From K-12 Engineering Outreach to Community Engagement – A Roadmap

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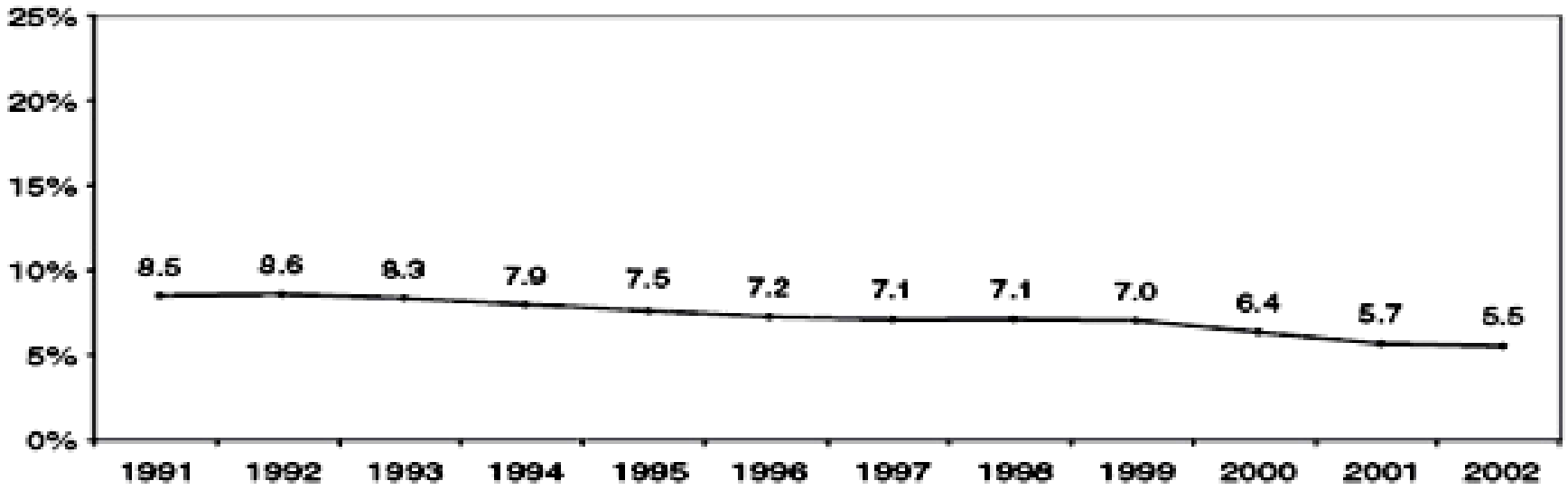
October 8, 2013

Overview

- Introduction
- K-12 Robotics Programs offered by TTU
- Get Excited About Robotics – LEGO Robotics
  - *TTU Perspective*
  - *Hutchinson Middle School Perspective*
- BEST/FIRST Robotics
  - *TTU Perspective*
  - *Estacado High School Perspective*
- Conclusions

Trends in Engineering Enrollment

Houston, we have a problem…..Houston? Hello?



Percent American high school students selecting engineering as a major, by year. (American College Testing 2001-2006, *The High School Testing Report,* Iowa City, IA.

Once upon a time …

TETC-TYT Grant, Spring 2006:

Integrated Outreach, Mentoring, and Placement of Texas Youth in Engineering Careers

- *K-12 Engineering Outreach Activities*
- *Summer Camps / Enrichment Classes*
- *Internships for High School Students*
- *Mentor Positions for ECE Undergraduate Students*

TETC
Texas Engineering and Technical Consortium

Robotics

Why Robotics?

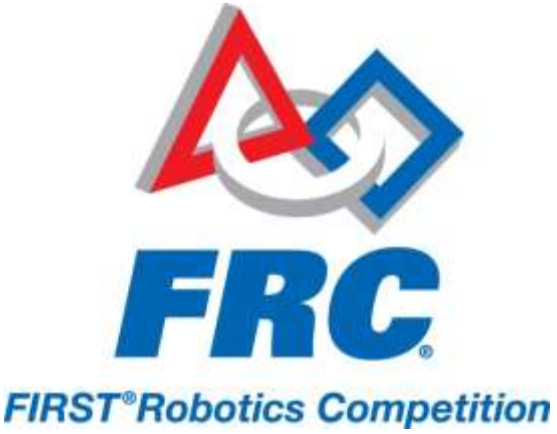
- Critical thinking skills
- Problem solving skills
- Hands-on skills
- Math and science
- Engineering process
- Programming
- Teamwork
- Leadership
- Time management

Pipeline of K-12 Robotics Competitions

GEAR
1st-8th grade

BEST
7th – 12th grade

FRC
9th-12th grade



Get Excited About Robotics (GEAR)

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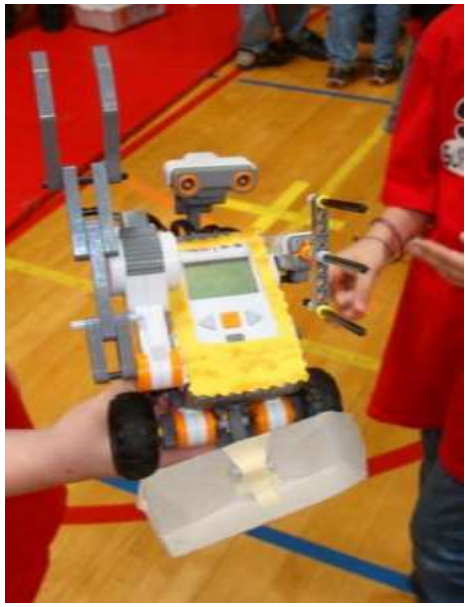


- 6 - 8 week LEGO robotics competition for elementary school and middle school students
- Goal: get students excited about STEM disciplines, learn problem solving skills, design, trouble-shooting, etc.
- Most schools work on challenge after school or during special class periods
- No participation fee for schools
- GEAR competitions at TTU since 2006
- 50 participating schools, about 200 teams, 600 participants in 2013
- www.gearrobotics.org

GEAR Events

- New Teacher Training Workshop (January)
- Advanced Teacher Training Workshop, live video streaming to remote locations (February/March)
- Kickoff Event: (February)
- GEAR Trial Run (March)
- GEAR Game Day(April)

GEAR Kickoff Event: February

- Reveal Challenge
- Relationship to Real World Engineering Tasks
- Hands-on Activity
- Distribution of Game Pieces

GEAR Trial Run & Game Day







Edward E. Whitacre Jr.
College of Engineering


POWER
HAYNES


FABSOFT
TEXAS

Engineering Student Involvement

ENGR 1315: Introduction to Engineering

- ENGR 1315 is taught as Service Learning Course (45 students in 2013)
- Students mentor elementary and middle school students participating in GEAR and participate in GEAR events
- Students come to all LEGO robotics meetings at the schools
- Students are knowledgeable in LEGO robotics through course assignments
- Students can provide teachers with ideas for curriculum

ENGR 1315 Students at GEAR Trial Run

TECHNOLOGY

Hutchinson Middle School

Robotics

Toby Klameth

Technologist

Achieving Excellence through Technology

Background

- 15 Years teaching experience
- Science, Math, and Social Studies
- Introduction to Technology – Digital Media and Animation
- GEAR Robotics – 6 Years

Achieving Excellence through Technology

Curriculum

- Technology Applications
  - 126.14(c)(1)(B-D)
  - 126.14(c)(4)(A-F)
- Creativity
- Innovation
- New Technologies
- Real Word Experience

Achieving Excellence through Technology

TECHNOLOGY

Why

- Motivation
- Inspiration
- Opportunity
- Integration
- Problem Solving

Achieving Excellence through Technology

Value

- Unique opportunity for students
- Excitement
- Interest

Achieving Excellence through Technology

TECHNOLOGY

Don't Take It From Me!

- Team work
- Learn from others
- "Play" with a robot

Achieving Excellence through Technology

BEST™
Boosting Engineering, Science & Technology™

BEST Robotics Middle School and High School (6-12)

What is BEST?

- 6 weeks program for middle schools and high schools (clubs, after school programs)
- Design and build a functioning machine that can perform certain, specific tasks in three minutes
- Robotics kit consisting of e.g. plywood, PVC pipe, screws and other hardware, irrigation valve cover, piano wire, aluminum paint grid, a bicycle inner tube
- Vex Cortex programming node: EasyC, RobotC, MatLab/Simulink

BEST Facts

- BEST Robotics Inc. (BRI) is a non-profit, volunteer-based organization headquartered at Auburn University (AL).
- Schools participate at no cost -- there is no fee.
- Any school may participate regardless of socioeconomic status, size, or location – 750 schools
- Students are the primary participants and benefactors; mentors serve as guides and advisors – 11,000 participants
- Engineers and other technical professionals from local industries serve as team mentors.
- Over 3500 volunteers help run the local competitions and regional championships.

As a result of participating in BEST, students…

- Understand the practical use of math concepts and applied physics
- Solve real-world science and engineering problems
- Gain an increased interest in engineering, math, and science
- Understand what engineers do — the engineering profession is “demystified”
- Experience “design-to-market” product development
- Receive recognition and acclaim typically reserved for their peers in sports

As a result of participating in BEST, Estacado High School and students…

- **Have access to applications for math and physics**
  - ***BEST Robotics Challenges are based in Math, Science and Technology***
- **Get the opportunity to compete in hands-on problem solving**
  - ***Outside of the academic multiple choice format***
  - ***Gives the hands on students a chance to prove themselves***

As a result of participating in BEST, Estacado High School and students…

- Introduced to engineering
  - *Format*
  - *Creating for an end product*
- Allows them to work with college mentors
  - *SHPE mentors for technical and engineering*
  - *College life and expectations*
  - *Interact with successful college students with a similar background*

As a result of participating in BEST, Estacado High School and students…

- Get to experience real-world expectations and results
  - *Successes*
  - *failures*
- BEST allows Estacado to showcase other programs and individuals
  - *EHS JROTC*
  - *EHS Choir and Band*

FIRST ROBOTICS

Establish the next step for local students

Very technical, very challenging, very rewarding

LEGO's => BEST => FIRST

Peer, and near peer program

Year-round contact

Help develop confidence and relevant skills

Founded in 2005 www.team1817.org

First competition year in 2006

Funded by NASA grant for first 3 years

Boeing, X-FAB, and Texas Tech are current primary sponsors

First robot was steel, machined primarily with hand tools

Current robots are primarily aluminum, CNC'd

2005: students from 2 local high schools

2010: students from 5 local high schools and 1 middle school

Teachers participation not required

Open to all students in the Lubbock and surrounding area

2012 Success

Woodie Flowers Finalist: Travis Ray

Dean's List Finalist Award: Kenyan Burnham

Excellence in Engineering Award

Industrial Safety Award

The Chairman's Award

2013 Successes

Started Hub City Regional

- Started 14 New FRC Teams
- Technical and Non-Technical Resources

Competition Awards

- Judges Award
- Industrial Safety Award
- Dean's List Finalist Award: Hiro Goodson

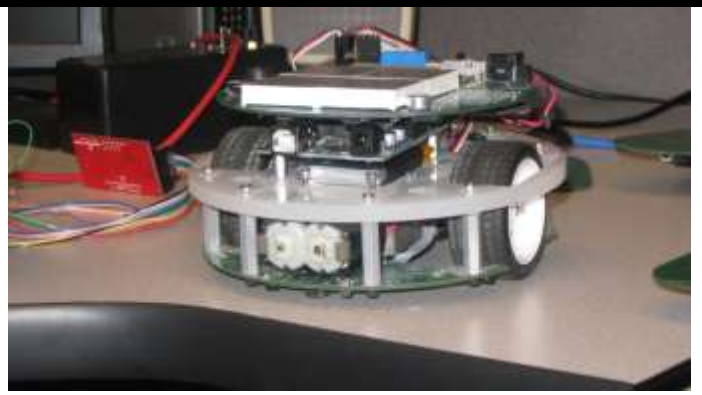
College Entrance Success Rate

- **Advanced problem solving**
  - *FRC has very challenging problems*
  - *National Promotional materials and kickoff inspire students*
- **Mentorship**
  - *Working with professionals*
  - *Technical and non-technical roles*

- Assume roles with in an organization
  - *Marketing*
  - *Engineering*
  - *Real world time and budget constraints*
- Exposure to college
  - *Exposure to college and expectations*
  - *College row*
  - *Universities look for extra-curricular and value FRC participation*

- Ability to compete and represent Estacado High School , Lubbock ISD and Lubbock on a State and National Level
  - *FRC Competitions allow banners and promotional items*

FIRST has a proven success rate for Estacado High School and Lubbock ISD



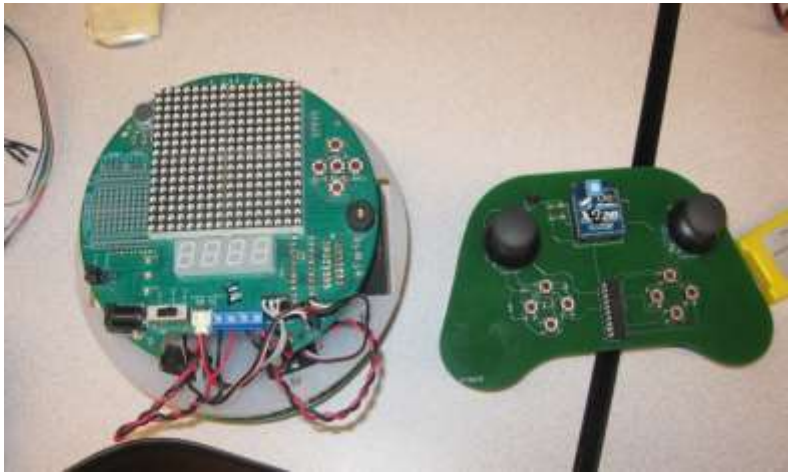
High school demos

Mentors help BEST and LEGO Robotics teams

Mentors participate in as many COE events as possible

- Catch the Engineering Bug
- Admitted Students Day
- Prospective Student Tours
- Middle school group presentations

Summer camps

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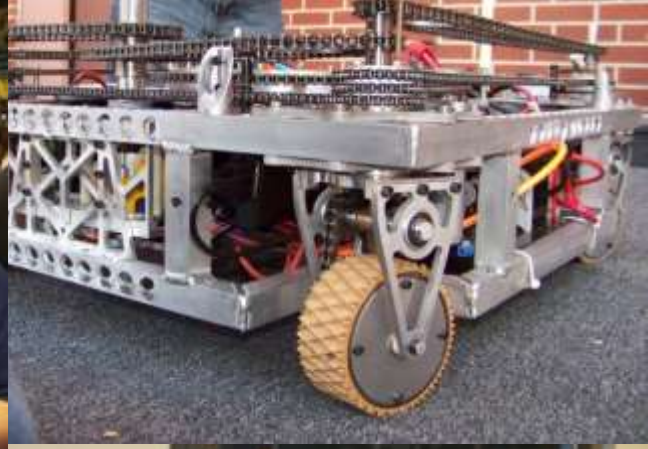
HOUSTON'S #1 COUNTRY STATION




AR
1817

Peer and Near-peer mentoring

College mentor-student relationship

Mentor

- Learning by teaching
- Learning by taking responsibilities
- Leadership

Student

- Easy to bond with mentors
- Learning by doing
- Inherent values of diversity

Influence on Retention of Engineering Students

Influence on Retention of Engineering Students

Conclusions

Key Success Factors

- Flexibility of implementation at school level
- Collaboration between teachers and engineering students
  - *Students are familiar with LEGO robotics*
- No participation fee for schools
  - *We provide game pieces and game mats for schools*
- Educational opportunities for engineering students
  - *Participation for partial course credit*
  - *Service learning projects*
- Promoting engineering (STEM) through role models