Tools to Transform Teaching Technology in STEM

213B

Daphene C. Koch, PhD, Building Construction Management,
Mary E. Johnson, PhD, Aviation Technology
Introductions

Who are we and who are you?
Faculty members from Industry

- Daphene Koch, PhD
- Building Construction Management
- Over 10 years industry experience (petrochemical in TX and Commercial Mechanical in IN)
- BS and MS in Construction, PhD in Ed Tech

- Mary Johnson, PhD
- Aviation Engineering Technology
- Over 10 years industry experience
- Taught at UT Arlington and A&M Commerce
- BS, MS, PhD all in Industrial Engineering
Who are you?

- Name
- City, State
- Grade Level
- What area do you teach?
- Why are you here today?
- What is your biggest challenge that we might be able to help you with?
Agenda

• What does the data say?
• Who are the STEM kids that we are looking to influence?
• Why do they pick a career?
• Examples of what has worked?
• How can you connect to industry students?
• What are some resources that we think may benefit you and your students?
STEM

• The Science, Engineering and Math have been very successful in growing populations
• Technology seems to be the least popular / most unknown area
• The College of Technology at Purdue University is unique to offer so many options
Data on STEM and K-12

• Disengage from STEM before age 14
• Age 11 – 14 is key, must connect by then
• 21% students decide careers in middle school or earlier
• 24% students don’t chose career because they don’t know about it
Specific sources

• Research shows that children as young as 8 years to 10 years of age are also not interested in science and/or mathematics (Abell & Lederman, 2007).
Why do they pick a career?

- Several studies have concluded that selection of a college major is derived from career choice (Ganzel, 1999; Gordon & Kline, 1989; Hackett & Lent, 1992).

- Researchers have explored the link between student beliefs, college major, and career choices, particularly in the fields of science and mathematics (Lent & Hackett, 1987).

- Study of 500 construction management students showed the only statistically significant factor is work experience, (paid and voluntary).
Connecting to careers

- The use of role models can be very effective tool for influencing students (Smith & Erb, 1986), but there are few role models in STEM areas especially those related to more specific engineering technology careers (Blickenstaff, 2005).
Girls need relevance and confidence

- Research has suggested that three factors explain the low rates of participation by woman in engineering fields: societal relevance, tinkering self-efficacy and technical self-efficacy (Baker, Krause, Yasar, Roberts & Robinson-Kurpius, 2007)
Using the post it notes

• Write the first words that you think of when you hear “Technologist”
Using the post it notes

• Write the first words that you think of when you hear “Engineer”
What is the difference between Engineering and Engineering Technology?
Technology

• Take the design and build it
• Apply the model and simulate if it works
• Applied math, science, and physics
• Build it!
Engineers

- Design on paper or computer
- Model something or research something
- Have ideas about what they want to try
- Use LOTS of math, physics, and science
Engineering and Engineering Technology

• Both roles are complementary and are part of a continuum in the design and implementation process
• Engineering Technology Programs emphasize the application of engineering principles through mastery of the processes, systems, tools, and techniques within a field of technology
• Engineering focuses more on the entire engineering systems and the theoretical processes of creating an engineering design
Topics related to helping people or the environment

• Green Buildings (air, energy)
• Healthcare (research, electronics to treat cancer)
• Sustainable products
• Energy (smartgrid, solar, wind)
• Building Information Modeling (BIM) (graphics)
  – 3D model of building to show how it will go together before it is built.
Make jobs real

• Service learning, so you practice and learn
• Visualization to see what you are going to be doing
• Mentoring, you are not alone
How can we connect to what you do?
Purdue Solar Decathlon Team

- Built by over 200 students from different majors on campus
- Toured and assisted with COT camps
- Connected with major industry sponsors
  - Ingersoll Rand
  - U.S Dept of Energy
  - G.E.
  - Hensel Phelps
  - Indiana Housing and Community Development
Purdue University’s “iNhome” during the Solar Decathlon competition in Washington, D.C., last fall (left); and under re-construction back home in Indiana last month.
The INhome exhibits a number of cutting-edge technologies:
1. Biowall
2. Trane Hyperion 8 air handling unit
3. Trane FreshEffects energy recovery ventilator
4. Trane XL20i heat pump
Biovall

Home air filtration system utilizes plants in a vertical wall
* removes harmful chemicals
* Air drawn through the plant wall where the chemicals are removed by the plants and used as a food source.
* very little maintenance waters itself
* improves the air quality in the home, saves energy, and provides a calming ambiance by bringing nature inside the home.
INhome central control system

smart phone can:
* remotely and securely operate the door locks
* change the temperature settings
* turn on lighting, and
* display electrical consumption.

Web-enabled touchscreen controller:
* functions as the thermostat
* provide up to date weather information and many other features
How do we collaborate with industry to recruit?

1. Industry partners have given scholarships
2. Donated materials to make hands on activities
3. Presented with academics
Why do students pick a career?
Top influences for career decision making?

Can we make a top 10 list?
Make your own ranking to understand $$$

How much do the career make?
Rank the following jobs from Highest paid 1 to the lowest paid 15
The Ranking of Common Occupations

<table>
<thead>
<tr>
<th>Job</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect</td>
<td></td>
</tr>
<tr>
<td>Building Construction Management Grad</td>
<td>Recent grad after completing 4 yr program</td>
</tr>
<tr>
<td>Civil Engineer</td>
<td></td>
</tr>
<tr>
<td>Construction laborer (40 hrs / wk)</td>
<td></td>
</tr>
<tr>
<td>Construction Manager</td>
<td></td>
</tr>
<tr>
<td>Construction Operator (40 hrs / wk)</td>
<td></td>
</tr>
<tr>
<td>Drafter / AutoCAD Operator</td>
<td></td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td></td>
</tr>
<tr>
<td>Electrician (40 hrs / wk)</td>
<td>Average hrly salary X 40 hrs, but they usually work more</td>
</tr>
<tr>
<td>Field Supervisor of Trades</td>
<td></td>
</tr>
<tr>
<td>Interior Designer</td>
<td></td>
</tr>
<tr>
<td>Lawyer</td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineer</td>
<td></td>
</tr>
<tr>
<td>Registered Nurse</td>
<td></td>
</tr>
<tr>
<td>Teacher</td>
<td></td>
</tr>
</tbody>
</table>

[www.careerinfonet.org](http://www.careerinfonet.org)
### Ranking Careers results average salary

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Rank</th>
<th>Average Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawyer</td>
<td>1</td>
<td>$112,800</td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td>2</td>
<td>$83,100</td>
</tr>
<tr>
<td>Construction Manager</td>
<td>3</td>
<td>$82,300</td>
</tr>
<tr>
<td>Mechanical Engineer</td>
<td>4</td>
<td>$77,000</td>
</tr>
<tr>
<td>Civil Engineer</td>
<td>5</td>
<td>$76,600</td>
</tr>
<tr>
<td>Architect</td>
<td>6</td>
<td>$72,700</td>
</tr>
<tr>
<td>Registered Nurse</td>
<td>7</td>
<td>$63,800</td>
</tr>
<tr>
<td>Field Foreman of trades</td>
<td>8</td>
<td>$58,300</td>
</tr>
<tr>
<td>Teacher</td>
<td>9</td>
<td>$58,300</td>
</tr>
<tr>
<td>Building Construction Management Grad</td>
<td>10</td>
<td>$55,000</td>
</tr>
<tr>
<td>Electrician (40 hrs / wk)</td>
<td>11</td>
<td>$47,200</td>
</tr>
<tr>
<td>Interior Designer</td>
<td>12</td>
<td>$46,200</td>
</tr>
<tr>
<td>Drafter</td>
<td>13</td>
<td>$45,300</td>
</tr>
<tr>
<td>Construction Operator (40 hrs / wk)</td>
<td>14</td>
<td>$39,800</td>
</tr>
<tr>
<td>Construction laborer (40 hrs / wk)</td>
<td>15</td>
<td>$29,100</td>
</tr>
</tbody>
</table>
OCCUPATIONS REQUIRING 4-YEAR DEGREE AND ADDING 50,000+ NEW JOBS BETWEEN 2010 AND 2020

Occupation Projected Growth Rate 2010 Median Pay

- Computer and Information Systems Managers 10 to 19 percent $75,000
- Computer Systems Analysts 20 to 28 percent $75,000 or more
- Cost Estimators 29 percent or faster $55,000 to $74,999
- Human Resources, Training and Labor Specialists 20 to 28 percent $35,000 to $54,999
- Information Security Analysts, Web Developers and Computer Network Architects 20 to 28 percent $75,000 or more
- Management Analysts 20 to 28 percent $75,000 or more
- Market Research Analysts and Marketing Specialists 29 percent or faster $55,000 to $74,999
- Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products 10 to 19 percent $55,000 to $74,999

Source: U.S. Bureau of Labor Statistics
## College of Technology

Purdue University Salary Survey May 2011 Bachelor and Professional Degrees

<table>
<thead>
<tr>
<th>Field</th>
<th>Low</th>
<th>High</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautical Engineering Technology</td>
<td>$40,000</td>
<td>$68,000</td>
<td>$53,636</td>
</tr>
<tr>
<td>Aviation Mgmt/Professional Flight</td>
<td>$16,000</td>
<td>$85,000</td>
<td>$37,213</td>
</tr>
<tr>
<td>Building Construction Mgmt</td>
<td>$30,000</td>
<td>$60,000</td>
<td>$45,873</td>
</tr>
<tr>
<td>Computer Graphics Technology</td>
<td>$19,000</td>
<td>$70,000</td>
<td>$41,208</td>
</tr>
<tr>
<td>Computer Information Technology</td>
<td>$19,000</td>
<td>$72,500</td>
<td>$52,943</td>
</tr>
<tr>
<td>Electrical Engineering Technology</td>
<td>$40,000</td>
<td>$100,000</td>
<td>$59,466</td>
</tr>
<tr>
<td>Industrial Technology</td>
<td>$30,000</td>
<td>$72,600</td>
<td>$50,098</td>
</tr>
<tr>
<td>Mechanical Engineering Technology</td>
<td>$29,120</td>
<td>$83,000</td>
<td>$53,600</td>
</tr>
<tr>
<td>Organizational Leadership &amp; Supervision</td>
<td>$30,000</td>
<td>$73,800</td>
<td>$44,241</td>
</tr>
<tr>
<td>Technology Education</td>
<td>$28,500</td>
<td>$48,000</td>
<td>$35,412</td>
</tr>
</tbody>
</table>
Best Jobs, US News and World

- Overall Score:
- 10-Year Growth Volume (15%)
- 10-Year Growth Percentage (15%)
- Median Salary (20%)
- Job Satisfaction (15%)
- Current Employment Rate (10%)
- Future Job Prospects (25%)
Best Jobs, US News and World

**Bold is college of technology career**

- Registered Nurse
- Software Developer
- Pharmacist
- Medical Assistant
- Database Admin
- Web Developer
- Computer Systems Analyst
- Physical Therapist
- Computer Programmer
- Occupational Therapist
- Maintenance worker
- Elementary School Teacher
- Clinical Lab Tech
- Speech Pathologist
- Paramedic
- Meeting Planner
- School Counselor
- Social Worker
TOOLS TO CONNECT TO CAREERS
Aviation Alternative Fuels

Aviation uses about ___% of the world’s liquid fuel.

What is your carbon footprint?

One passenger flying round trip from Indianapolis to Dallas/Ft Worth travels 2,434 km round trip in economy class and generates about 294.92 kg of CO₂.

Assumes an average of 166 seats and 5,703 kg of fuel.

http://www.icao.int/environmental-protection/Pages/alternative-fuels.aspx

ICAO Carbon Calculator for Flights
Aviation Alternative Fuels

Molecular Formula

$\text{C}_x\text{H}_y$ (general), $\text{C}_n\text{H}_{2n+2}$ (alkanes)

Energy crops and trees, agricultural food and feed crops, agricultural crop wastes, wood wastes, used oils and residues

Properties of Biofuels

- Density at 20°C: 0.76 kg/l
- Viscosity at 20°C: 4 mm$^2$/s
- Heating value: 44.01 MJ/kg

Beginner’s Guide to Aviation Biofuels


Biofuels
Aircraft Flying on Alternative Fuels

Just a few:
- Alaska Airlines
- United/Continental
- Navy’s Blue Angels

http://www.youtube.com/watch?v=iY3Zp1rr1DI
USDA on commercial biofuels (2min)

http://www.youtube.com/watch?v=ubTfC9cCM_A&feature=related
Continental Eco-skies (5min) aircraft and ground vehicles reduce emissions

http://www.youtube.com/watch?v=T3zEw_86uYA
NAVAIR Aireel Blue Angels on plant based biofuel (3min)
Anaerobic bacteria in landfills decompose organic waste to produce biogas that contains methane.
International Civil Aviation Organization (ICAO) Carbon Calculator for Flights (www.icao.int)

If a change to the aircraft or engine would reduce fuel consumption by 5%, what is the reduced amount of CO₂ released? ____________ kg
Energy Calculation Sheet

• Handout
OTHER HANDOUTS
Not only is a variety of free software available for students, workshops and tutorials on how to use the programs are accessible as well.
Additional workshops relating energy efficiency, proper selection of materials, and utilizing “green” structures in designs are also available.
More “Sustainability” Workshops from Autodesk

Natural Ventilation

Natural ventilation, also called passive ventilation, uses natural outside air movement to both passively cool and ventilate a building.

Natural ventilation is important because it can provide and move fresh air without fans. For warm and hot climates, it can help meet a building’s cooling loads without using mechanical air conditioning systems. This can be a large fraction of a building’s total energy use.

Successful natural ventilation is determined by having high thermal comfort and adequate fresh air for the ventilated spaces, while having little or no energy use for active HVAC cooling and ventilation.

Types of natural ventilation

<table>
<thead>
<tr>
<th>Wind Ventilation</th>
<th>Stack Ventilation</th>
<th>Night Purge Ventilation</th>
</tr>
</thead>
</table>

You can choose the right strategy based on the temperature and humidity of your site. The following chart shows how much these different strategies can extend the comfortable climate range for people.
The PBS website allows for educators to search through a database of resources based on topic and/or the desired type of resource.

In some cases, the resources may tie into a specific PBS show, though this is not always the case.
Middle School Pathways

Full of information and projects relating to math and science for middle school students and teachers
While this website focuses primarily on engineering, it also provides lesson plans and activities are also available for many other subjects in math and science.
Purdue Zip Trips

- http://www.agriculture.purdue.edu/ziptrips/
Women in Engineering

This website contains a number of projects relating to engineering and technology for students in grades 3-12.
American Institute of Aeronautics and Astronautics

- Provides classroom resources for both students and teachers including homework, classroom projects, and games
- Can help educators with grant money for a variety of projects
- A packet containing different careers relating to aerospace education can be viewed or downloaded directly from their website

- Visit “aiaa.org” for more information
What connections have worked?

Nationally

• ACE Mentoring, after school program started in 1994 by industry to support Architecture, Construction and Engineering careers.
• 66% of ACE alumni are either studying architecture, engineering, construction and the skilled trades, or are already working in one of these fields.
History at Purdue

- College of Technology was formally organized in 1964, the concept of technology education began at Purdue with Department of Practical Mechanics was established in 1879.
- First engineering degree granted in 1878.
College of Technology

- Considered one of the largest most renowned technology colleges in the nation
  - Grants the largest number of B.S. degrees in technology of any public university
  - College of Technology currently has 3,270 undergraduates
  - Fall 2011 Total University Enrollment is 39,637
7 Departments, 13 academic programs

- Aviation Technology
- Computer Graphics Technology
- Electrical & Computing Engineering Technology
- Mechanical Engineering Technology
- Building Construction Mgmt.
- Computer Information Technology
- Technology Leadership and Innovation
What is the College of Technology?

- Hands-on laboratory work
- Putting Concepts Into Practice
- Exposure to cutting edge technology that enable graduates to understand and meet the changing needs of business and industry
- Technologists are able to solve problems and MAKE A DIFFERENCE!!!
Student Resources

- 40 study abroad programs
- Opportunities for Internships and jobs
- Learning Communities
- Service Learning
- Free tutoring programs

Many student organizations
- Women in Technology
- Minority Technology Association
- Departments Orgs tied to industry
What are the next steps

- Everyone needs to educate P-12 Teachers, Students, and Parents
- Possibilities are endless
Thank you

Questions and Discussion?

Daphene Koch (cyrd@purdue.edu)
Mary E Johnson (mejohnson@purdue.edu)