Project-Based Learning in a Flat World

National Academy of Engineering
Frontiers of Engineering Education

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In a flat world, tests and homeworks become exercises in connectedness.
Flatness brings awareness. But students wonder and search for impact channels.

How can flatness, connectedness, and global awareness be aligned in engineering projects?
The process of reconstructing the lifecycle of a product – customer requirements, design specifications, and manufacturing processes – to understand the decisions that led to its development.
**senior design methods class**

- Required senior course for ME and AE students
- Focus is on the design process
- 150-180 students (30-35 groups)
- Half of their grade is based on group work
- 3 mini-projects, each one month long
**grand challenge projects**

- **NAE Grand Challenges:**
  - Make solar energy economical
  - Provide energy from fusion
  - Develop carbon sequestration methods
  - Manage the nitrogen cycle
  - Provide access to clean water
  - Restore and improve urban infrastructure
  - Advance health informatics
  - Engineer better medicines
  - Reverse-engineer the brain
  - Prevent nuclear terror
  - Secure cyberspace
  - Enhance virtual reality
  - Advance personalized learning
  - Engineer the tools of scientific discovery

- **Mini-project 1**
  - Make solar energy economical

- **Mini-project 2**
  - Provide access to clean water

- **Mini-project 3**
  - Restore and improve urban infrastructure
Oceanic Material Acquisition Robot

Great Pacific Garbage Patch
- Swirling vortex of garbage
- Estimated to be at least the size of Texas
- Hazard to animals

- Solar powered
- Autonomous
- “Roomba of the Sea”
- Collects/Compacts garbage
- Helps the environment

Presented by: Group 29
Providing Access to Clean Water

Group 6

Lack of Clean Water in Medical Facilities in Laos

- Water borne illness = 8.5% of all deaths
- Health services usage = 38% of population
- Gov’t spends 14 times less per capita on healthcare (equates to $36 per capita)
- Capabilities of medical facilities are dramatically decreased as a result

Idea Generation and Decision

- 6-3-5 Method
- Voting
- Screening Matrix
- Weighted Ranking System

Solution: Plastic tanks located outside the facility in which water is disinfected by the sun, then passed through to a deionization process, and then through an activated carbon filter into a storage system.
New Delhi, India: Garbage Collection & Transportation Infrastructure

Transportation of waste using Modular Design and minimal human interaction

1. Waste Collection
   - Household waste through vacuum and sink tubes

2. Waste Sorting
   - Screw Conveyor Feeder Tube separates solid & liquid waste

3. Waste Transport
   - Enclosed Conveyor belt taking solid waste to designated disposal area
Mini Project 3
Restore and Improve Urban Infrastructure

-The region of focus is Kisumu, Kenya
-Our design is a transportable water purification system which will improve urban infrastructure and restore the urban infrastructure during or after a natural disaster.
Clues in the form of pictures or word descriptions are revealed one at a time through the course Facebook page.

- The first group to guess the correct product/system earns bonus points.
- Only one guess per group.
.sample graphical dig

- Flashlight
- Laser pointer
- Hot glue gun

- Air spray paint gun

Remaining clues:
<table>
<thead>
<tr>
<th>Clue</th>
<th>Guesses</th>
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<tbody>
<tr>
<td>shaft</td>
<td>• vacuum cleaner</td>
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<tr>
<td>lever</td>
<td>-none-</td>
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<td>motor</td>
<td>-none-</td>
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<td>pulley</td>
<td>• mill/drill press</td>
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<td>• lawnmower</td>
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<td>• weed whacker</td>
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<td>• onboard boat engine</td>
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<td>• motorized window blinds</td>
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<td>• operating crane</td>
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<td>• garage door opener</td>
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<td>• clothes dryer</td>
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<td>• electric generator</td>
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| tracks           | • tank  
|                  | • snowmobile                                                           |
| linkage          | • conveyor system                                                      |
| control rods     | • escalator  
|                  | • rotary railcar dumper  
|                  | • tow truck  
|                  | • forklift                                                            |
| bellcrank        | • motorcycle  
|                  | • bulldozer  
|                  | • generator  
|                  | • satellite  
|                  | • wheelchair lift  
|                  | • train locomotive  
|                  | • nuclear reactor  
|                  | • inkjet printer  
|                  | • excavator  
|                  | • jimmy jib  
|                  | • gondola cable car  
|                  | • roller coaster  
|                  | • remote control car  
|                  | • wing flap/aileron system                                              |
Final thoughts

- Grading rubrics are critical to ease frustrations – theirs and yours.
- Quantitative assessment of student learning in such environments has been done – *Mary and Ann’s workshops*.
- Currently developing opportunities for students to engage with the villages, regions, and people groups they are designing for – *connection with Kathleen’s and Patricia’s students from Panel 1*.
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