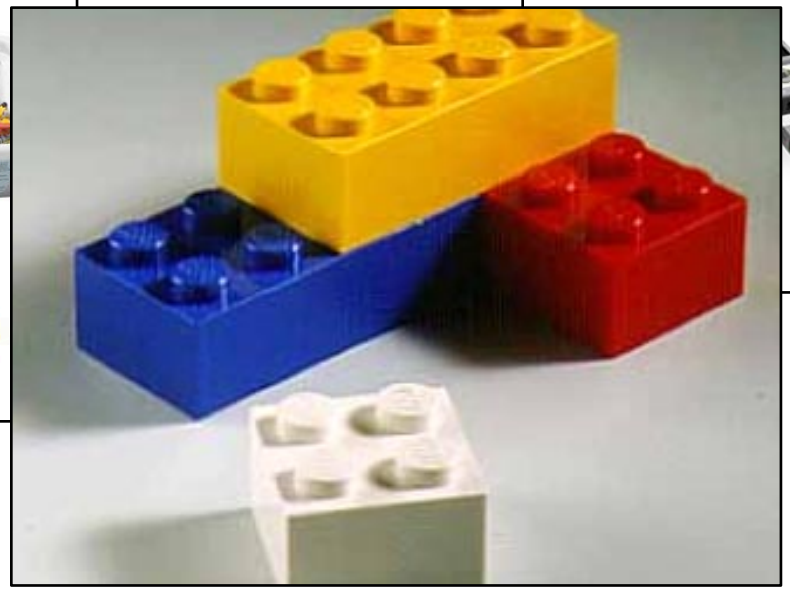
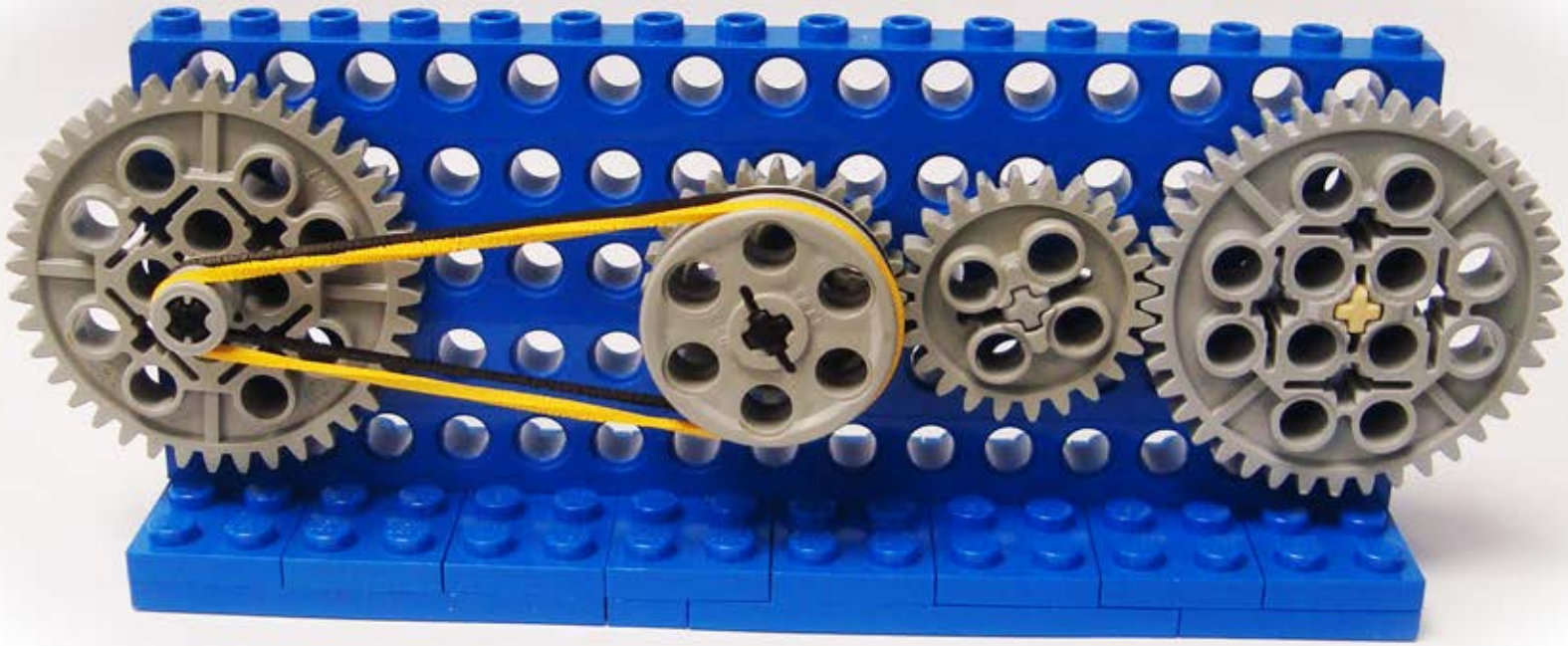
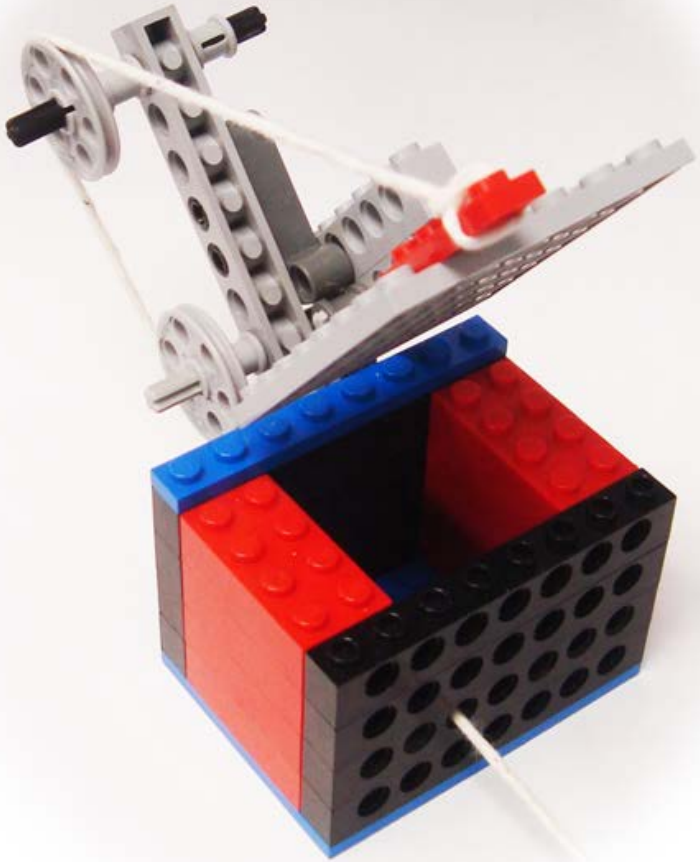
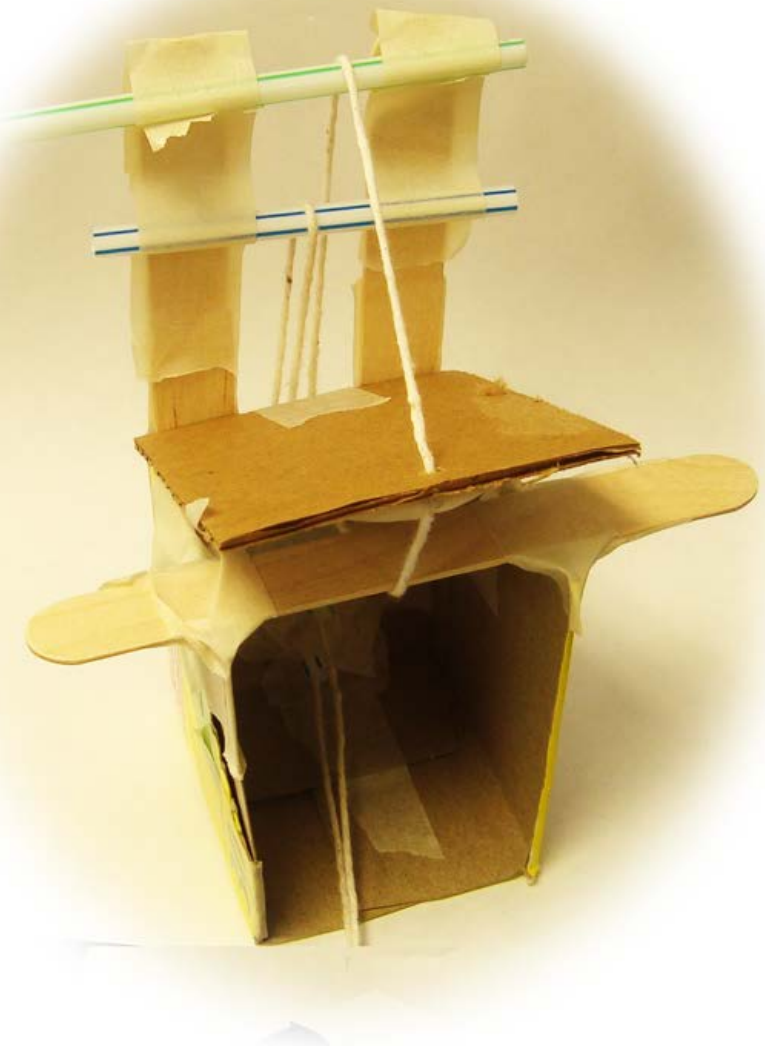
LEGO education

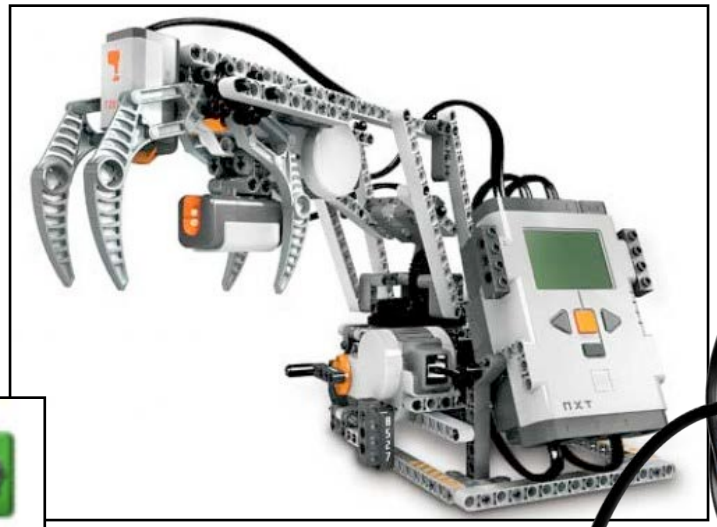









LEGO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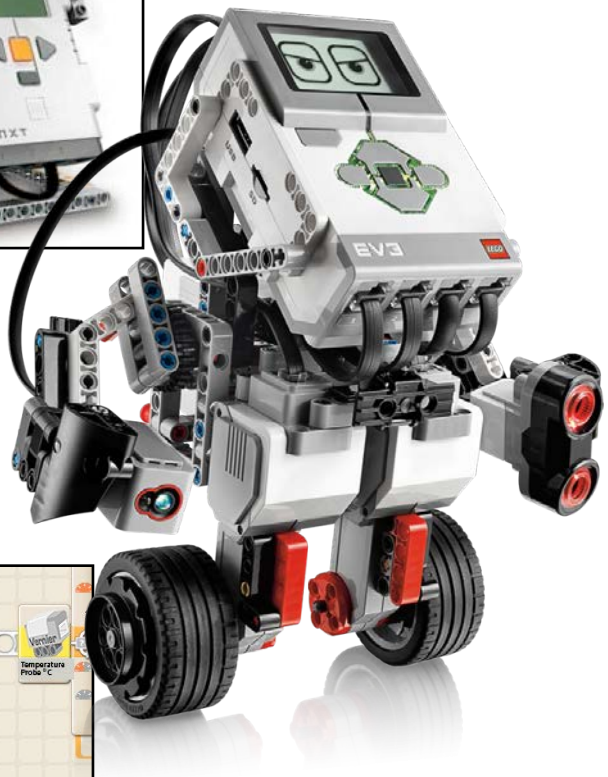
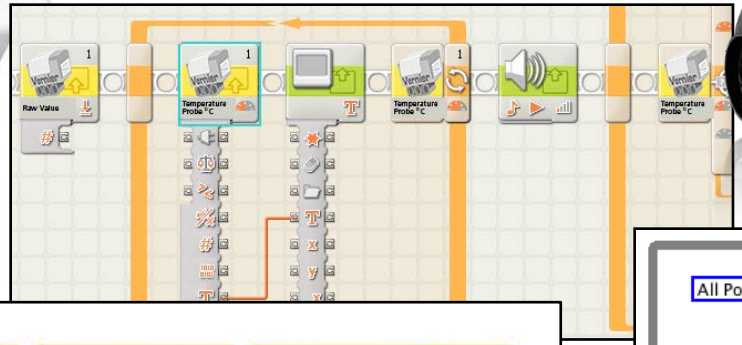
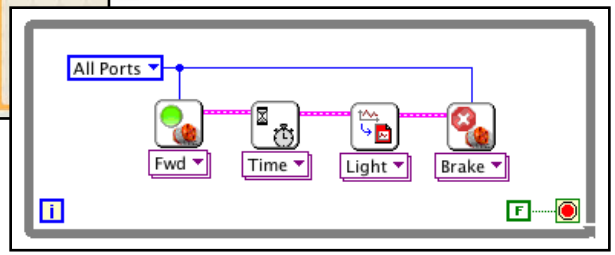
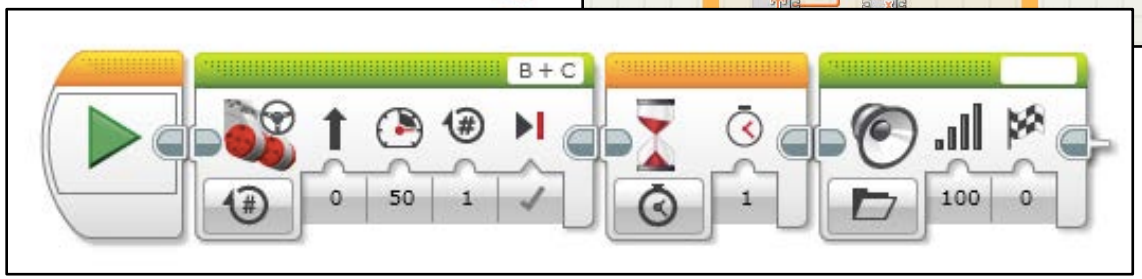

EV3

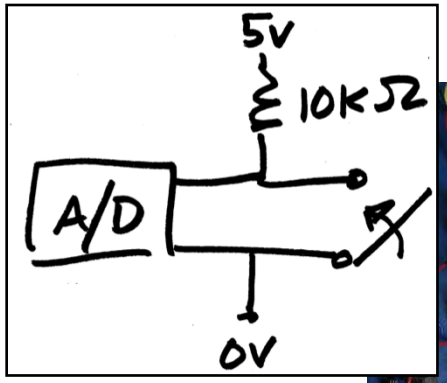

education
education

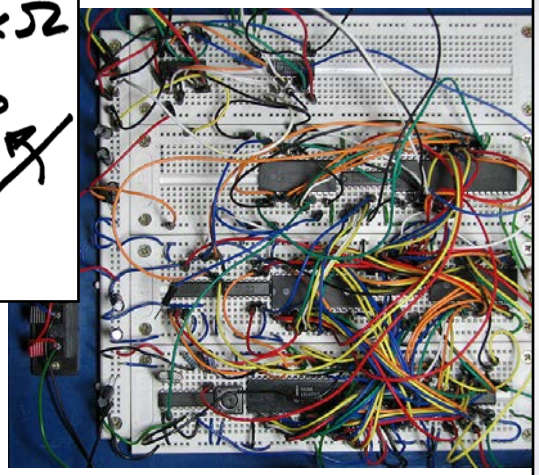

Raw Value
Temperature Probe °C


All Ports
Fwd
Time
Light
Brake


B + C
0
50
1
1
100
0

1990's: Learn to Build a Robot



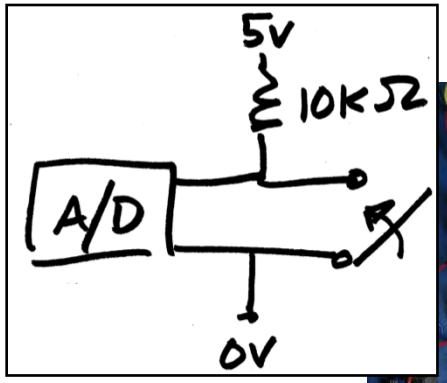


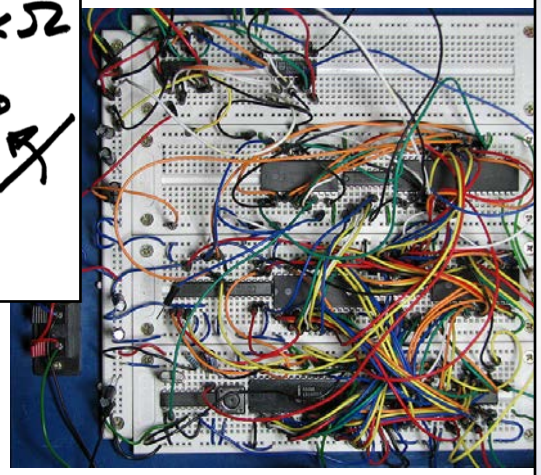
```
clare variables
al l,r,f,edgef,edgeb
al cnt,state


Get sensor information
=GetSensor(320)
=GetSensor(40)
=GetSensor(0)
dgef=GetGroundSensor(0)
dgeb=GetGroundSensor(180)

State selector
f state==0 Then
 If f>.7 Or l>.7 Or r>.7 Then
   state=1
```

1990's: Learn to Build a Robot





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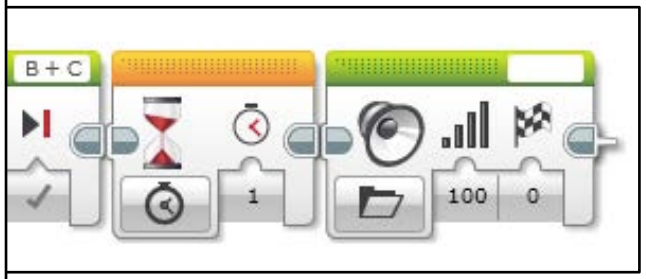
   state=1
```



2000's: Design and Create a Robot

The Education Continuum

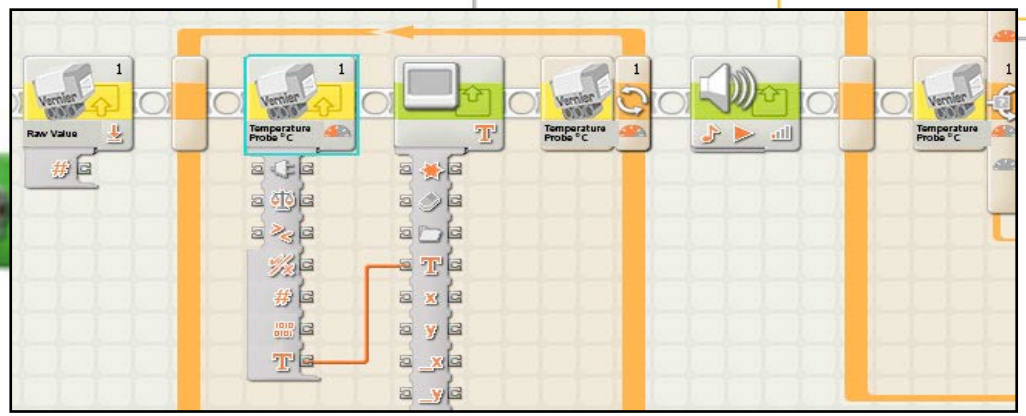
Industry

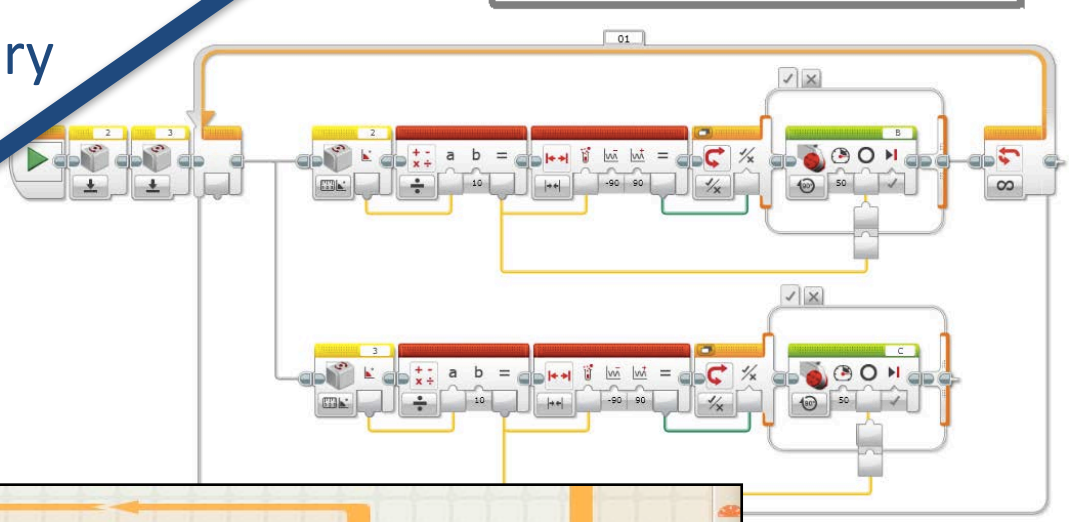
University

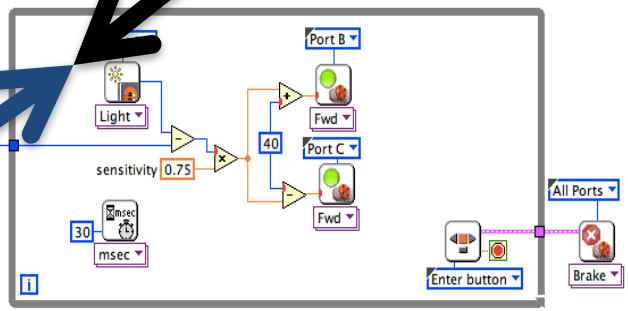
Secondary

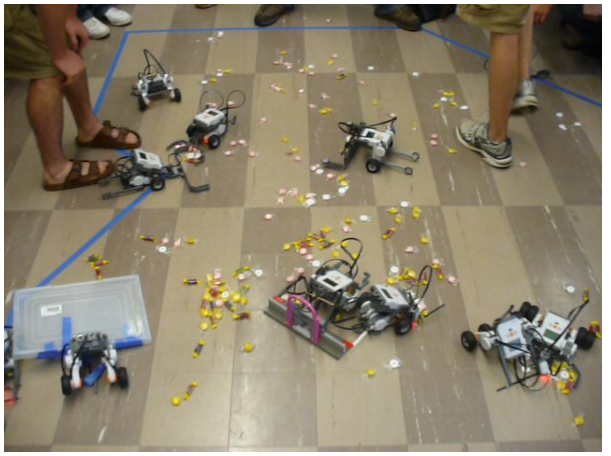
Primary

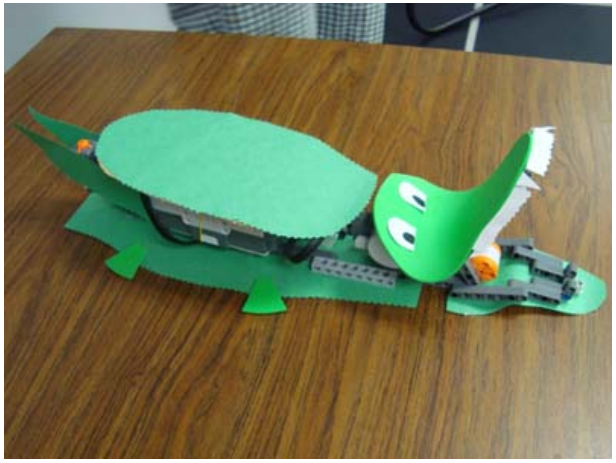
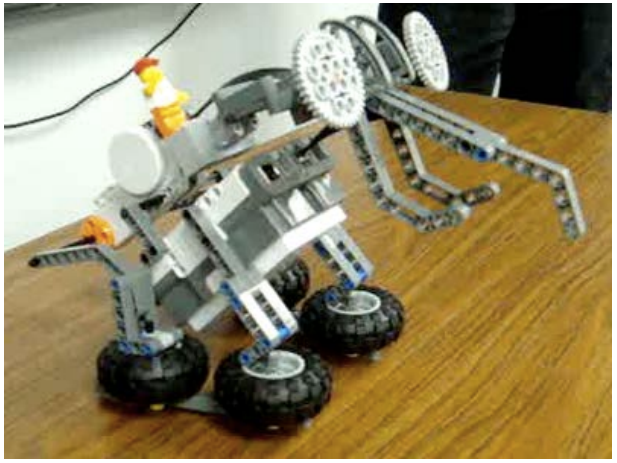
Pre-K

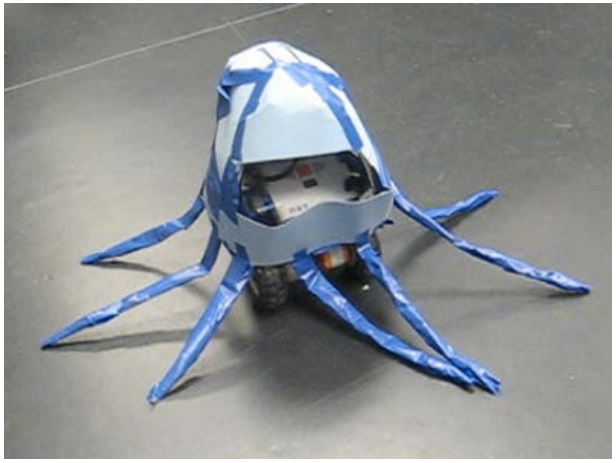


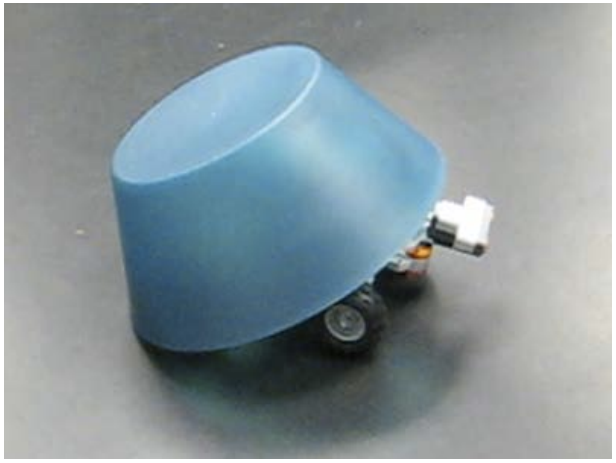
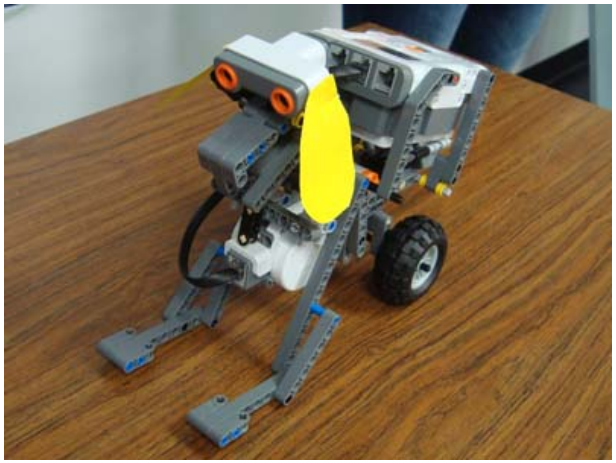
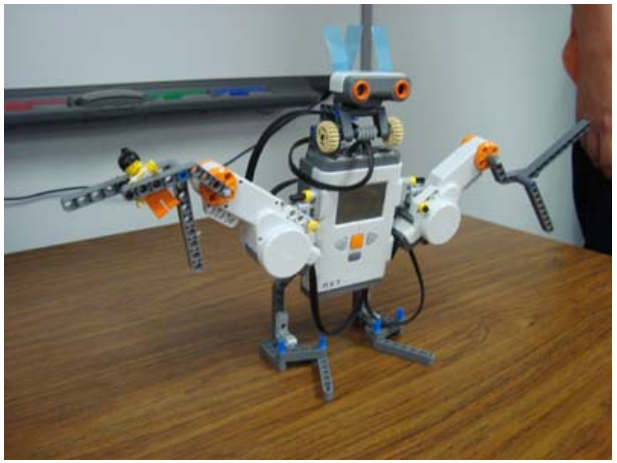
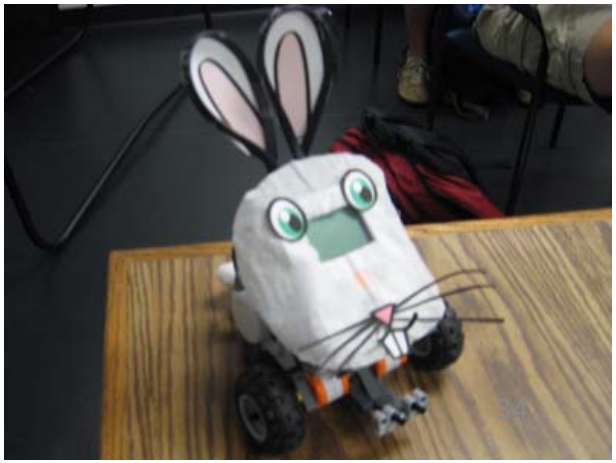




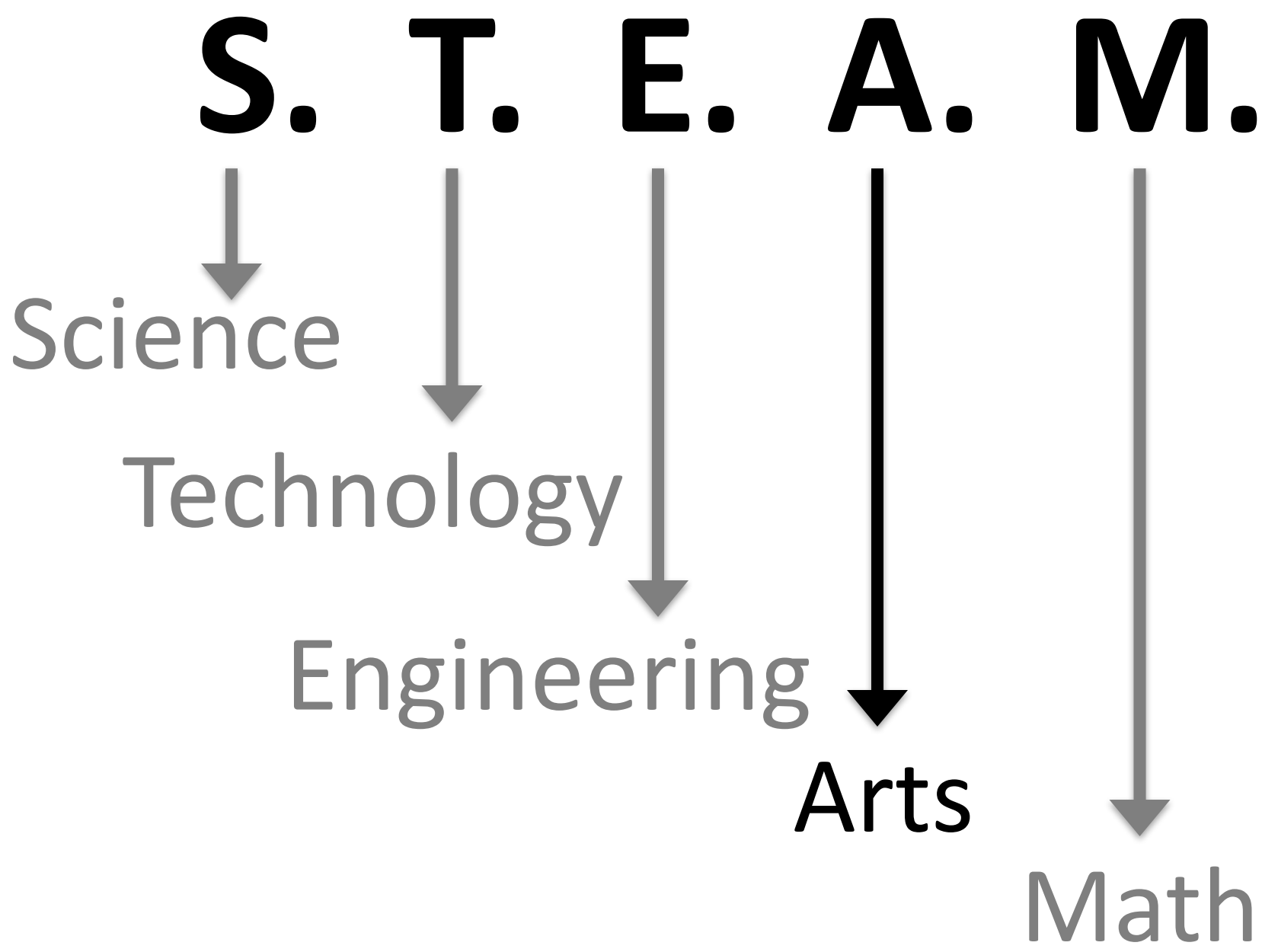


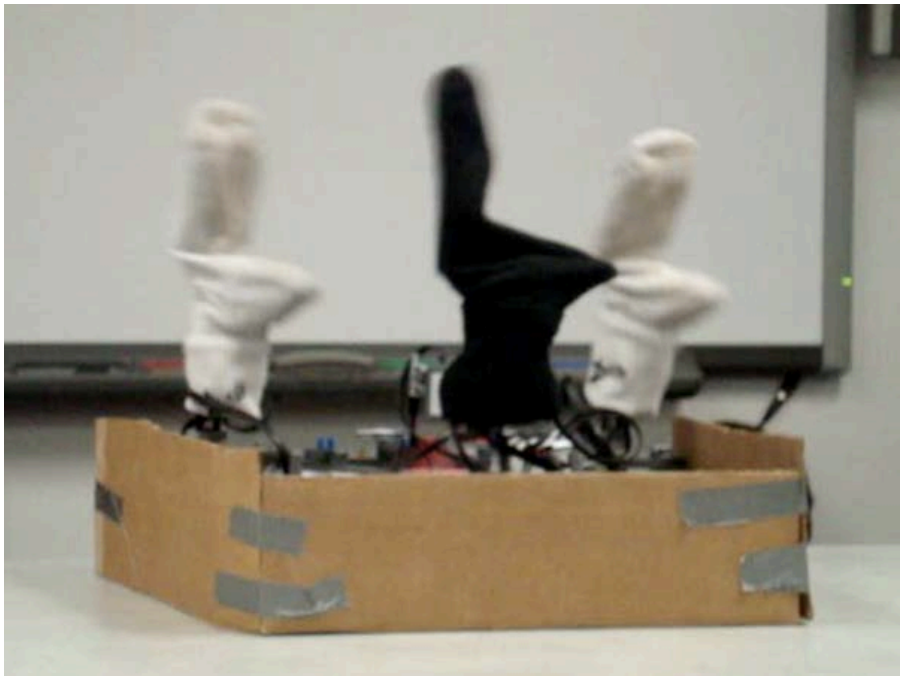





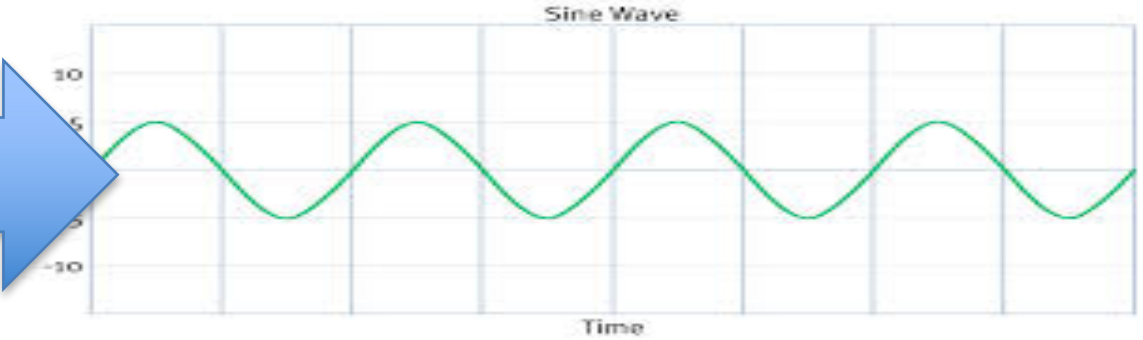





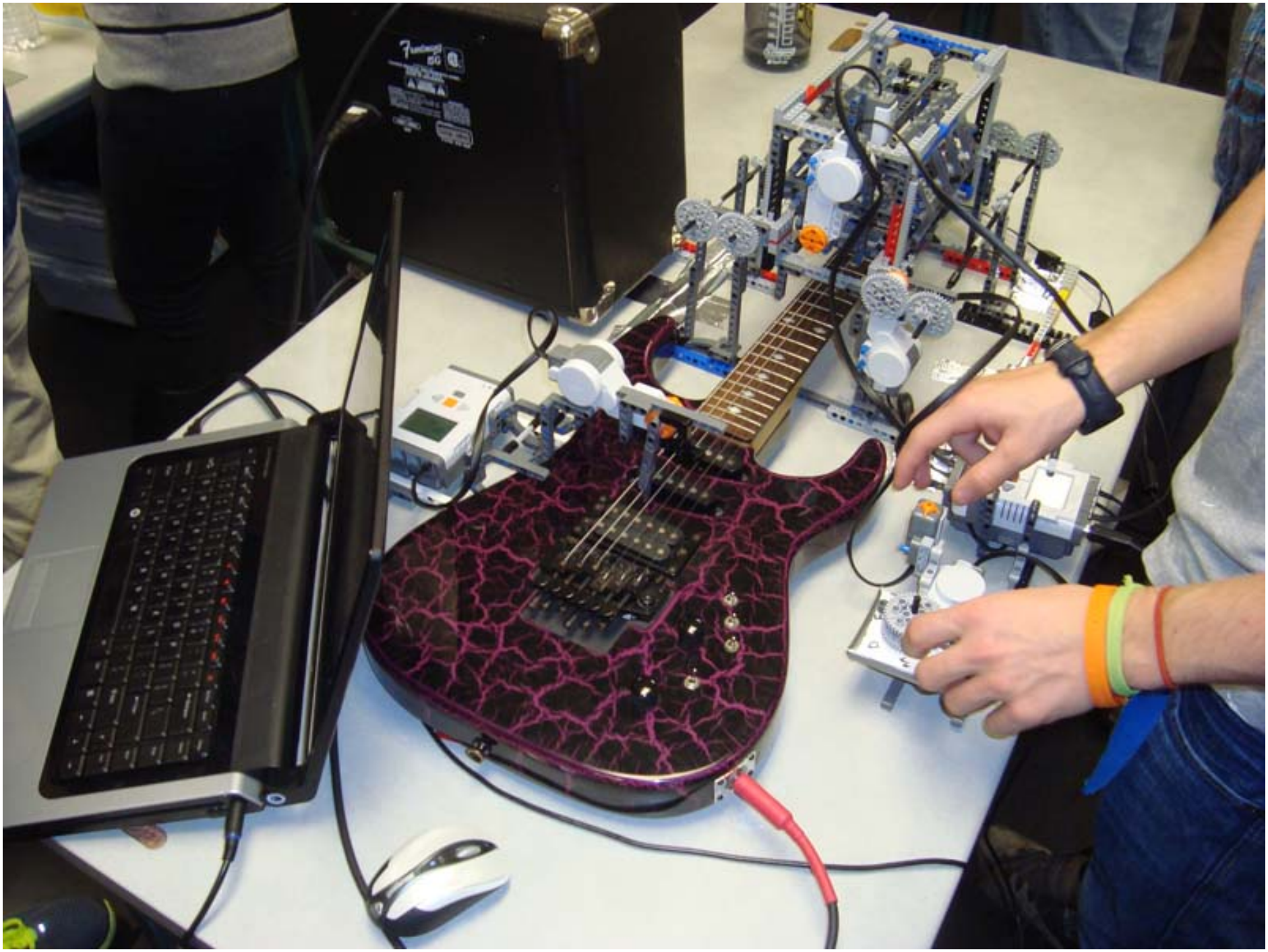

FUN
!!

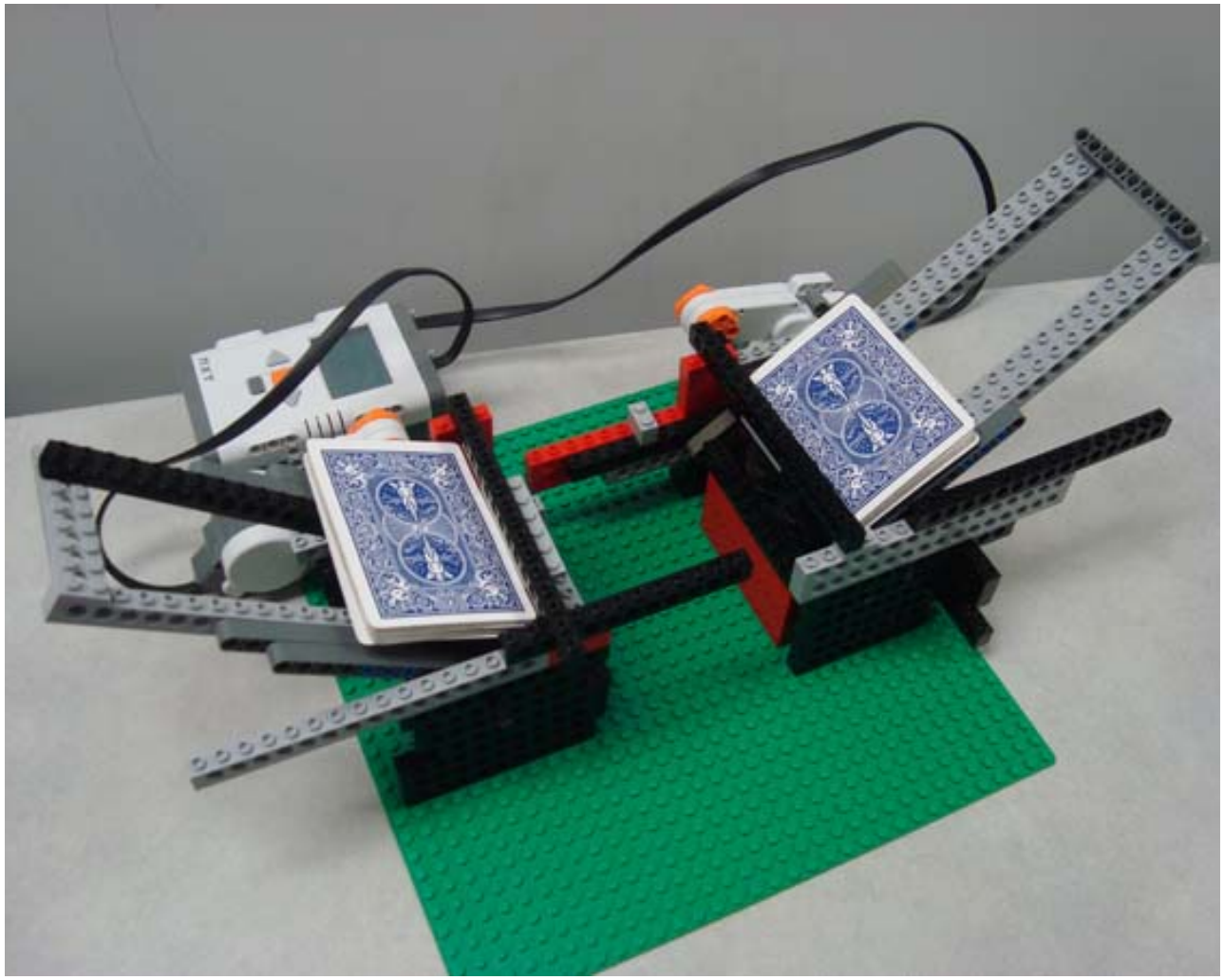

S. T. E. A. M.
Science
Technology
Engineering
Arts
Math

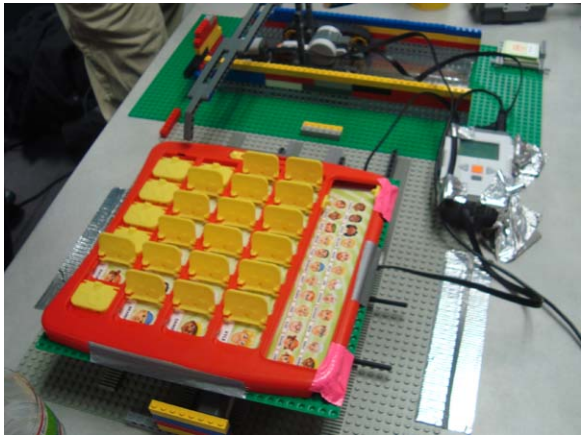


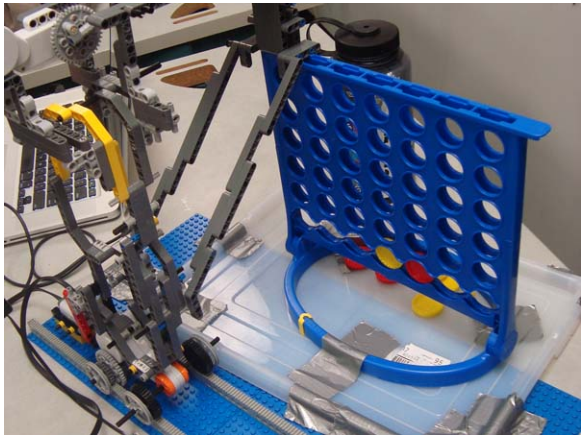

the crew


Sine Wave
10
-10
Time







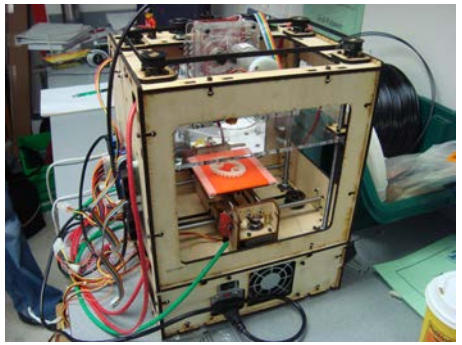


What I didn't show…

Physics Glasses

iPad & mobile devices

Alternative Platforms (URAPI)

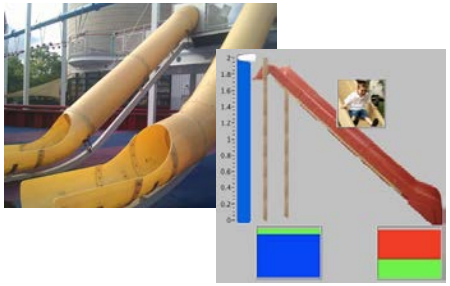


Maker Movement

Touch Table Interfaces

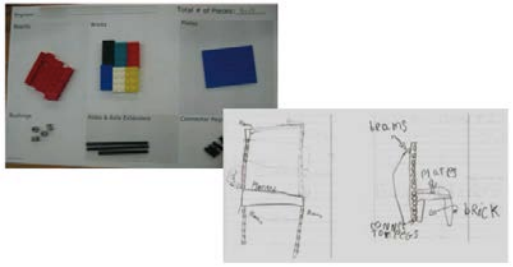
I.E.L.
Integrating Engineering and Literacy

Teacher Professional Development

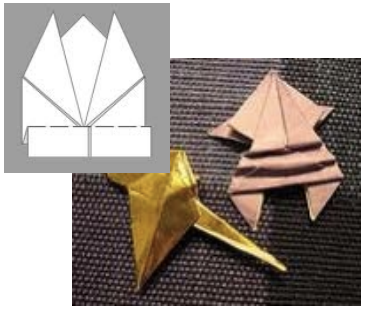


Interactive Playground Science (SciGames)

Conferences/Workshops



Education Research



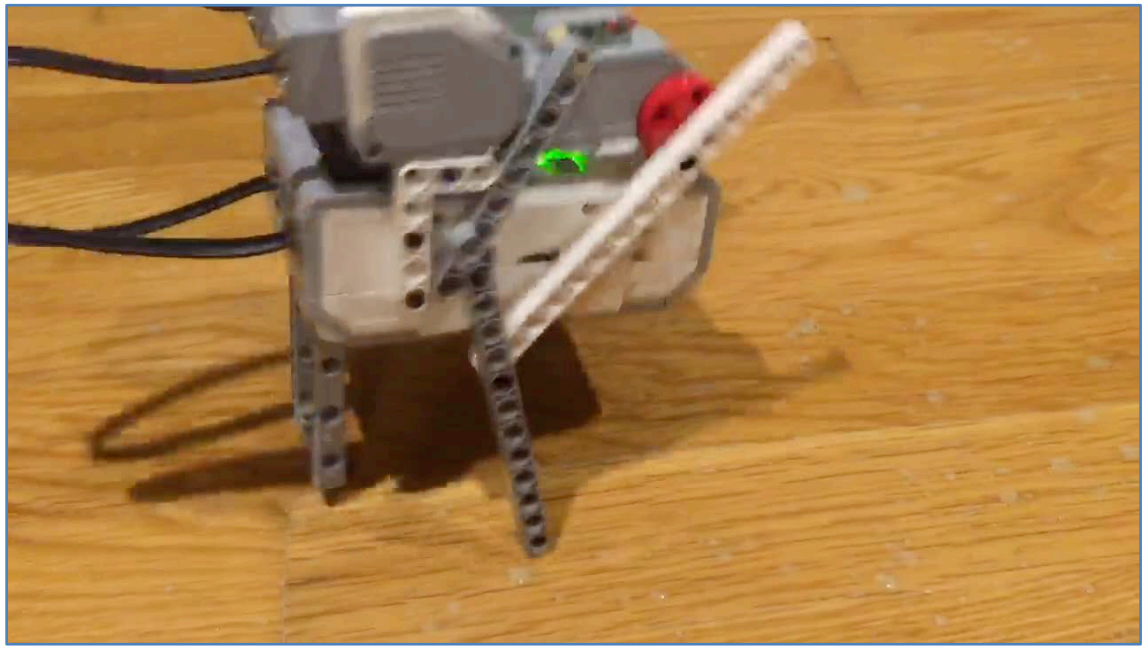
Paper Robots

RoboBooks

and more…

Tufts UNIVERSITY | Center for Engineering Education and Outreach

Dr. Ethan Danahy - ethan.danahy@tufts.edu



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http://DrEsChallenges.com

http://NovelEngineering.com

http://STOMPnetwork.org

http://VisualClassrooms.com

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