

# So, what does it take for your students to learn something new?



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# Course Learning Objectives

(What should the students be able to do at the end of the course?)



Case Studies  
Role Playing



Lectures  
Labs  
Simulation  
IT Debate

29 June 2016

Mercantec Workshop 2

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# Session Goals

- ❑ *Explore* our own Learning.
- ❑ *Understand* what it takes to learn something new (Conditions of Learning).
- ❑ *Apply* this understanding to our Teaching.

# Individual Reflection: 5 min

- Think & write about a time when you were trying to learn a new skill (academic, sport, music, other), and you succeeded.
- What were some of the things, without which you wouldn't have learned this skill?

# Team Sharing: 10 min

- Exchange stories.
- Come up with **key words** to describe what contributed to your learning experience (e.g. practice, persistence, etc.)

# CONDITIONS OF LEARNING

(Brian Cambourne)

1. Immersion
2. Demonstration
3. Engagement
4. Expectations
5. Responsibility
6. Approximations
7. Employment (Practice)
8. Response (Feedback)

# Where did this theory come from?

- ❑ **Brian Cambourne**, in his effort to find an educationally relevant theory of literacy learning, conducted research with young children for a period over 20 years, from the early 1970's to the mid-1990's.
- ❑ My Thesis: **The 8 Conditions of Learning are universal!**

# **IMMERSION**

**The state of being  
saturated by,  
enveloped in,  
flooded by,  
steeped in,  
or constantly bathed  
in that which is to be learned.**

# IMMERSION: *some ideas*

- @ Home Exposure
- Internships / Co-ops / Full-time job in the field of study
- Hobbies
- Field trips
- Service Learning
- Decorations

# Curtiss T-32 Condor, 1933

2<sup>nd</sup> generation biplane transport,  $V = 145$  mph, 12 passengers



# 1<sup>st</sup> modern air transport: Boeing 247, 1933

clean design, 10 passengers / 2 pilots / 1 steward, 160 mph,  
only 75 were built !!



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# Like this, only better!



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# DC-3, 1936

V = 185 mph, 21 passengers

Built: 10,654 DC-3 & C-47 + 2,500 Li-2 (Soviet Union) & L2D (Japan)



# IMMERSION: What is NOT ☹️

- ❑ Working 10 – 40 hrs / wk in jobs unrelated to the field of study
- ❑ Spending 2 hrs / day commuting
- ❑ Spending free time in activities unrelated to the field of study
- ❑ Decline of school-supporting leisure habits – lower reading rates, fewer museum visits..

# IMMERSION

2 min – Reflect & Team Share...

- Ways to increase the level of immersion of your students in your field.
- Write down your ideas.

# DEMONSTRATION

The ability to...



observe,  
see,  
hear,  
witness,  
experience,  
feel,  
study,  
explore

actions and artifacts.

# Missing Demonstrations?

- ❑ No example problems – “Go to the workshops!”
- ❑ Examples limited to very simple problems but tests involve complex problems.
- ❑ Students are assigned OEP w/o a demo of the process on how to tackle one.

# Student Comment

*“Example problems done in class are a decoy, to lure you away from potential exam material !”*

# DEMONSTRATIONS

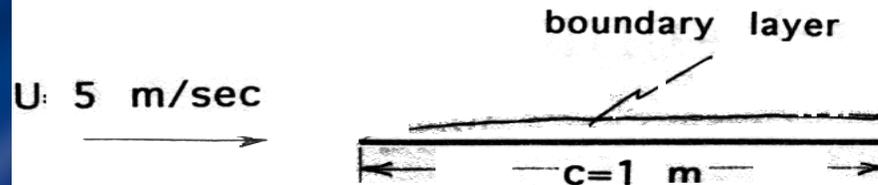
## *some ideas*

- Teach students how to think like a(n)...
  - ✓ Aerodynamicist
  - ✓ Structural Engineer
  - ✓ Design Engineer
- Make demonstrations “whole”!
- Give students the big picture.
- Students do not need to grasp everything at once.
- Include case studies.
- Integrate the curriculum.

# Un-whole Demonstration



Calculate the skin-friction drag of a flat plate with a span  $b=5\text{ m}$  and a chord  $c=1\text{ m}$  for an airspeed of  $5\text{ m/sec}$ .



For sea-level, standard air the density is  $\rho = 1.2\text{ kg/m}^3$   
and the viscosity is  $\mu = 1.789 \times 10^{-5}\text{ N}\cdot\text{sec/m}^2$   
The Reynolds number for the flow over the plate is

$$Re = \frac{\rho U c}{\mu} = \frac{1.2(5)1}{1.789 \times 10^{-5}} = 3.35 \times 10^5 \leq Re_{cr} = 5 \times 10^5$$

so the boundary layer is laminar. The skin-friction coefficient for the plate can be calculated from:

$$C_F = \frac{1.33}{\sqrt{Re}} = 0.0023$$

The surface area of the plate on one side is:

$$S = bc = 5(1) = 5\text{ m}^2$$

while the dynamic pressure of the free-stream is:

$$q = \frac{1}{2} \rho U^2 = 15\text{ N/m}^2$$

Finally, the skin-friction drag of the plate is

$$D = 2C_F q S = 2(0.0023)15(5) = 0.345\text{ N}$$

# *Whole Demonstration: Piaggio Avanti P-180*



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# DEMONSTRATION

3 min – Reflect & Team Share...

- Ways to improve your demonstrations of the skills you expect your students to learn.
- Ways to introduce “whole” demonstrations in your field.
- Write down your ideas.

# ENGAGEMENT

*means:*

- ❑ **Attention** which comes as a result of a perceived need or purpose for learning in the first place.
- ❑ **Active participation** by the learner, which in turn involves some risk taking.
- ❑ **Very little learning can occur w/o it!**

# ENGAGEMENT

*learners must be convinced that:*

- ❑ Are **potential doers** of the demonstrations they are observing.
- ❑ Engaging will **further the purpose of their lives.**
- ❑ Can engage and try to emulate **without fear** of physical or psychological hurt if their attempts are not correct.

# ENGAGEMENT

*what can we do ?*

- Probability of engagement increases if students:
  - ✓ Have bonded with us.
  - ✓ Think highly of us.
  - ✓ Believe we like them and care about them.
- \$\$, bonus points not strong motivators!
- Tell them stories!
- Must come from within; need inspiration!
  - ✓ Why do I ...tango?..climb mountains? ..ran ultras?

# ENGAGEMENT

## *What does brain research say?*

- ❑ Our ability to learn has deep roots in relationships.
- ❑ Our learning performance may be deeply affected by the emotional environment in which learning takes place.
- ❑ ***Quality of education may in part depend on the relationship between student & teacher***

Medina, John: Brain Rules; 12 Principles for Surviving and Thriving at Work, Home, and School, Pear Press, 1<sup>st</sup> ed., 2008.

# ENGAGEMENT: *the challenge*

- ❑ % of frosh declared as essential objective of their university education to “*develop a meaningful philosophy of life*”:
  - ✓ 1967: 86%
  - ✓ Now: 45%
- ❑ % of frosh declared as essential objective of their university education to “*become well off financially*”:
  - ✓ 1967: 40%
  - ✓ Now: 82%
- ❑ Students no longer come to discuss assignments during office hours

Mark Bauerlein, English Professor @ Emory U., “What’s The Point of a Professor?”, NYTimes, 10May15

# ENGAGEMENT

3 min – Reflect & Team Share...

- Are your students engaged in your field of study?
- What makes you think so?
- Is there anything you can do to increase the level of engagement of your students?
- Write down your ideas.

# EXPECTATIONS

## *Students:*

- Achieve what we expect them to achieve and fail if we expect them to fail.**
- Must be given the message that they are expected to learn the concepts, to perform the experiments, design and build a plane that will fly, etc.**

# EXPECTATIONS

- ❑ Avoid hinting that the task is too difficult or that there is a chance the student might not be able to complete.
- ❑ Students are more likely to engage in demonstrations of teachers whom they regard as significant and hold high expectations for them.

# EXPECTATIONS

*what can we do ?*

- Be positive!
- Be genuine and realistic!
- Know our students' abilities and challenge them to the fullest of their capacity;
  - ✓ Too simple a task - boredom
  - ✓ Too challenging a task -anxiety
- Maintain good rapport with students.

# EXPECTATIONS

## *a few examples*

- ❑ Guidelines for report writing, OEP
  - ✓ Return ungraded if guidelines not followed!
- ❑ AE171B: SAE Aero Design Competition
  - ✓ Crash 3 days before competition; 36 x 3 man-hrs to rebuild plane
- ❑ Come to class prepared for problem solving!
  - ✓ 5 min quiz on reading assignment @ beginning of class
  - ✓ more points earned if problem is completed within given time in class

# EXPECTATIONS

3 min – Reflect & Team Share...

- Expectations you have for your students.
  - ✓ Are these expectations genuine?
  - ✓ Are they realistic?
  - ✓ Do most of your students meet your expectations? Why?
  - ✓ Is there anything you think you need to do differently in your courses?

# RESPONSIBILITY

- ❑ Students are allowed to make some decisions about when, how, and what “bits” to learn in any task.
- ❑ Learners who lose the ability to make decisions are disempowered.
- ❑ Implications for **Lifelong Learning!**

# RESPONSIBILITY

## *some ideas*

- ❑ Students take responsibility to learn some things on their own.
  - ✓ Project-Based Learning
- ❑ Students design, not simply perform experiments in the lab.
- ❑ Students occasionally present new material in class.
- ❑ Portfolios, choice of assignments.

Seymore Papert  
Cognitive Psychologist:

*Better learning will not come  
from finding better ways  
for the teacher to instruct  
but from giving the learner  
better opportunities  
to construct !*

# RESPONSIBILITY

3 min – Reflect & Team Share...

- Ways you are encouraging / could encourage your students to take responsibility for their own learning in your courses, beyond the customary (i.e., they are supposed to read the book and do the homework).
- Write down your ideas.

# APPROXIMATIONS

Students are not expected to wait until they have completely mastered a skill before they are allowed to use it. Rather, they are expected to “have a go” (i.e. attempt to emulate what is being demonstrated).

# APPROXIMATIONS

The attempts of the learner, though not perfect, are received enthusiastically, warmly, and joyously. Mistakes are essential for learning to occur.

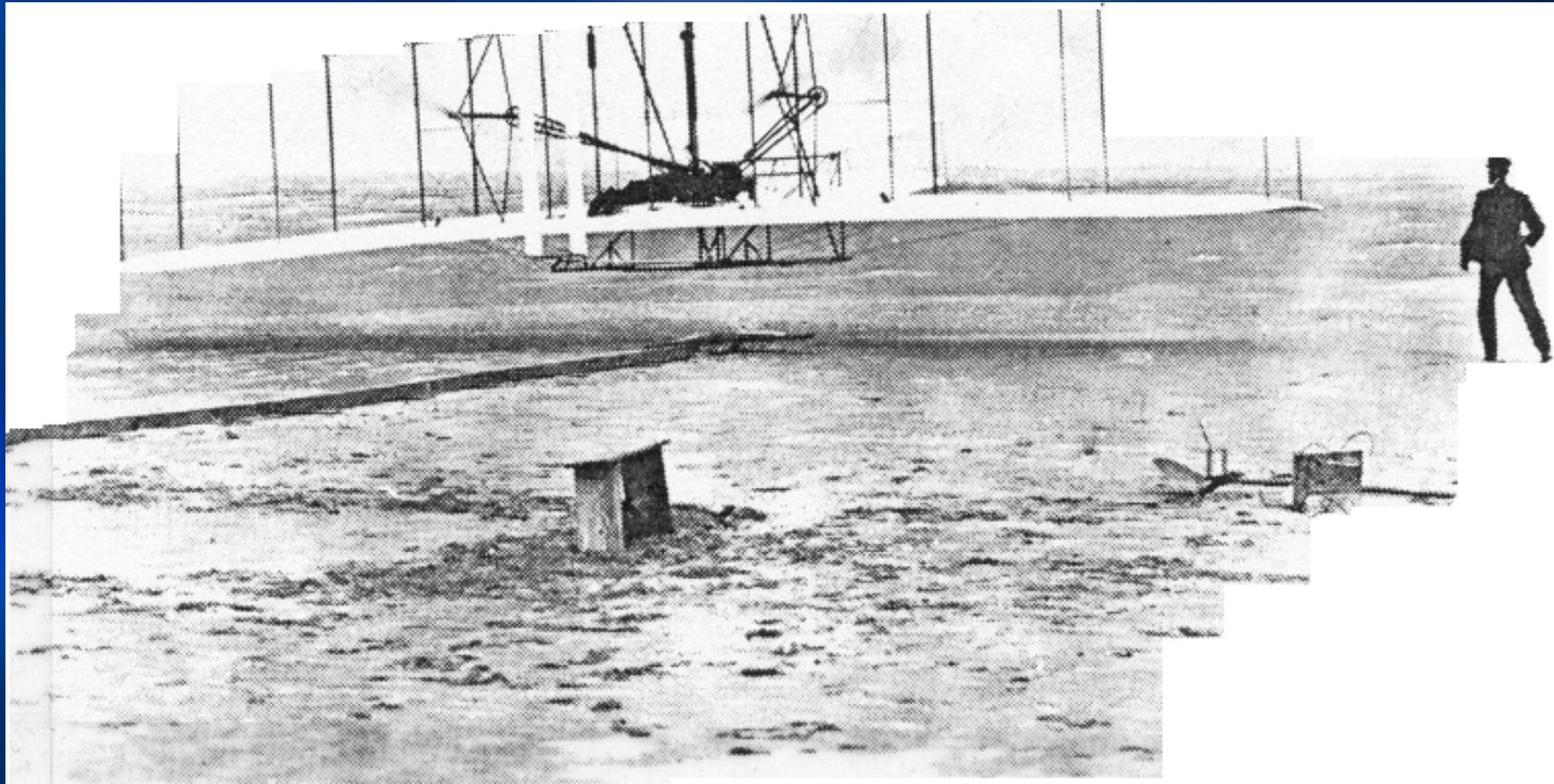
Engineering  
is the science of  
doing things over.

# APPROXIMATIONS

## *some ideas*

- Role of failure in engineering; design & iteration (e.g. early bridge design)
  - ✓ “Nobody will fly for 1,000 years!”  
*Wilbur Wright, 1901.*
  - ✓ Allow + reward students to rework papers, homework problems, design / lab reports.
- AL & CL in the classroom:
  - ✓ Opportunity to approximate when feedback is readily available.

# Wright Flyer, 1903.



# APPROXIMATIONS

3 min – Reflect & Team Share...

- Ways you are encouraging / could encourage your students to “approximate” in your courses.
- Write down your ideas.

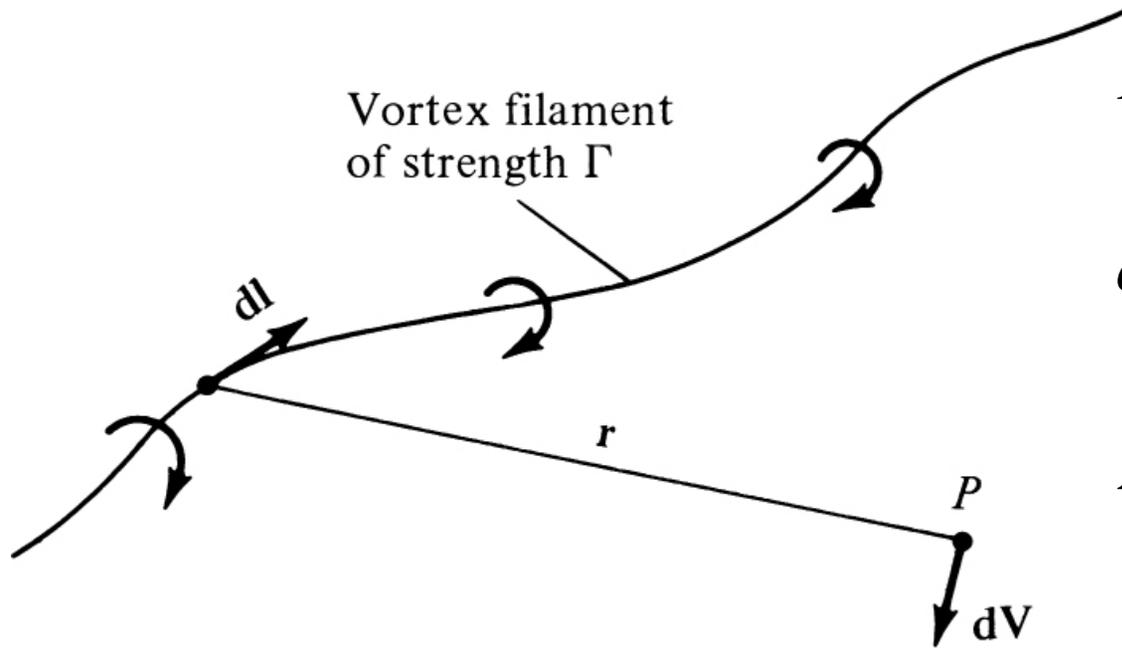
# **EMPLOYMENT (Practice)**

Learners need time and opportunities to use, employ, and practice their developing skills.

# EMPLOYMENT: *some ideas*

- Must be meaningful!
  - ✓ A flat plate IS NOT!
  - ✓ An airplane wing IS!
  - ✓ A vortex filament IS NOT!
  - ✓ A visible tip-vortex IS!

# Biot – Savart Law



Vortex filament  
of strength  $\Gamma$

*Electromagnetics*

$$d\vec{B} = \frac{\mu I}{4\pi} \frac{d\vec{l} \times \vec{r}}{|\vec{r}|^3}$$

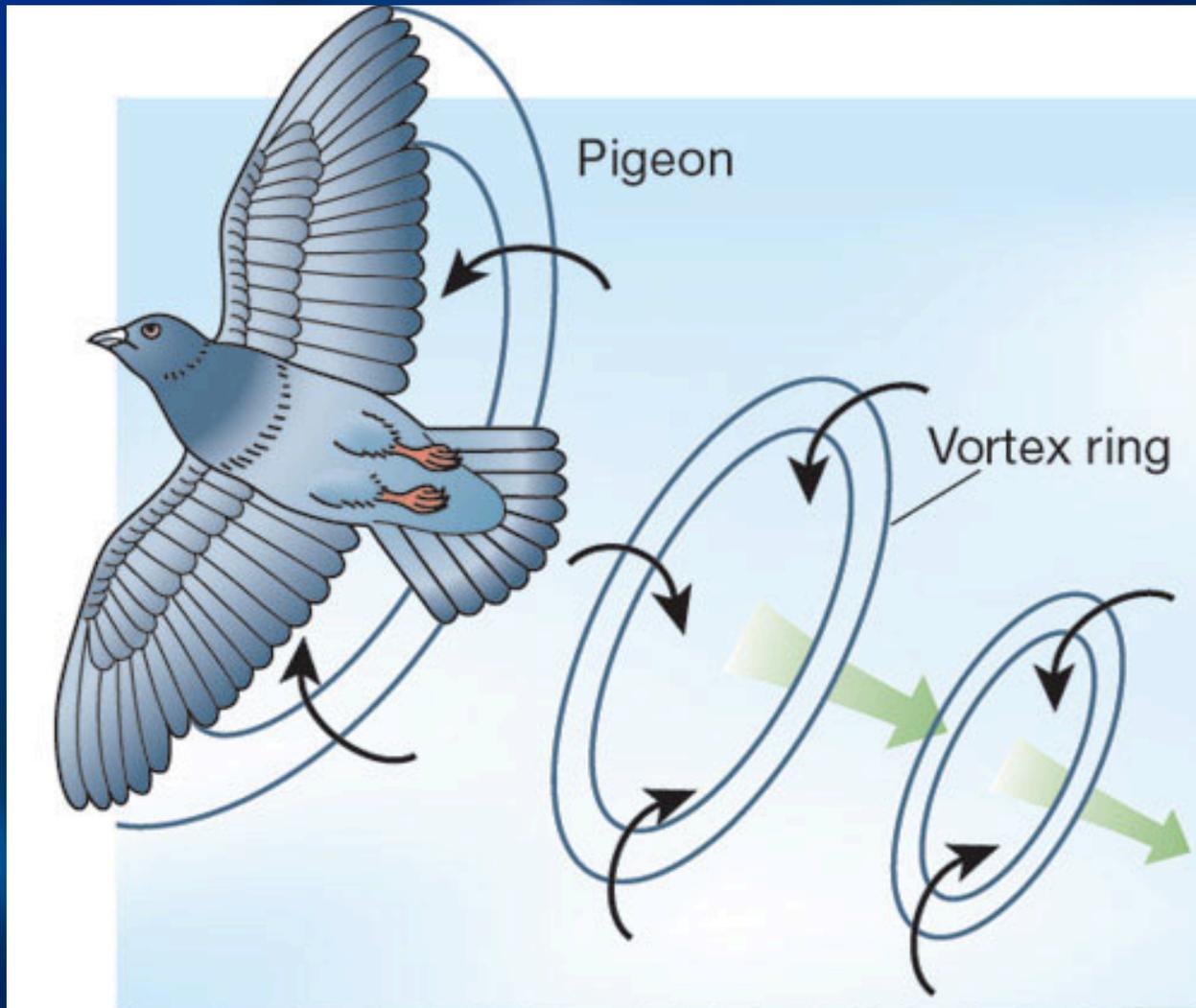
*Aerodynamics*

$$d\vec{V} = \frac{\Gamma}{4\pi} \frac{d\vec{l} \times \vec{r}}{|\vec{r}|^3}$$

$\mu$  : permeability of the medium

$I$  : current intensity

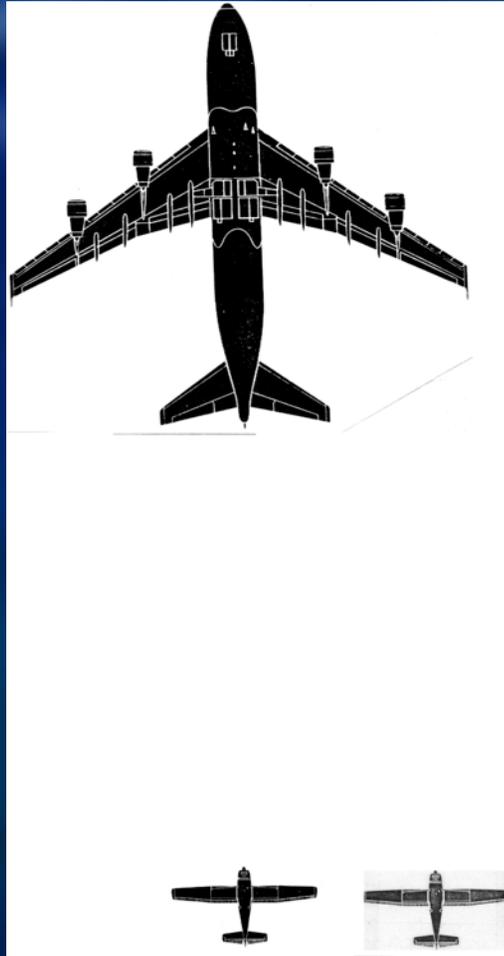
# Vortex Rings



# A tip-vortex from a crop-duster



# C-152 following B 747



# EMPLOYMENT: *some ideas*

- ❑ Must relate to students' personal lives !
  - ✓ Reflection Journals
  - ✓ Share stories in class
- ❑ Problem-Based Learning
- ❑ Inquiry-Based Learning
- ❑ Active Learning in class!

Chickering & Gamson, 1987

*“Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must **talk** about what they are learning, **write** about it, **relate** it to past experiences, **apply** it to their daily lives. They must make what they learn part of themselves.”*

# Missing Employment ?

- ❑ Students do not practice (e.g. problem solving) on their own!
- ❑ Students spend little time studying outside of class.
- ❑ Ineffective study skills.

# EMPLOYMENT

2 min – Reflect & Team Share...

- Ways you are encouraging / could encourage your students to “**meaningfully**” employ what they learn in your courses.
- Write down your ideas.

# RESPONSE (Feedback)

- ❑ Learners must receive feedback from exchanges with more knowledgeable others (teacher, classmates, engineers from industry, etc.).
- ❑ Response must be relevant, appropriate, timely, readily available, and non-threatening, with no strings attached.

# RESPONSE: *some ideas*

- ❑ Maintain good rapport with students.
- ❑ Classroom Assessment (e.g. 1 min papers).
- ❑ Cooperative Learning (feedback from peers)
- ❑ Involve other professionals / community members:
  - ✓ Student Conference Day
  - ✓ Industry-sponsored projects
  - ✓ Internships / Co-ops
  - ✓ Service-Learning Projects
  - ✓ National Design Competitions

# RESPONSE

3 min – Reflect & Team Share...

- Non-traditional ways (i.e. exams, hw) you are providing / could provide “meaningful” feedback to your students.
- Write down your ideas.

# What research says about improving undergraduate education – 12 attributes of good practice

AAHE Bulletin, April 1996, pp.5-8

## *Organizational culture that values:*

1. High expectations.
2. Respect for diverse talents and learning styles.
3. Emphasis on early years of study.

# What research says about improving undergraduate education – 12 attributes of good practice

AAHE Bulletin, April 1996, pp.5-8

## *Quality curriculum:*

4. Coherence in learning.
5. Synthesizing experiences.
6. Ongoing practice of learned skills.
7. Integrating education and experience.

# What research says about improving undergraduate education – 12 attributes of good practice

AAHE Bulletin, April 1996, pp.5-8

## *Quality instruction:*

8. Active learning.
9. Assessment and prompt feedback.
10. Collaboration.
11. Adequate time on task.
12. Out-of-class contact with faculty.

# What Works & What Doesn't

ASEE Prism, Nov. 1995, pp.21-25

What works *according to Students*:

- Lectures w. anecdotes and examples
- Professors w. mastery of English
- Guest lecturers
- Textbooks w. many examples
- Real-world problems
- Homework that includes course projects & teamwork
- Courses in humanities
- Computer assignments
- Tests that focus on methodology

# What Works & What Doesn't

ASEE Prism, Nov. 1995, pp.21-25

What doesn't work *according to Students*:

- Chalk & talk lectures
- Brilliant researchers who can't communicate
- Isolation from real-world engineering
- Professors who lecture straight from the text
- Plug & chug problems
- HW that's too difficult for most students to complete successfully
- A curriculum that emphasizes only math and science
- Assignments that require timely calculations
- Tests that focus on memorization

# Individual Task – 3 min

## Reflection

- The most interesting thing you're taking away from this session.
- Unanswered questions ?