Improve Student Academic Performance and Retention: The Design Your Process to Become a World Class Engineering Student Project

Steffen Peuker, California Polytechnic State University, San Luis Obispo

Raymond B. Landis, California State University, Los Angeles

Gayle E. Ermer, Calvin College, Grand Rapids, Michigan

Krishna Pakala, Boise State University, Boise, Idaho

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Outline of the Workshop

- The Core Idea – Steffen
- Implementation of the “Design Your Process of Becoming a World Class Engineering Student" (DYP) Project – Steffen
  - 15 minute break (~10:45am)
- Testimonial – Gayle
- Testimonial – Krishna
- Q & A

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The Core Idea

Students can do much more than they do.

(and you can make it so!)

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CONCRETENESS

- Only 40-50 percent of students who start engineering programs in the U.S. ever graduate in engineering
- Those who do graduate probably work at about 70 percent efficiency (2.8/4.0 GPA)
- Overall efficiency of engineering education is between 28-35 percent (less than power plants!)
- Between 65-72 percent of our potential is wasted.
- Academic performance and retention of certain subgroups of students is differentially lower

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The Gap

Attitudes and behaviors we want from students

Attitudes and behaviors we get from students

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We Need a Hypothesis – Two "World Views"

- Students are successful because of their **ability**
- Students are successful because of their **attitudes** and their **behaviors**

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Negative Attitudes

- **Naivete** – Engineering study will be like my high school experience.
- **Weak commitment** - I'm not sure I want to be an engineer.
- **Self confidence** - I lack confidence in my ability to succeed in engineering study.
- **Self sabotage** - I have a tendency to sabotage my success.
- **External locus of control** - I tend to blame others for my failure.
- **Fixed mindset** - I don't see any need to change myself or to grow or develop.

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Negative Attitudes

- **Aversion to seeking help** - I'm generally unwilling to seek help from others.
- **Procrastination** - I tend to procrastinate, putting off the things I need to do.
- **Avoidance behavior** - I tend to avoid doing things that I don't enjoy.
- **Shallow** – I have difficulty focusing on complex problems.
- **Unwillingness to read** – I hate reading.
- **Fear of professors** - I avoid contact with my professors outside the classroom.
- **Lone wolf syndrome** - I prefer to study alone rather than with other students.

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Wrong Behaviors

- **Overcommitted** - Program themselves for failure through too many commitments.
- **Non academic environment** - Spend little time on campus.
- **Effort/Time on task** - Neglect studying.
- **Procrastination** - Delay studying until a test is announced.
- **Preparation** - Come to each lecture unprepared.

Wrong Behaviors

- **Avoidance of authority figures** - Avoid professors (in and outside of the classroom).
- **Class attendance/attention** - Cut classes and/or don't get the most out of lectures.
- **Note taking** - Fail to take notes or take notes but fail to use the notes properly in the learning process.
- **Focus on grade not learning** - Skim over the material in the text in a rush to get to the assigned homework problems.
- **Problem solving** - Fail to solve the assigned problems. Don't approach problems using a systematic problem solving process.

How to solve the problem?

What Doesn't Work

Telling people how to run their lives doesn't work!

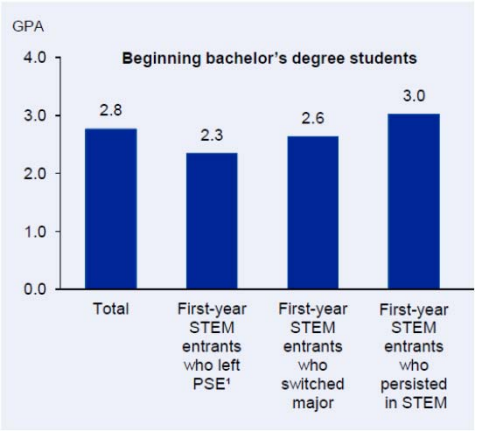
For example: I can tell my students to study at least 25 hours a week, eat healthy, exercise regularly, attend office hours, prepare for lectures, etc., yet why don't my students do all of it?

The Solution – Closing the Gap

- Include student development topics in your first-year engineering courses AND provide students a comprehensive way to reflect on the key objectives for their success:
  - Goal Setting
  - Community building
  - Academic development
  - Personal development

  } Develop self-regulation

And we need to close the gap early…



Source: STEM Attrition: College Students' Paths Into and Out of STEM Fields, NCES 2014-01

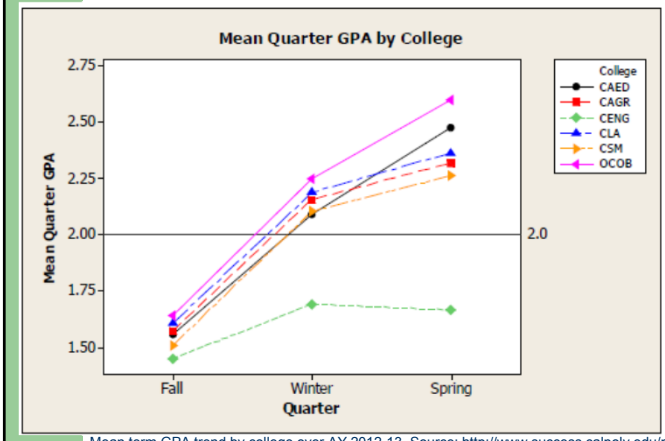
What Does Work?

- Turning it over to your students to figure out by themselves how to be successful
- Holding up a "mirror" for them to look into
- Guiding them in reflecting on a number of issues related to their learning process
- Using the power of group problem solving to find the answers

Ultimate "Student Centered" Approach

Design Your Process of Becoming a "World-Class" Engineering Student

Why a "Design Your Process of Becoming a World Class Engineering Student" Project?



General success seminars work well, but engineering students need more specific development.

Mean term GPA trend by college over AY 2012-13. Source: http://www.success.calpoly.edu/program-background

Why a "Design Your Process of Becoming a World Class Engineering Student" Project?

- Providing students a comprehensive way to reflect on the key objectives for their success:
  - Goal Setting
  - Community building
  - Academic development
  - Personal development

Steffen's story

- Taught Introduction to Engineering course
  - Overview of engineering majors and job functions
  - Engineering computations, documentation, graphical representation
  - Significant figures, dimensions, unit conversion
  - Engineering problem solving
  - Intro to statics, electrical engineering
  - Ethics in engineering

Steffen's story

- It worked well:
- Excellent teacher: 4.9/5.0 based on student rating
  - "Dr. Peuker is a very good instructor and brought his excitement of his field into the teaching of this course!"
  - "I really enjoyed this class. It helped solidify my choice of this particular field of study."

Steffen's story

- After curriculum reform, Introduction to Engineering was cut from 3 to 1 credit hour
- I was the only one teaching the "new" course for 100 students in the Fall 2012
- While attending Ray Landis' workshop I realized that focusing on student development is important
- I volunteered to try out a new project, the ***"Design Your Process of Becoming a World Class Engineering Student"***

Pages 6-18

Reading
tiny.cc/DYP

- Please read the Project statement (page 6 in your handout) and the student report (pages 8-18).

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Group Activity

- What strikes you as positive/interesting, or noteworthy about this student report?
- Do you think having your students write a similar report will have a positive effect on your students?
- Discuss in your group for 10 minutes.

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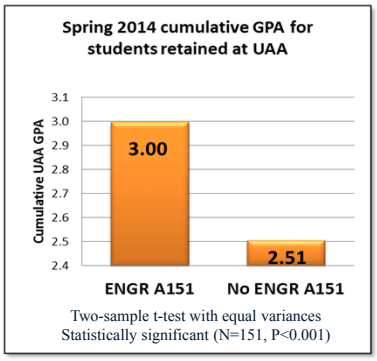
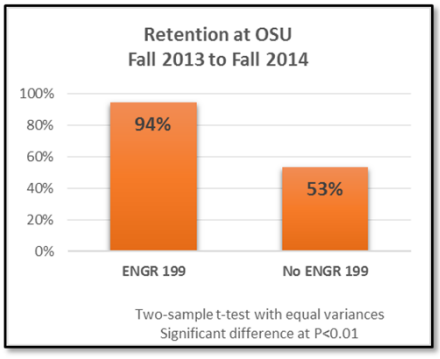
Benefits from Implementing the Project Results from UAA and OSU





Schauss, Nova A. G., Peuker, Steffen, "Improving Student Success and Retention Rates in Engineering: An Innovative Approach for First-Year Courses", 122nd Annual ASEE Conference, Seattle, 2015

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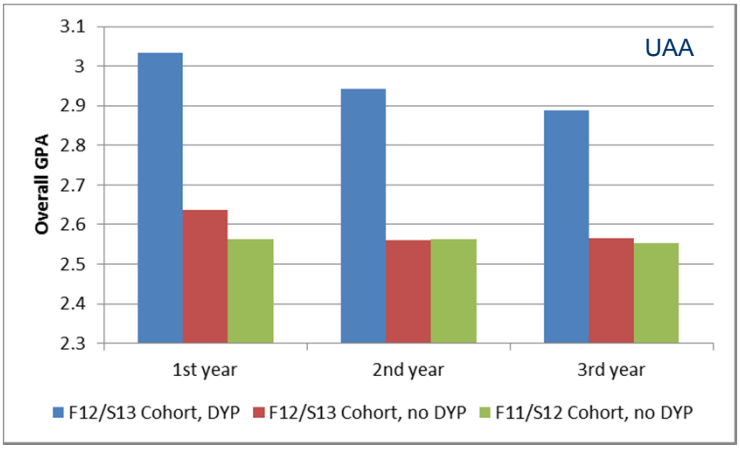
Benefits from Implementing the Project Results from UAA since Implementation



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To good to be true? Consider this…

- People assume that "large" problems require "large" solutions
- BUT, even a seemingly small social-psychological intervention can lead to large gains in student achievement and sharply reduce achievement gaps even months and years later
  - Change students' mind-sets to take greater advantage of available learning opportunities

David S. Yeager and Gregory M. Walton, Social-Psychological Interventions in Education: They're Not Magic *Review of Educational Research June 2011 81: 267-301*

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Develop Early to Gain Lasting Impact

- Students increase their effectiveness in learning (study skills)
- Students form better relationship with their peers and professors
- Students' belief about their potential changes, leading to more investment in college
- ➢ Students achieve and sustain better academic outcomes

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Benefits from Implementing the Project Results from Cal Poly – Winter 2016

	Before ME163	Today	Difference
Interaction with professors.	2.815	2.987	0.172*
Group study/collaborative learning.	3.146	3.537	0.391***
Time management.	3.353	4.033	0.680***
Devotion to studying.	3.316	3.673	0.358***
Preparation for lecture.	2.566	3.107	0.541***
Keeping up in classes.	3.007	3.453	0.447***
Immersion in academic environment.	3.809	4.100	0.291***
Practicing good study skills.	3.709	4.099	0.391***
Awareness of reading comprehension methodologies.	3.243	3.682	0.439***
Goal setting/academic goals.	3.760	4.309	0.549***
Managing personal life.	3.829	4.087	0.258***
Motivation to obtain degree.	4.158	4.497	0.339***
Feeling part of the academic learning community.	3.592	4.026	0.434***
Awareness of campus resources.	3.263	3.669	0.406***
Educational experience within major.	4.059	4.167	0.107*
Confidence to succeed academically.	4.000	4.173	0.173**

*p<0.05, **p<0.01, ***p<0.001, N=153

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Steffen's story - continued

- ME freshmen seminar course at Cal Poly
  - 190 students in one lecture hall
- How can I implement the project?
- How do I grade 190 reports?
- How can I make it a meaningful experience for students?
- Quarter vs. semester: less time and in addition two lecture periods are devoted to Service Learning project.

Keys for Successful Implementation

- Syllabus
- Course content
- Introduction of Project
- Assigning homework in support of project
- Delivery of material, pedagogical tools
- Support material
  - ppts, grading rubric, assessment
- Grading reports
- Barriers for Implementing the Project

It's not only an Assignment it is an Approach

- Assigning the project without covering student development topics will not be beneficial for the students.
- The project builds upon the student development objectives introduced in the course.
- How much student development topics need to be covered?

Pages 20-24

Example: Syllabus ENGR A151 at University of Alaska Anchorage

- 1 credit hour → 14 class sessions, 50 minutes each
- 5 "special lectures"
  - Engineering Student Clubs
  - Student Success Manager
  - Library Orientation
  - Panel of Practicing Engineers
  - Panel of Engineering Department Representatives
- 9 class session devoted to cover student development topics

Example: ME163 at Cal Poly

- 1 unit → 10 class sessions
- 2 "special lectures" devoted to freshmen service learning project
- 8 class session devoted to cover student development topics
- E-portfolio
  - tiny.cc/DYP

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Keys for Implementation: Introduction of Project

- Introduce early, make it significant (30% of grade)
- Provide handout
  - Project statement p. 6-7
  - Alternative project statement – shortened version p. 25
  - Alternative project statement – extended version p. 26-29
- Emphasize that the project is the students process to success, no other single assignment will have that importance
- Provide clear expectations, e.g. grading rubric
- Explain that students write the project for themselves, not you as the instructor

Homework in Support of Project

- Assign homework related to the objectives of the project
- 89% of my students found homework helpful

Pages 30-34

Example Homework

Homework #2

- Graduating with a bachelor of science degree in engineering: How important is that goal for you? How can you make it even more important? Write a two page essay.

Group Activity

- As a group, come up with an assignment which addresses objective 3: “Be prepared to deal with inevitable adversity.”
- Let’s take 10 minutes and then shares some assignments.

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Adversity

- For first-generation students, seeing their backgrounds as a strength, has great potential to improve their overall comfort in higher education and equip them with the tools that they need to thrive.[1]
- Women engineering students who viewed daily adversities as more manageable improved their first-year GPA.[2]

[1] Nicole M. Stephens, et al. (2015). A Difference-Education Intervention Equips First-Generation College Students to Thrive in the Face of Stressful College Situations. *Psychological Science*, Vol. 26(10) 1556–1566
[2] Walton, G. M., Logel, C., Peach, J. M., Spencer, S., & Zanna, M. P. (2014). Two interventions to boost women’s achievement in engineering: Social-belonging and self-affirmation-training. *Journal of Educational Psychology*.

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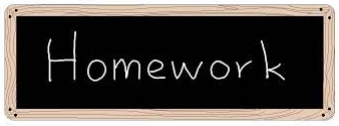
Homework in Support of Project

- Provide an overview of how the homework assignments relate to the project objectives
- Explain the relevance of each homework assignment in relation to the project objectives



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1., 3. (1.a.) Setting your goal(s), i.e., major, time to graduation, GPA	Homework #1, #2
2. (1.b.) Strengthening and clarifying your commitment to your goal(s)	Homework #1, #2, #3
2. (1.c.) Set-up a "Road Map"—a plan to guide you over the next years to graduation	Homework #4
2. (1.d.) Understanding the essence of engineering	Homework #3
7. (2.a.) Building relationships, and making effective use of your peers	Homework #5
10. (2.b.) Participating in co-curricular activities	Attend Engineer's Friday night
14. (3.a.) Navigate the UAA system, resources and academic advising	Homework #8
6. (3.b.) Understanding teaching styles and learning styles and how to make the teaching/learning process work for you.	Homework #5
5., 7. (4.b.) Outline what attitudes and behaviors you need to change/add to be successful	Homework #1, #3, #5, #9, #10
9., 11. (4.a.) Enhance your self-awareness and improve your skills to practice academic success strategies	Homework #5, #6, #9
12. (4.d.) Engaging in good health and wellness practices including management of stress	Homework #10
4., 8. (4.c.) Manage time and tasks	Homework #7
13. (4.e.) Developing a high sense of personal and professional integrity and ethical behavior	Homework #11

Note: Numbers in () refer to the alternative project statement objectives

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Delivery of Material

- Use pedagogical tools other than just lecture, e.g. group discussions
- Keep lectures short → Long lectures are fun to give, but not fun to receive
- Flip the class room – Team Based Learning  Page 36
  - Achieving High Functioning Teams Using Team Based Learning in Flipped Classrooms
  - Using Team-based Learning to Ensure Student Accountability and Engagement in Flipped Classrooms
  - Implementing Team Based Learning in Freshmen Engineering Courses

"A student's most important teacher is often another student"
Chickering and Reisser (1993)

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Minute Paper

Date: 02/20/2015 **Attendance Form – ME163**

Circle first letter of last name: A B C D E F
Circle second letter of last name: A B C D E F

Make sure you print your name and sign the form and turn it in at the end of the lecture.

Name:___ Signature:___

1. What was the most persuasive or convincing argument/idea in today's lecture?
   - positive feelings produce positive thoughts which produce positive actions
   - a commitment to do something is an attitude

2. During today's class, what idea(s) struck you as things you could or should put into practice?
   - productive actions
   - continuously change to grow & improve
   - form the habit of doing things I don't like to do

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Minute Paper Summary

1. What was the most persuasive or convincing argument/idea in today's lecture?

- Change your attitude to change behaviors
- Strive continuously to improve
- "If it ain't broke, improve it"
- It takes commitment to make a change
- Successful people have the habit of doing things they don't like to do.
- Negative feelings cause negative thoughts, leading to unproductive results while positive thoughts lead to positive actions
- Have a balance between immediate and future gratification
- Mental health, self-confidence, self-esteem

Minute Paper Summary

2. During today's class, what idea(s) struck you as things you could or should put into practice?

- Identify negative habits to make a change
- Improve time management - make a schedule
- Start assignments earlier
- Find a personal balance between work and gratification
- Take better notes
- Balance work and play
- Reward myself for successes
- Do things I don't want to do to be successful
- Less distractions
- Use exercise and proper nutrition to handle stress
- Have a positive attitude towards classes I don't like

Comment from Teaching Assistant

- "I feel like I got a lot out of this class, despite not actually being in the class. There was one particular instance where I had a long list of things I did not want to do for my classes and then I read the answers from your lecture on how successful people do things they sometimes don't like to do. Talk about a wake-up call!"

Support Material

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Web Content

- http://discovery-press.com/discovery-press/studyengr/NewResource/0.asp

1. Project student assignment statements
2. Impact of implementing the project at University of Alaska Anchorage and Oregon State University
3. List of colleges/universities that have implemented the project including contacts
4. Implementation Guide
5. Syllabi at colleges and universities implementing the project
6. Sample student final project reports
7. Material to support implementation of the project
8. Assessment/research materials for measuring impact of project
9. Things "Implementers" can do to support the "Design Your Process" movement

Support Material for Instructors

http://discovery-press.com/discovery-press/studyengr/NewResource/0.asp

- 7. Material to support implementation of the project
  - 7.1 Syllabus
  - 7.2 Assignments to guide students through each step of the project
  - 7.3 PowerPoint slides
  - 7.4 Project Report template
  - 7.5 Example Project Grading Rubric

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Grading Rubric

Category	4	3	2	0
Content	All objectives as outlined on the project statement are addressed sufficiently	Three or less objectives are not addressed	Six or less objectives are not addressed	Less than six objectives are addressed and/or contains lengthy copied passages from sources
Length	Meets or exceeds the stated length requirement	1 page short	2 pages short	Less than 6 pages
Fluency	Each sentence is clear and has obvious emphasis. All sound natural when read aloud.	Some sentences are awkward or difficult to understand; almost all sound natural when read aloud	Several sentences are awkward or difficult to understand; most sound natural when read aloud.	Almost all sentences are awkward, repetitive, or difficult to understand
Grammar and Spelling	Less than 2 spelling or grammar mistakes per page	Less than 4 spelling or grammar mistakes per page	Less than 6 spelling or grammar mistakes per page	More than 6 spelling or grammar mistakes per page
Formatting and Organization	Adheres to all format requirements and has a clear organization, for example title page, headings for each objective etc.	Adheres mostly to all format requirements; misses title page or has other minor organizational deficits	Has major formatting issues and/or major organizational deficits	Does not adhere to format requirements and does not show any organization
Citation				Contains verbatim copied passages without proper citation or other forms of plagiarism -> results in 0 score for report regardless of above scores

Pages 40-42

Example Report, Template

Web Content

- Provide an example report to set expectations
- Provide a template for the report, focus should be on writing not formatting
- Use plagiarism software, e.g. SafeAssign to discourage "reusage" of old reports

Grading Reports and Homework

- Grade yourself → fascinating insights into your students issues and how they are or planning to tackle them
- Use graders, e.g. can use graders from English department
- Use peer grading

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Why you may want to consider peer grading…

- Students reading other students assignments can have a powerful impact
- Students grade each other, not the instructor → project is about the students
- Students learn about evaluation
- Students get feedback from their peers
- Allows grading for large class sizes

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Calibrated Peer Review™

- Calibrated Peer Review (CPR) is a web-based, instructional tool that enables frequent writing assignments in any discipline, with any class size, even in large classes with limited instructional resources.
- CPR reduces the time an instructor now spends reading and assessing student writing.
- Visit: http://cpr.molsci.ucla.edu/Home.aspx

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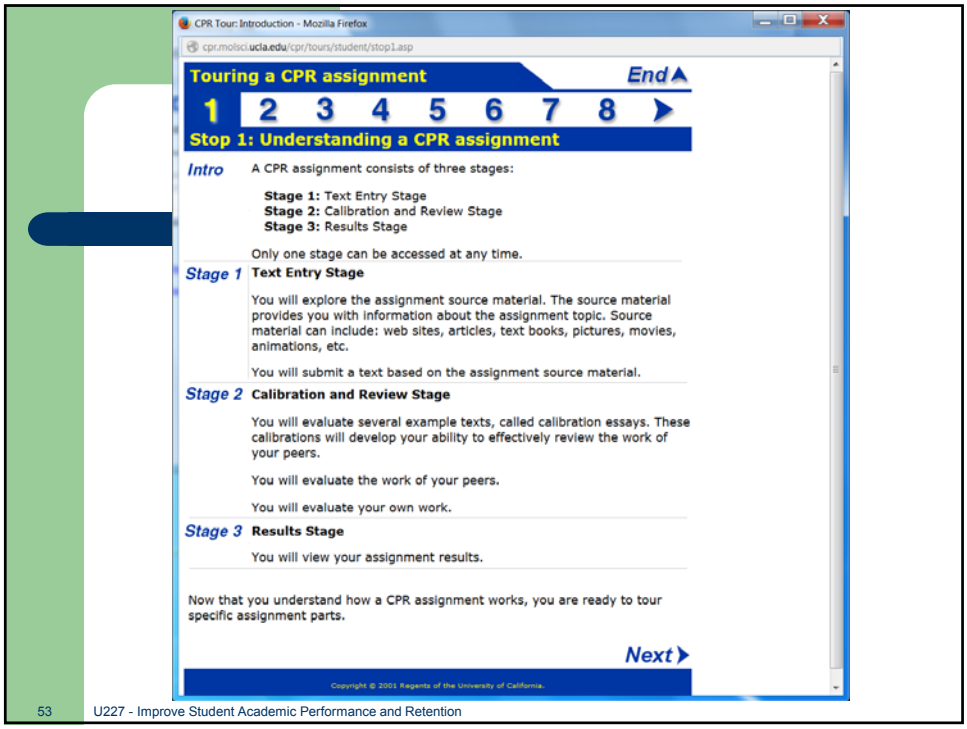
CPR Tour: Introduction - Mozilla Firefox
cpr.molsci.ucla.edu/cpr/tours/student/stop1.asp
Touring a CPR assignment
End
1 2 3 4 5 6 7 8
Stop 1: Understanding a CPR assignment
Intro
A CPR assignment consists of three stages:
Stage 1: Text Entry Stage
Stage 2: Calibration and Review Stage
Stage 3: Results Stage
Only one stage can be accessed at any time.
Stage 1 Text Entry Stage
You will explore the assignment source material. The source material provides you with information about the assignment topic. Source material can include: web sites, articles, text books, pictures, movies, animations, etc.
You will submit a text based on the assignment source material.
Stage 2 Calibration and Review Stage
You will evaluate several example texts, called calibration essays. These calibrations will develop your ability to effectively review the work of your peers.
You will evaluate the work of your peers.
You will evaluate your own work.
Stage 3 Results Stage
You will view your assignment results.
Now that you understand how a CPR assignment works, you are ready to tour specific assignment parts.
Next
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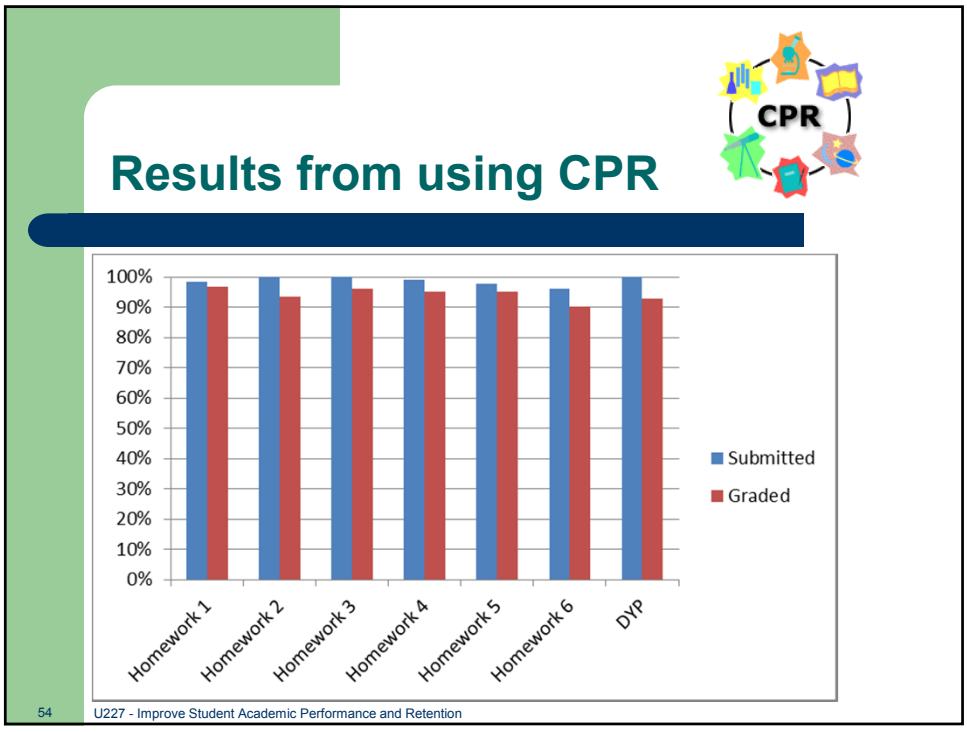
Results from using CPR
CPR
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Homework 1
Homework 2
Homework 3
Homework 4
Homework 5
Homework 6
DYP
Submitted
Graded
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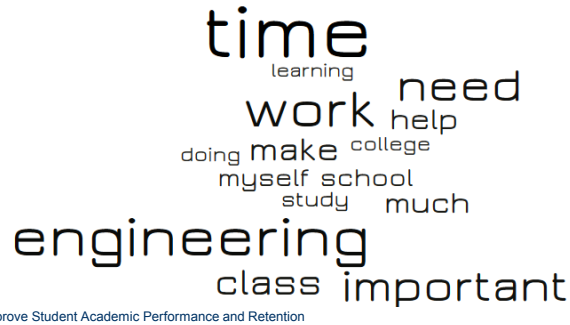
Results from using CPR

- Class size: 183
- 100% of students submitted project
- Average grade: 97/100
- Total words: 941,723 (5,146/student)



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CrowdGrader
www.crowdgrader.org/

crowdgrader

CrowdGrader lets students submit and collaboratively grade their solutions to homework assignments.

Login via any Google account.
Students: use the account specified by your teacher, if any.

LOGIN

Learn about CrowdGrader
Try CrowdGrader

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Barriers for Implementing the Project

- No room in the curriculum
- Nobody willing to teach the course
- Too much work/preparation time to implement
- No faculty buy-in
- Not in my area of expertise
- Highly selective college, no need for student development
- Already teaching effective Introduction to Engineering course
- Reports with an average of 14 pages are too much to grade
- Push back from students

Barriers for Implementing the Project

"…signs of discomfort and upset are not necessarily negative. On the contrary, they often signal that developmentally fruitful encounters are occurring, that stimuli for learning are at work." Chickering and Reisser (1993)

15 Minute Break

Calvin's Experience - Context

- BSE Program with concentrations
- Common first two years
- ENGR 101
  - History
  - Student Success Focus
    - Textbook readings with on-line responses
  - Adaptable DYP project
    - Tied to reflection on Christian vocation

Calvin's Experience - Results

- Most students receptive to success strategies
- Faculty perspectives on DYP
  - Linking reflection on vocation to success strategies is more effective than previous approaches
  - Project documents are inspiring (and sometimes surprising) to read
- Student perspectives on DYP

A Community of World Class Engineering Students – by Krishna

- Living Learning Community - Predetermined cohort of first-year undergraduate students, who may share common classroom experiences, residence hall co-curricular activities, and faculty involvement outside the classroom.
- Faculty in Residence - A faculty member lives in the residence hall, holds office hours in an office or common area of the residence hall, hosts study groups or review sessions before examinations, and attends co-curricular activities with the students.

A Community of World Class Engineering Students – by Krishna

- Learning Outcomes:
  - Increase learner self-assurance.
  - Confidence in public communication.
  - Academic achievement.
  - Self-assessment skills.
  - Digital fluency.
  - A sense of belonging to the community and to the university as a whole.
- Student Projects in Fall and Spring:

(1) Design your process for becoming a "world class" engineering student in Fall.

(2) Open-ended projects in Spring.

A Community of World Class Engineering Students – by Krishna

Student Involvement			
		ENGR 100/120	
Resident Assistants (RA)	12	TA	2
Program Assistants (PA)	5	REU	1
Peer Mentors (PM)	13	Study Abroad	4
		McCain Foods	
COEN Peer Advisor	2	Interns	2
NASA Internship	1	Summer intern	1
		Projects presented at Senior Design	
VIP Projects	3	Projects	12
Research Lab	3	Space Broncos	5
		Microgravity	
HP Internship	2	Team	1

% and Average GPA	
GPA	Engineering LLC
3.7 to 4	36% and 3.86
3.3 to 3.7	26% and 3.48
3 to 3.3	10% and 3.11
2.7 to 3	13% and 2.83
2.3 to 2.7	13% and 2.47
2 to 2.3	2% and 2.22
Engr. LLC Average GPA	3.34
COEN Average GPA	2.94

Retention for 2014 to 2015 and 2015 to 2016 for Engineering LLC

Engineering: 73%

Changed majors but still at Boise State: 16%

Dropped/transferred: 11%

Last Thoughts

- Reading students reports is fun and you learn a lot about ***your*** students issues and struggles.
- Students who read more than 40 pages a week and wrote more than 20 pages showed higher gains in learning and critical thinking skills [1].
- What barriers are you willing to overcome to implement the project?

1. Academically Adrift: Limited Learning on College Campuses, Richard Arum, University of Chicago Press, 2011

Positive attitudes produce positive results.

Negative attitudes produce negative results.

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Become Part of the Movement

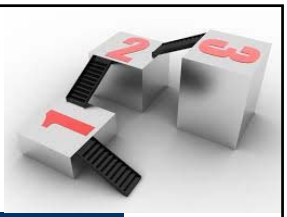
Web Content

8. Assessment/research materials for measuring impact of project

"Practitioners may also encounter less than supportive attitudes among staff members…Such attitude can arise from such factors as lack of understanding of the value of theory… Demonstrating the effective use of theory may help convince others of its value."

Nancy J. Evans at al., 2010

Three Levels of Implementation



1) Implement the Project
2) Implement the Project and share your experiences with us
3) Implement the Project and participate in our research effort to compile data from several institutions

Upcoming Workshop

Eighth Annual (FYEE) First Year Engineering Experience Conference at The Ohio State University, Columbus, OH July 31-August 2, 2016

Workshop: "Design Your Process of Becoming a World-Class Engineering Student"–A Powerful Project for Enhancing Student Success, Monday, August 1st, 10:30am

Q&A

Improve Student Academic Performance and Retention: The Design Your Process to Become a World Class Engineering Student Project

Steffen Peuker, California Polytechnic State University, San Luis Obispo

Raymond B. Landis, California State University, Los Angeles

Gayle E. Ermer, Calvin College, Grand Rapids, Michigan

Krishna Pakala, Boise State University, Boise, Idaho