

**Appendix Q: Strategic Plan Project-Based Learning  
Workgroup PowerPoint Presentation**

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# University Strategic Plan

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## Current Activities

- College SWOT Analyses
- Trend Analyses
- Working Groups
  - Global Perspective
  - Graduate Programs
  - Project Based Learning**
  - Interface Disciplines
  - Academic Computing/Technology

# Overview of Our Task & Recommendations

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“The Working Group on PBL should gather information on successful PBL programs at other universities to determine if there are practices that we ought to adopt.”

- *PBL enhances Learn By Doing, where it is appropriate*
- **Successful PBL programs are currently at work at Cal Poly and at other universities**
- **Overall resource needs on campus should be defined**
- **Institutional support should be provided to programs and faculty that are willing to make PBL a more prominent element of our curriculum**

# Committee Members

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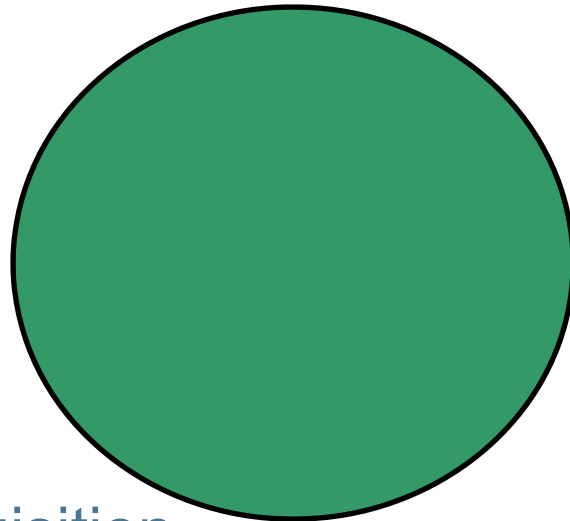
- **Sema Alptekin (Chair), Honors Program**
- **David Gillette, English**
- **Tom Jones, Deans Council**
- **Saeed Niku, Mechanical Eng.**
- **Lou Rosenberg, Mechanical Engineering/Education**
- **David Marshall, Aerospace Eng.**
- **David Arrivé, Music**
- **Charles Chadwell, Civil and Env. Eng.**
- **Chip Appel, Earth and Soil Sciences**
- **Rich Savage, Materials Eng.**
- **Alex Dekhtyar, Computer Science**
- **Jaymie Noland, Animal Science**
- **Nikki Adams, Biological Sciences**
- **Brad Campbell, English**

6 Colleges were represented:  
Agriculture, Food and  
Environmental Sciences  
Architecture & Environmental  
Design  
Education  
Engineering  
Liberal Arts  
Science & Mathematics

# What is Project-Based Learning?

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*Learning*



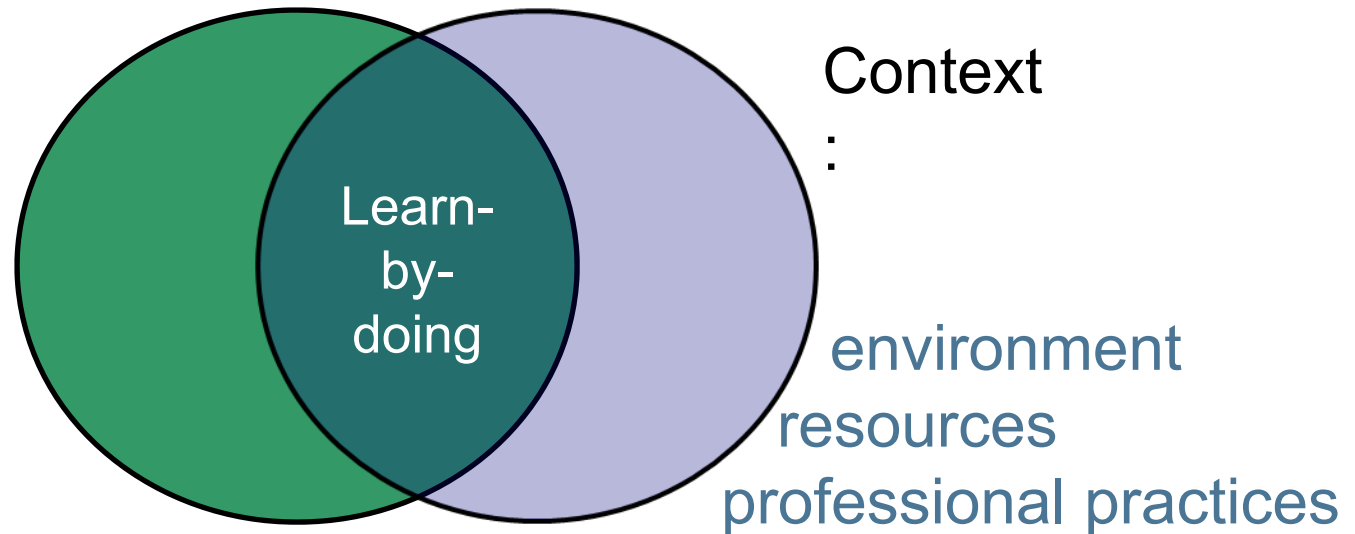
Knowledge acquisition

❖ All universities

# What is Project-Based Learning?

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## *Learn-by-doing*



Knowledge acquisition

Context

:

environment

resources

professional practices

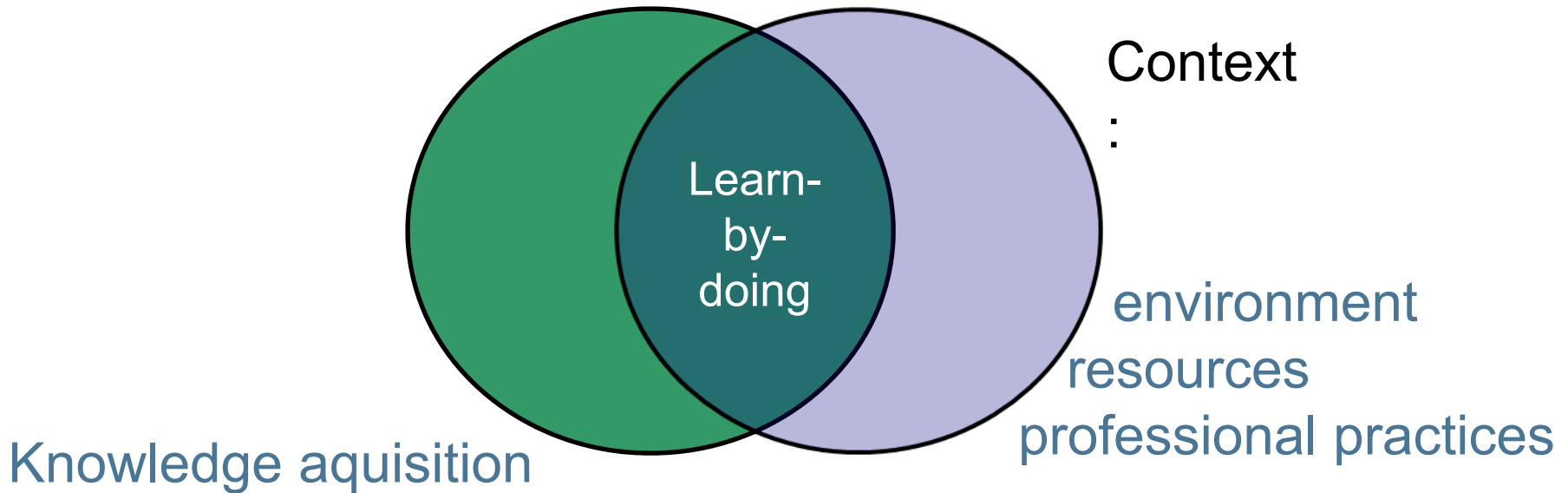
Learn-  
by-  
doing

# What is Project-Based Learning?

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Cal Poly

Learn by Doing



# What is Project-Based Learning?

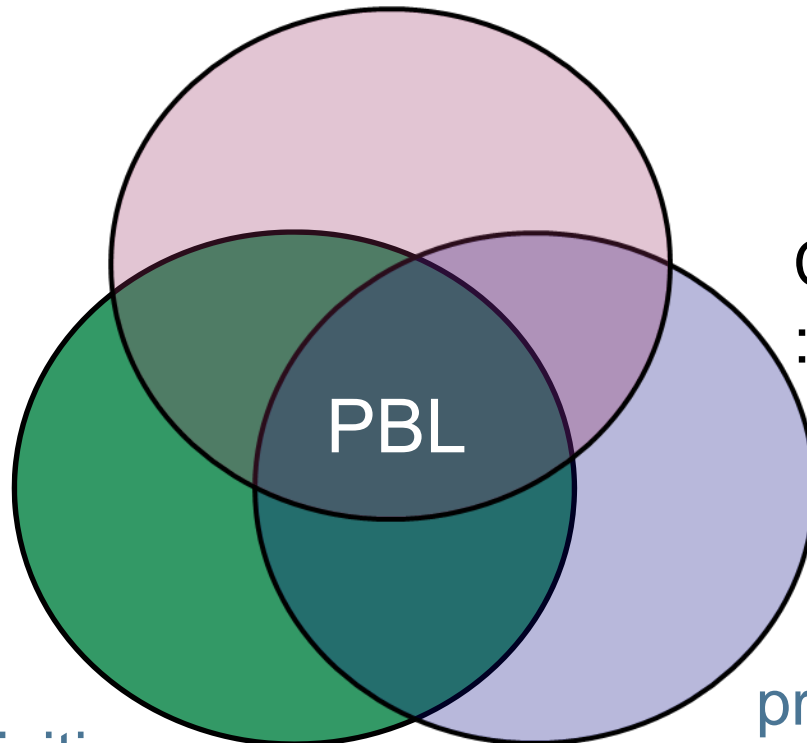
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## *Defined*

Authentic Work Product

*product that arises  
from behaving as  
professionals in  
chosen discipline*

Knowledge acquisition



Context  
:

environment  
resources  
professional  
practices



# Project-Based Learning

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## Committee Definition

*An academic effort that tasks students with producing an **authentic work product** and by doing so, has them **address a range of curriculum goals.***

# Project-Based Learning

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PBL can be:

*... and its implications*

➤ Team-based

❖ Multi-disciplinary

✓ Customer-originated

➤ Individual

❖ Single-disciplinary

✓ Faculty-originated

❑ Predetermined deliverable

❑ Open-ended deliverable

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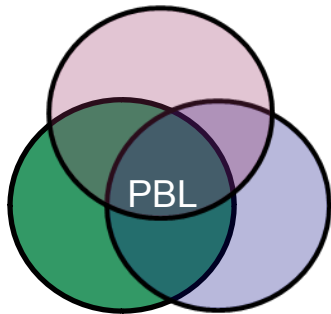
❑ Predetermined deliverable

❑ Open-ended deliverable

*...in any combination.*

# Project-Based Learning @ Cal Poly

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Project-Based Learning  
**enhances** Learn-by-Doing

## HOWEVER

- There is no clear definition of what we mean by “Learn by Doing,” even on the Cal Poly web site.
- To truly enhance “Learn by Doing” we need to have a university-wide understanding of what the phrase really means for Cal Poly.

# Recommendations

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Cal Poly must provide clear vision for its “Learn-by-Doing” motto.

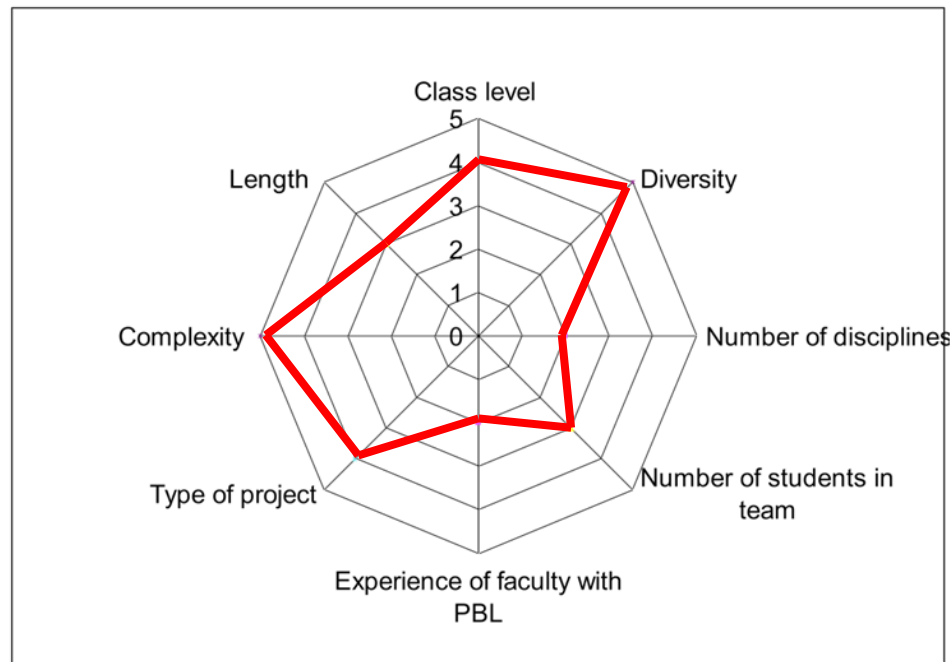
“Learn by Doing” needs to be defined not only in general terms, but also by specific historical and current examples.

A working group has already been established to solidify this definition

# Overview of Projects

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- A wide variety of PBL practices already exist on the Cal Poly campus.



- These projects are both multi-disciplinary and within the majors, they are of varying size and student make-up. The types of projects include industry, faculty and student generated, most are also humanitarian in nature.

# Project Based Learning on the Cal Poly Campus

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## Overview

- College of Architecture & Environmental Design
- College of Engineering
- College of Liberal Arts
- College of Science & Math
- College of Agriculture
- College of Education

# Architecture & Environmental Design: Architecture

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## Project Based Learning

- “Cold Lab” based design studios are a feature for all quarters all five years in architecture and landscape architecture.
- Fourth and fifth year projects are based substantially on real clients and real sites.
- Some design labs include guest practitioner partners as co-teachers, or periodic reviewers. Some projects are conducted as “service learning” for the benefit of off campus communities.
- All labs meet 15 hours per week, plus they have some “co-requisite” tie ins in Arch (Practice) and in the new L. Arch. curriculum. Faculty are given 10 WTU for lab portion, approx 24 students in years 1-2, 16-19 in years 3-5.



# Architecture & Environmental Design: Architectural Engineering

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## Project Based Learning

- From years two onward, all projects are based on a realistic building program and often are drawn from an actual structure upon which the faculty member has worked or is drawn from their industry network.
- All projects entail two dimensional and three dimensional drawings, physical model of whole project, larger models of component parts, and from third year on 3-D digital presentations.
- Some design labs include guest practitioner partners as co-teachers, or periodic reviewers. Some conducted as “service learning” in and for benefit of off campus communities.

# Architecture & Environmental Design: Construction Management

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## Project Based Learning

- New curriculum started in 2008 adopting “architecture program” style integrated labs as the core of the curriculum. New curriculum developed over 5 years with full industry/faculty interaction and seen as a national model for CM programs.
- Sequence of seven labs using teams starting in spring quarter of second year, then all quarters over years three and four. One is interdisciplinary lab (CM 431 in current curriculum) required of all.
- All integrated labs meet about 19 hours per week, (5 unit lab plus co-requisite support classes), with one primary faculty coordinator + other “faculty subject matter experts” on team. Average total 12-12.6 WTU per lab per quarter, 24 students per lab all years.

# Architecture & Environmental Design

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## City and Regional Planning

- Upper division labs based substantially on real clients + real sites. In fourth year, required CRP 410 and CRP 411 lab sequence used to do a real community planning project with a public agency in California. This project meets full professional standards and is fee supported by the agencies.
- All projects entail two dimensional and some three dimensional drawings, some require physical model of whole project, and from second year on 3-D digital presentations.
- Lower division labs meet 12 hours per week and faculty given 8.0 WTU per quarter, upper division meet 15 hours per week and faculty given 10 WTU. 24 students in years 1-2, 20 + in years 3-4.

# CENG: Project Based Learning Institute

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## Overview

- Senior (Capstone) Design
- Year long 3 quarter sequence of ENGR classes. 4-6 students per team, 1 team per project, 6 projects. Teams are in interdisciplinary thrust areas across majors in the CENG
- Projects are industry sponsored covering materials and participating faculty costs.
- Projects are coordinated through the Bonderson Project Center.
- Each CENG major can fit their Senior Design /Capstone into this CENG format within a target thrust area.

# CLA: Department of Music

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## Opera Production

- Rehearse and perform a full, staged opera or opera scenes for the public
  - Students draw upon musical, theatrical and movement skills to achieve a cohesive, unified, public performance - an authentic goal
  - Similar to the preparation and performance of a professional opera - the real world for an opera singer
  - Students work with an active, professional Director
- **MU 383**  
Roughly 30 students participate each year
  - No faculty credit for conductor, producer, assistant producer.

## CLA: Department of Psychology

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### Child Development Lab

- An operating 3-days/week preschool program for 3-4 year olds.
- MWF 9 -12
- about 30 children
- 18-20 students
- Authentic work product: preschool experience for children
- Elements of both team and individual learning
- Students take 1 quarter CDL + 3 quarters Computer Lab
  
- One instructor supervises the course
- ( 8 WTUs)
- Resources
- CDL, observation room, outside play area
- Parents pay \$300/quarter (goes towards program support/operation)

# CAFES: Earth and Soil Sciences

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- Soil and Water Chemistry (SS 423) class project
- Zinc contamination in the soil and plants surrounding a galvanized power line tower
- Elevated concentrations of zinc were found in nearby soils and plants, but pose little risk to humans and animals
- ≈ \$1000 for equipment (labor not included)
- New project for the course next year with similar costs

# CAFES: Earth and Soil Sciences

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- CAFES, Earth and Soil Sciences, Soil and Water Chemistry (SS 423) class project
- Lead concentrations in the soil and plants at a shooting range on Camp SLO and risks of off-site contamination. Some contaminated material was traveling off-site potentially threatening health of grazing animals
- ≈ \$1000 for equipment (labor not included)
- New project for the course next year with similar costs



# COSAM: Biological Sciences

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## Individual Project-Based Courses

- Senior Projects-  
Students typically spend two quarters to one year exploring literature, designing and implementing project
- Experimental Analyses in Class-  
Most upper division courses incorporate hypothesis-driven laboratory exercises whereby students design and perform experiments within a short time frame (1-multiple lab sessions).
- Field Courses  
Students perform short and long-term monitoring projects (surveys) or environmental manipulations in the field

# CENG: Computer Science Dept. Software Engineering

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## Capstone Project

- 3 quarters: CPE 402/405/406 (5 WTU each)
- Single instructor (typically)
- Outside customers
- Adobe (2007-8), Amgen (now)
- no pay (for now?)
- 20-25 people in class; 5-8 teams

## CENG: CS/EE Departments

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### Computer Engineering Capstone Project

- 2 quarters: CPE 350/450
- Single instructor (typically)
- small teams
- Authentic work product:  
hardware/software design
- Customers: VideoRay LLC, JPL, Second Sight, Aeryon Labs
- Products: autonomous wheelchair, underwater robot software/controllers, ocular implant test device, MARS sandbox robot test

# CENG: Computer Science Department

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## Individual Project-Based Courses

- CSC/CPE 308/309 – Software Engineering sequence
  - CSC/CPE 484 – User-Centered Interfaces
  - CSC/CPE 366 – Database Design
  - CSC/CPE 172 – Interactive Game Design
- 
- Small team projects
  - Horse Nutrition Database (CSC366)
  - Library Commons Area Usability Design (CSC 484)
  - Game Development (CSC 172)
  - Customers
  - Cal Poly faculty (from other departments)
  - Companies
  - Often Multidisciplinary

# CENG: Civil Engineering

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## Individual Project-Based Courses

- Senior (Capstone) Design
- 2 quarter sequence where groups of 6 students design a multi-disciplinary assigned project in Civil Engineering.
- Currently in the third year - The new format provides a cost savings of about 30%.
- This year we have 173 students in the sequence. New Format (52 WTU /1038 SCH) Old Format (114 WTU/692 SCH)

# COSAM: Biological Sciences

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## Capstone Courses

- Senior Project Example: Sea Urchin Rearing Project (SURE) (Lab of N. Adams)
- Involves three MS students, six undergraduates (1 honors student)
- Group worked as team to design and perform experiments, each member is in charge of one part of final analysis (some overlapping).
- Results will be part of four senior projects and will be published in peer-reviewed journals

# MATE: Integrating PBL into the Curriculum

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## Educating Global Engineers

- Learning Outcomes
- Mastery of fundamentals
- Heuristic learning
- Systems thinking
- Teamwork, communication & planning
- Managing the impact of technology on society
- Freshman Experience (integration of STEM)
- Sophomores (design for sustainability)
- Juniors (systems approach to design)
- Seniors (balancing depth & breadth)

## IME: Poly House

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### Local Community Support

The purpose of PolyHouse is to allow students an opportunity to learn project planning and management skills while exposing them to the benefits of community service.



# UNIV: X424 Design of Museum Displays

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## Science, Engineering & Technology

- Interdisciplinary – both faculty and students
- Students: CENG, ARCH, CLA, CSM
- Faculty: Engineering, Architecture, Education
- 1 quarter (4 units)
- Offered in Fall 2007 first time
- Community partners
- Pioneer Valley High School, Santa Maria
- Discovery Museum, Santa Maria
- 24 students in class; 4 teams

## UNIV: 491

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# Appropriate Technologies for Impoverished Communities

- Interdisciplinary – both faculty and students
- Students: Architecture, Business, Computer Science, COMS, CRP, CRSC, CSC, Environmental Engineering, Industrial Engineering, IS, JOUR, Mechanical Engineering, Manufacturing Engineering, Modern Languages and Literature, Physics, SOCS
- Faculty: Industrial and Manufacturing Engineering, Physics, Psychology, Political Science, Economy
- 1 quarter (4 units)
- Offered in Winter 2007 first time
- 29 students in class; 4 teams

### •Focus Projects

- Development of a Microfinance system to empower women in Afghanistan
- India - Health Communication
- Development of a Photovoltaic domestic lighting system for Zambia
- Work with a local migrant farm worker in Guadalupe defining, developing, and deploying a helpful technology or business model

# Project Based Learning Programs

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## Examples from Around the USA

- WPI
- Portland State University
- Stanford University



STANFORD UNIVERSITY »



# Worcester Polytechnic Institute

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## Interdisciplinary Project Based Learning

- Project-Based Learning Community that uses active learning to develop independent, team-oriented learning skills
- Freshman year optional experience
  - Replaces “traditional” courses
  - Joins Calculus I and II, Humanities (History, Literature, Philosophy) and Physics
- Self quiz for students to determine if suited for PBL



# Worcester Polytechnic Institute

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## Interdisciplinary Project Based Learning

- Example year long projects include
  - Galileo and Faraday
  - Damming projects throughout the world
  - Robert Goddard's work in American rocketry and applications in Gulf Wars



# Worcester Polytechnic Institute

## Interdisciplinary Project Based Learning

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- *Tie project topics and educational disciplines through variety of projects*
  - *Physics and math associated with dam building*
  - *Societal impact of flooding region for dam*
  - *Ethics associated with building dam*

# Portland State University

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## Community Focused Project

- Community Based Learning in the Center for Academic Excellence
- Develop contributing citizens to the community as well as educating students in academic discipline
- Students perform community service as part of course
- Community service attempts to reinforce academic discipline
- Community service experience is evaluated as part of course

# Portland State University

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## Community Focused Project

- Typical course would
  - Include in-depth theoretical and practical examples
  - Integrate service and classroom work
  - Facilitate student learning and serving community more effectively
- Provide extensive resources for Service Learning assessment
- Driven by “Let Knowledge Serve the City”



## Stanford University

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### Interdisciplinary Project Based Learning

- Project Based Learning Lab in Civil & Environmental Engineering
- Mission – Engage students, faculty and industry with project based learning activities
- Focused on department objectives, typically construction oriented projects
- Have number of industry, university and government partners and sponsors

# Final Notes

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## Overall

- PBL enhances LBD, where it is appropriate
- Potential Models for Managing PBL
  - An “Institutional” model encourages large group projects
  - A “Grassroots” model allows for and encourages individual initiative
- Programs can apply PBL as it best fits with their programs

# Final Notes

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## Resources

- We can't assess the full needs as a working group but it should be studied with a larger, dedicated year-long committee.
- Consistent faculty support (counting units, butts in seats)
- Adequate space needs to be provided for projects
- Campus-wide coordination is helpful
- Institutional support for credit in terms of RPT

# Final Notes

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## What Not to Do

- Do not let industry interest impact too much upon the learning process, letting the product cycle drive and possibly distort course objectives.
- Ignore or play down the impact of economic and cultural diversity on group dynamics, both with students and with outside (non-university) collaborators.
- Make no provisions to ensure that the successes and failures of a project are documented.
- Fail to prepare for student initiative that carries a project well past the course limits, possibly becoming a competitor in the future.

# Final Notes

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## Organization

- There is a need for center/clearing house
- To help get people engaged, started
- To manage partnerships
- The PBL Center is fully staffed and supports the work of faculty
- Ongoing seminars, workshops, and mentoring occur so that faculty, students and “the customers” form effective working relationships that enhances student learning

# Final Notes

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## PBL Clearing House

- Brings people together with interests in PBL
- Promotes/Encourages early engagement with faculty
- Helps promote/document the final results of PBL (success/failure)
- Helps develop/gather assessment tools/methods, recommendations
- Helps gather/catalog curriculum materials (forms, exercises, etc.)
- Helps with fundraising/resource allocation, share, use, IP

# Resources

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- A wiki is developed and used during the duration of our “project”
- Project Based Learning Working Group – Recommendations – Draft - Spring 2008 <http://wiki.csc.calpoly.edu/pbl/wiki/Recommendation>
- Working group wiki: <http://wiki.csc.calpoly.edu/pbl>
- A BlackBoard site is populated with references.  
Send an e-mail to salpteki at calpoly.edu to be added to the Blackboard site.

# Select References

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- Savage R.N., et. al. , "Integrating Project-based Learning throughout the Undergraduate Engineering Curriculum", by, paper published in JSTEM
- Alptekin S., et al., "Flying Eye: A Project-Based Learning Experience", Journal of Manufacturing Systems, Vol. 24, No. 3, 2005.
- D. J. Olinger, William W. Durgin, A. N. Alexandrou, Advanced Aeronautics Design: Project Based Engineering Education at WPI,  
[http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1015&context=provost\\_schol](http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1015&context=provost_schol)
- Savage, R.N., et al., "Collaborative Design of Project-based Learning Courses: How to implement a mode of learning that effectively builds skills for the global engineer," Proceedings of the 2007 ASEE Annual Conference: Riding the Wave to Excellence in Engineering Education, June 24-27, 2007, AC2007-2321.
- Savage R.N., "A Design Methodology for Empowering Project-based Learning," Proceedings of the 2007 ASEE Annual Conference: Riding the Wave to Excellence in Engineering Education, June 24-27, 2007, AC2007-3119.



# Select References

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- "How People Learn", National Research Council report at [http://books.nap.edu/openbook.php?record\\_id=9457&page=18](http://books.nap.edu/openbook.php?record_id=9457&page=18)
- Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases, Prince and Felder, Journal of Engineering Education, April 2006, pp: 1-16