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Bridging the Gap between the Industrial Environment and the Classroom via Project-Based Learning

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Background

"Many of the methods and objectives of academia are often considered to be different from those of industry"

"Engineering schools need to have a clear mission focus that reflects the needs of their industrial customers and their place among all engineering schools"

Dutson, A., R. Todd, S. Magleby, C. Sorensen, "A Review of Literature on Teaching Engineering Design Through Project-Orientated Capstone Courses," *Journal of Engineering Education*, January 1997.

Black, M.K., "An Industry View of Engineering Education," *Journal of Engineering Education*, Vol.83, no. 1, 1994.

Background

According to recent report from National Academies, one of two major tasks required to generate desired student learning outcomes is ***"better alignment of engineering curricula and the nature of academic experiences with the challenges and opportunities graduates will face in the workplace"***

The National Academy of Engineering, *Educating the Engineer of 2020: Adapting Engineering Education to the Next Century*, The National Academies Press, 2005.

Background

"the disconnect between the system of engineering education and the practice of engineering appears to be accelerating"

The National Academy of Engineering, *Educating the Engineer of 2020: Adapting Engineering Education to the Next Century*, The National Academies Press, 2005.

Background

"A widespread emphasis on textbook-heavy theory over hands-on practice discourages many students and leaves the ones that remain unprepared for real-world problems"

Basken, Paul, "Engineering schools prove slow to change", *The Chronicle of Higher Education*, Vol 55, Jan 30, 2009.

Background

"To teach is to engage students in learning"

Christensen, C.R., D.A Garvin, and A. Sweet, *Education for Judgment: The Artistry of Discussion Leadership*, Cambridge, Mass.: Harvard Business School, 1991.

Background

Project Based Learning (PBL)

"an assignment to carry out one or more tasks that lead to the production of a final product . . . . The culmination of the project is normally a written and/or oral report . . . presenting the outcome."

Prince M., and R. Felder, "Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases", *Journal of Engineering Education*, April 2006.

Background

Other attributes of PBL

- Normally involve teams of students
- Projects are often open-ended and resemble situations the students may encounter in their future career
- Project emphasis focuses on application of previously obtained knowledge

Background

Advantages of PBL in relation to student outcomes:

- Improved communication and teamwork skills
- Increased motivation
- Better understanding of professional practice
- Improved application of knowledge to realistic problems
- Improved student satisfaction
- Increased student learning

Mills, J.E, and D.F. Treagust, "Engineering Education – Is Problem-Based or Project-Based Learning the Answer?" *Australian Journal of Engineering Education*, 2003-2004.

Dym, C., A. Agogino, O. Eris, D. Frey, and L. Leifer, "Engineering Design Thinking, Teaching, and Learning," *Journal of Engineering Education*, January 2005.

The Class

- ET 410 – Testing and Data Acquisition Techniques
  - 3 credit course – 2 hours lecture & 2 hours lab / week
  - Topics include:
    - Labview©
    - Calibration
    - Sensoring
    - Test Planning and Documentation
    - Analog to Digital Conversion
    - High Frequency Data Aquisition

The Project

Determine “something” you would like to know about or test on your vehicle. It needs to involve some type of engineering analysis or comparison. At least 2 independent pieces of information must be acquired. Possibilities include: pressure, temperature, current, flow rate, voltage, force, etc.

The Project

Deliverables:

- Project proposal
- Sensoring requirements
- Test Plan
- Labview program
- Preliminary data
- Final report & presentation

Example Projects

How much pull force can a truck exert when on a gravel surface?

Does the tire pressure effect the pull force?

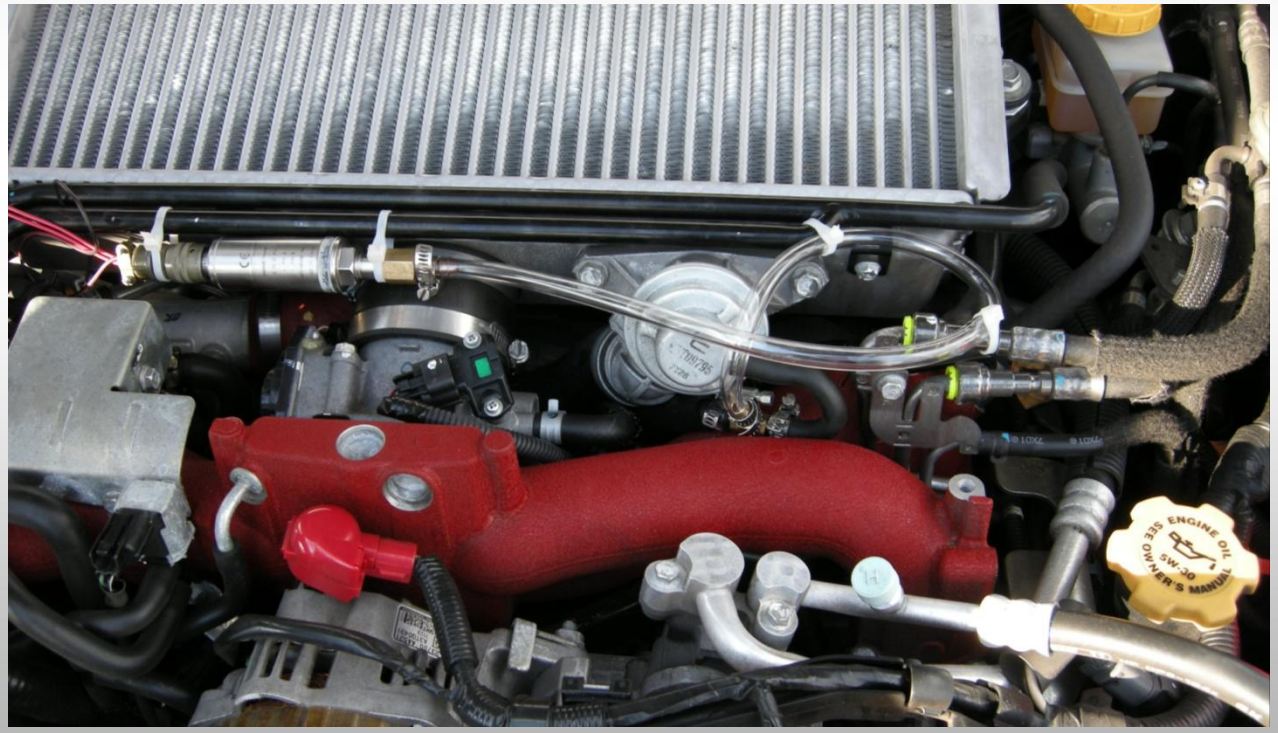
Is an aftermarket transmission cooler actually more effective than the production cooler?

Example Projects

Does blocking the radiator inlet in the winter increase the operating temperature of the engine and does it shorten the time of occupant cabin warm-up?

Example Projects

How does the starting engine speed effect “turbo-lag” upon a sudden change in throttle position?



Example Projects

Does use of Restore© actually increase cylinder compression in an older engine?

Effect of tire pressure on fuel economy.

What is the most efficient cruising speed of a particular vehicle?

Does the brake pad material effect brake rotor and brake pad temperatures?

Student Feedback

When asked the value of the project toward understanding of class material, 80% of the students responded with positive or very positive answers

Student Feedback

"I think this was the most interesting project of my college career and I learned more from this project than from any other paper/project I have done in the past"

"I wish that a lot of ET classes had a project that had a real life application to it"

"The semester long project helped me to understand how the DAQ would be used in a real life situation"

"The project really pulled everything in the course together"

Student Feedback

"Actually putting to use the knowledge that we were acquiring throughout the semester was an invaluable tool for understanding the course content"

"It was nice to use what we learned in a "real world" situation. I think it is important that we have practice working on projects similar to those we will have in our career"

"I believe the project helped show what would be expected of you if you were to pursue this type of careeer"

Lessons Learned

- Submission of preliminary data is necessary.
- Student interest in project appears to be closely related to student effort
  - Future projects will open the scope up to other test items (motorcycles, snowmobiles, home furnaces, etc)

?'s

Comments

Other Applications

Coupling a senior-level Quality Control class with a certificate-program level production CNC manufacturing class

Other Applications

Coupling a junior-level mechanical design class with a certificate-program level prototype CNC manufacturing class

Lessons Learned From Coupling Class Projects

The success of the project is closely related to the quality of the communication between the engineer and the machinist.

Should this communication be mandated by the instructor?

What is the best measure of student understanding of the importance of communication?

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Comments