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Harvey Mudd Design Conference VI

HUMAN-CENTERED SUSTAINABLE PRODUCT DESIGN: DESIGNING FOR DIVERSITY IN ENGINEERING EDUCATION

How can we design
engineering courses
that attract and retain
women & ethnic
minorities?

How does { Human-Centered
Sustainability
Service Learning }
content affect

{ Project preferences
A-K ABET criteria
confidence } of

{ Women
Ethnic minority } students

E10: ENGINEERING DESIGN AND ANALYSIS

General
Introduction
(3 wks)



First Module (6 wks)

- **Mechanical Engineering**
- Civil Engineering
- Industrial Engineering
- Nuclear Engineering*



Second Module (6 wks)

- **Mechanical Engineering**
- Civil Engineering
- Industrial Engineering
- Nuclear Engineering*

Mechanical Engineering Module

“Human-Centered Sustainable Product Design”

User
Research

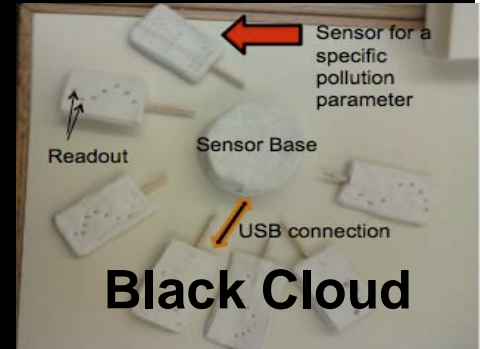
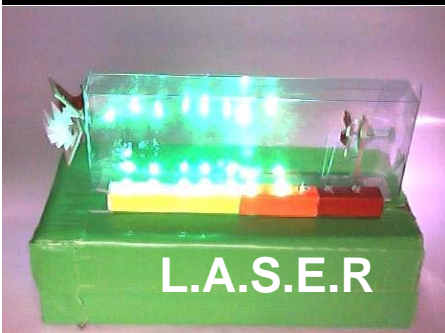
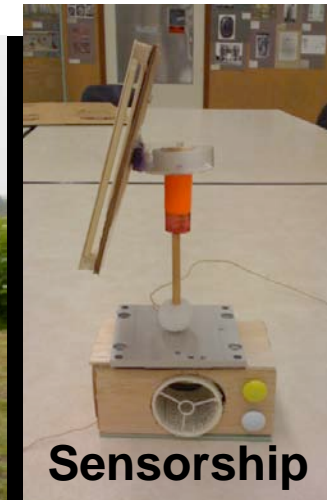
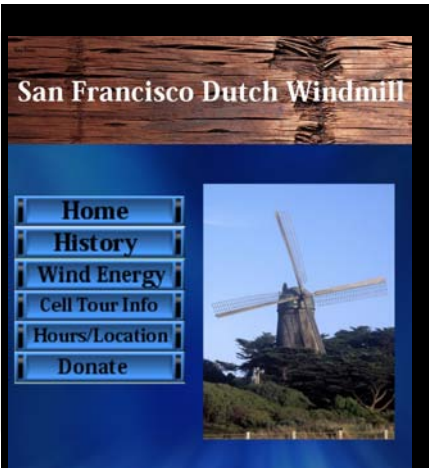
Brainstorming

Concept
Selection

Prototyping

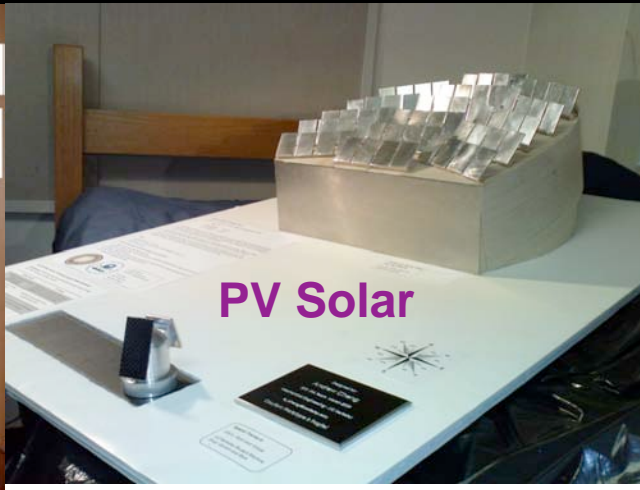
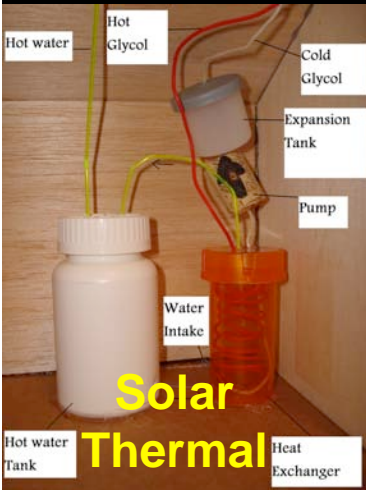
User Testing

Presentation



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Base use...
Black Cl...
technolo...
a cell ph...
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USB con...
charges...
portable...
data

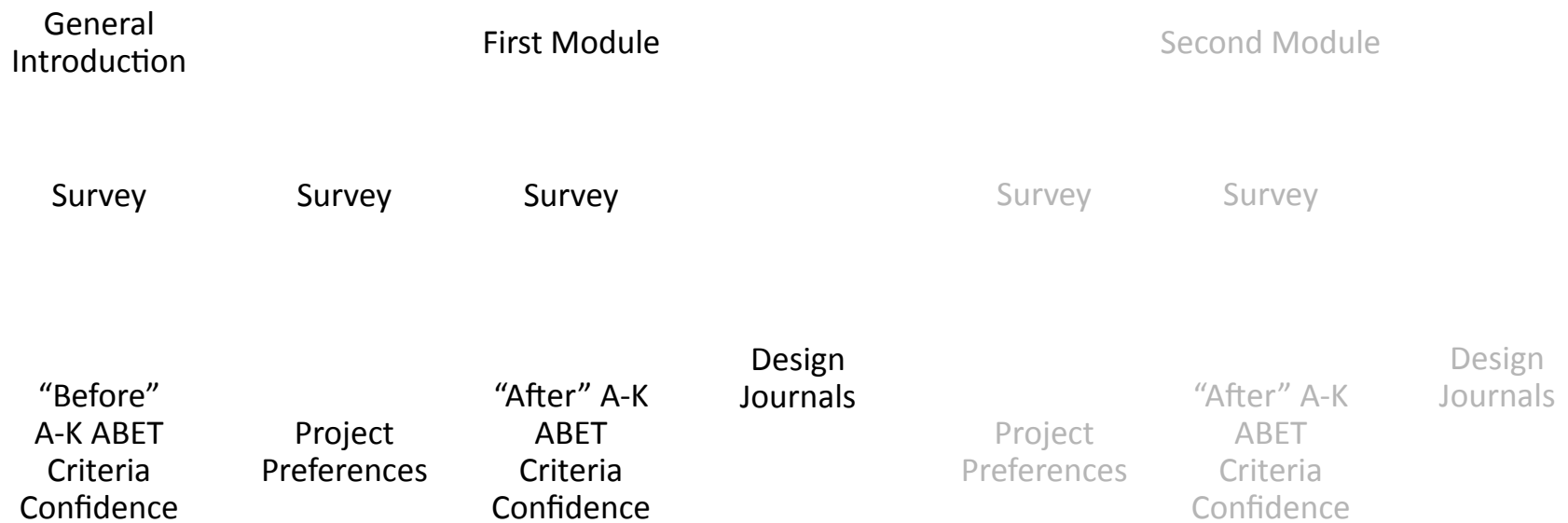
EXAMPLE PROTOTYPES



Pomo Nation Sustainable Culturally-Sensitive Housing

Does the ME module affect students' confidence in A-K ABET Criteria skills? Is this different for women and ethnic minority students?

Do women and ethnic minority engineering students prefer different types of design problems?



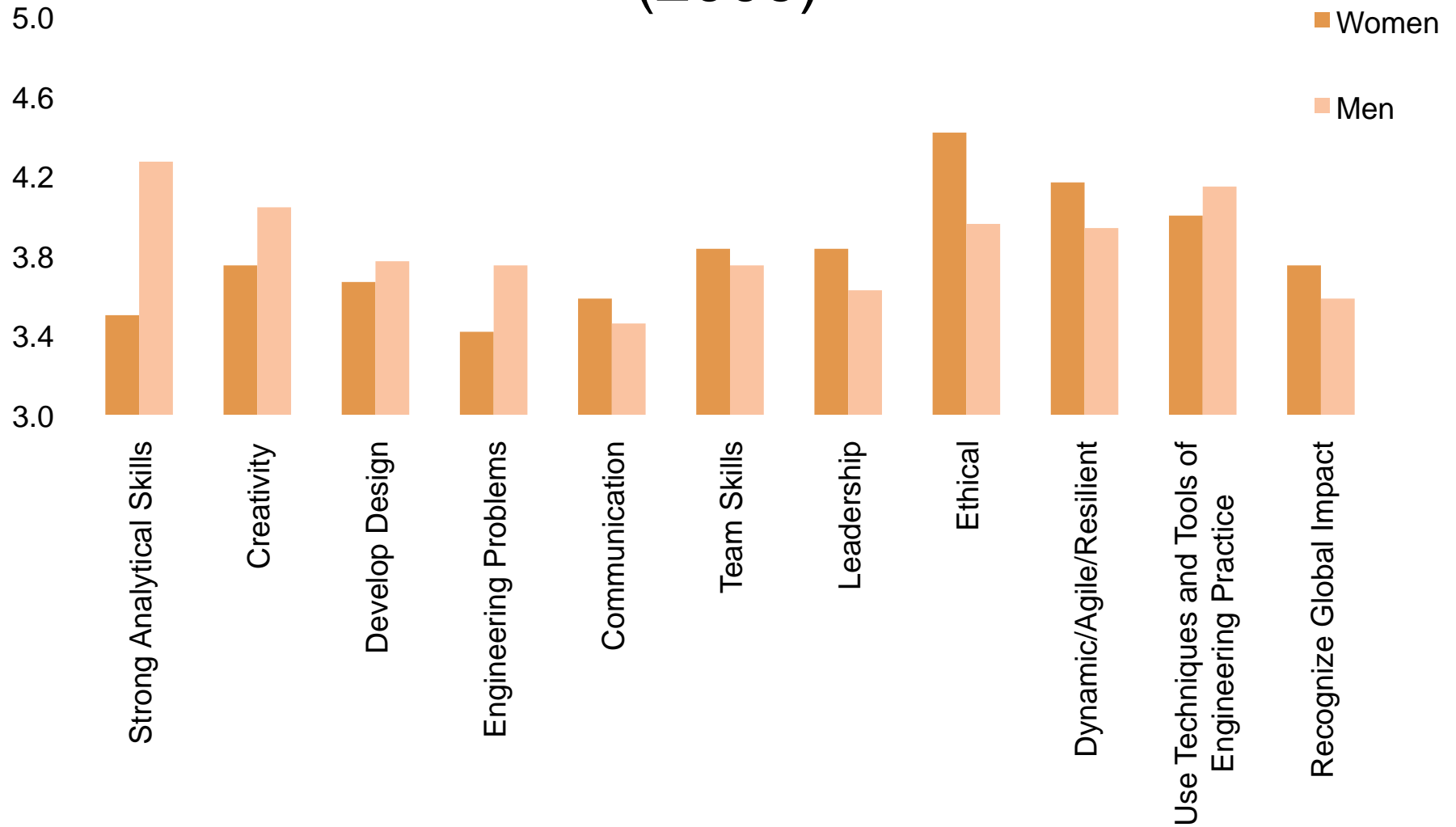
RESULTS

		2008			2009		
		Full Class	Module 1	Module 2	Full Class	Module 1	Module 2
Total Students		174	65	58	142	58	52
Gender	Women	45	17	12	34	13	12
	Men	129	48	46	108	45	40
Ethnicity	African-American	1	1	0	2	1	1
	Chicano	18	6	6	14	2	9

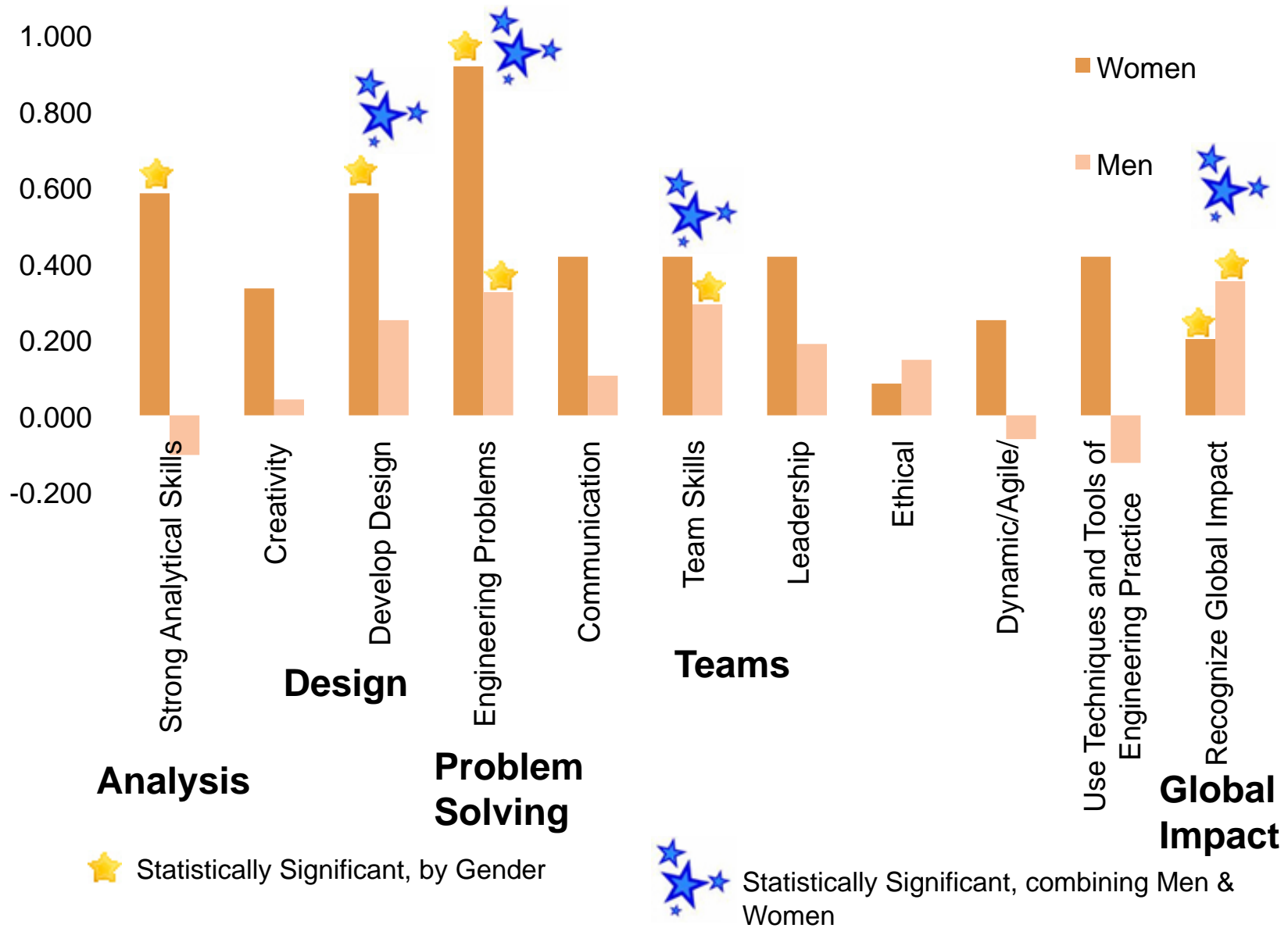
Project Preferences

- Women preferred...
 - projects serving underrepresented communities (Seguro, Pinoleville Pomo Nation)
 - education-related projects (Black Cloud, Mobile Learning)
- Men preferred...
 - “traditional” engineering projects (Bicycle Transportation, Wind Energy, Smart Lighting)

Average Confidence, Before ME Module 1 (2009)



Δ Confidence, after ME Module 1 (2009)



QUALITATIVE RESULTS

“I chose the material testing because **I know people who would actually be affected by these suits.** It would be a great opportunity to aid them in any way.”

“I liked the Pomo Nation project the best because I thought it would be really interesting to design an entirely green building; there are so many options it would be **fun to come up with the best options that would best fit the needs of the nation.**”

SUBJECT MATTERS

“I enjoyed learning and practicing the design process. I absolutely loved **being able to be creative and feeling that I could make a difference in the world around me.**”

“The class was very useful in **getting students' creative natures to come out.** It showed how design is a very important part of engineering. I like the whole design project.”

CREATIVE IMPACT

“I hated this module [...] **It communicated what Human Centered Design is, but that is not what all of Mechanical Engineering is.** I would actually be turned away from Mechanical Engineering if this module was my first introduction to it and I hadn't competed in over 20 robotics seasons and had years of experience in outside of High School that taught me what Mechanical Engineering can be.”

(FEW) EXCEPTIONS

Summary & Questions

Before/After Skill Improvement

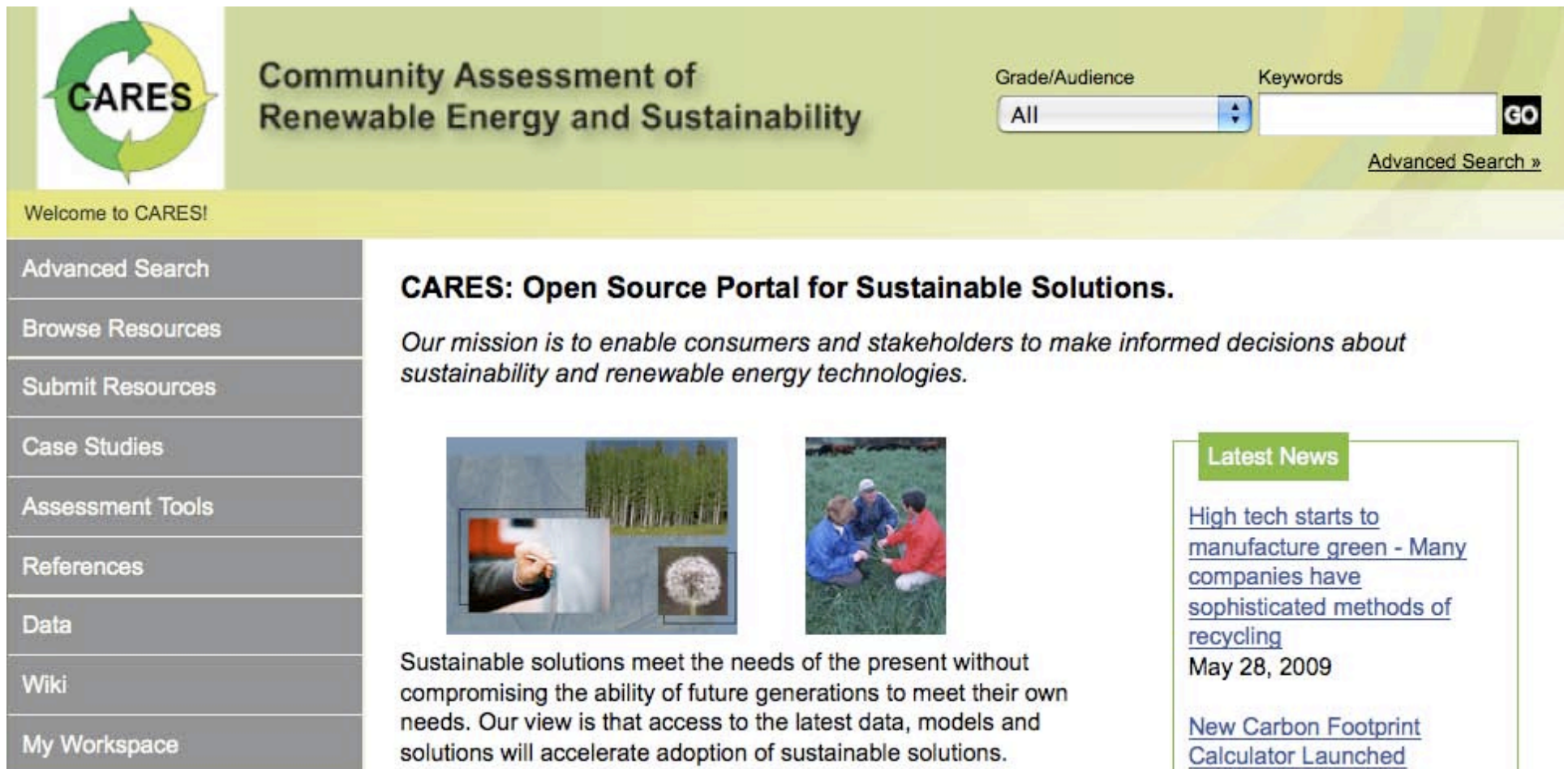
	Ability to Solve Engineering Problems
Male	Team Skills
	Recognize Global Impact
	Ability to Solve Engineering Problems
	Strong Analytical Skills
Female	Develop Designs to meet Objectives
	Recognize Global Impact

Discussion Questions

- How do we frame the design problems that engineering students tackle?
- How could this extend to K-12 education to recruit better engineering diversity?
- How are we defining “engineering”? How is this reflected in engineering curricula?
- Which of the A-K criteria are most important for sustainable design?

Upload/ Download Sustainable Design Lecture Slides, Exercises, Tools, etc.

www.planetcare.org



The screenshot shows the CARES website interface. At the top left is the CARES logo, a green circular arrow with the word 'CARES' in the center. To its right is the text 'Community Assessment of Renewable Energy and Sustainability'. On the right side, there is a search bar with a 'Grade/Audience' dropdown menu set to 'All', a 'Keywords' input field, and a 'GO' button. Below the search bar is a link for 'Advanced Search »'. A yellow banner below the header says 'Welcome to CARES!'. On the left is a vertical navigation menu with the following items: 'Advanced Search', 'Browse Resources', 'Submit Resources', 'Case Studies', 'Assessment Tools', 'References', 'Data', 'Wiki', and 'My Workspace'. The main content area features the heading 'CARES: Open Source Portal for Sustainable Solutions.' followed by the mission statement: 'Our mission is to enable consumers and stakeholders to make informed decisions about sustainability and renewable energy technologies.' Below this are two images: one showing a person pointing at a whiteboard with a forest and a dandelion in the background, and another showing three people sitting on the grass in a field. To the right of these images is a 'Latest News' section with a green header. It contains two news items: 'High tech starts to manufacture green - Many companies have sophisticated methods of recycling' dated 'May 28, 2009', and 'New Carbon Footprint Calculator Launched'.

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Latest News

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May 28, 2009

[New Carbon Footprint Calculator Launched](#)