Project-Based Learning

Impacts and Implementation

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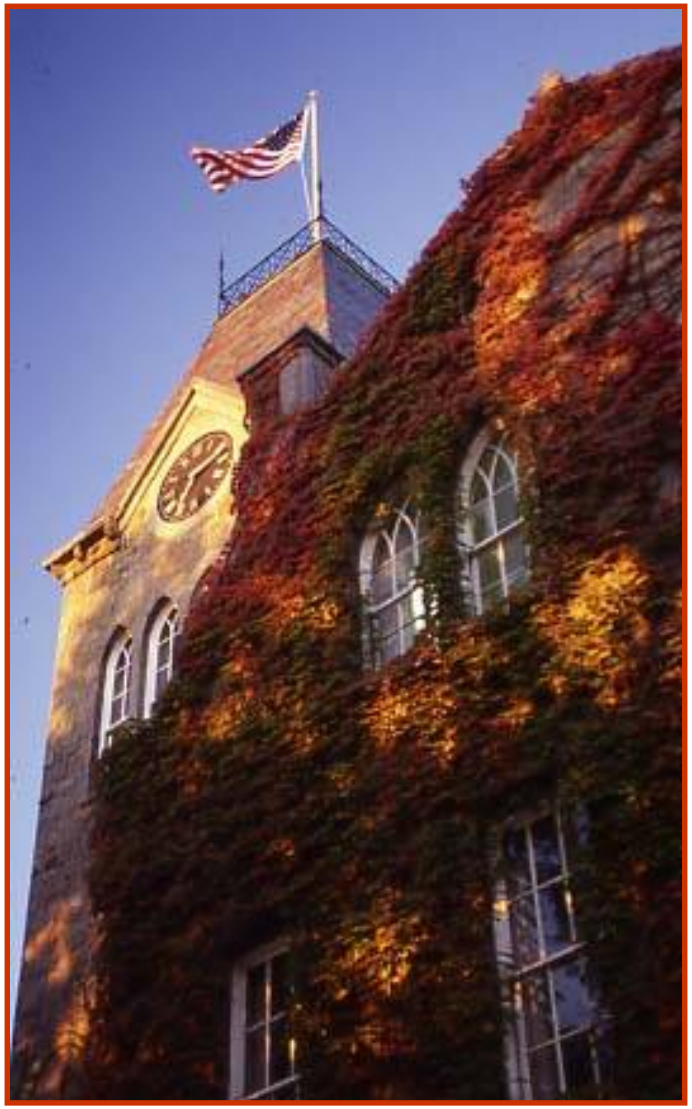
Goals for the Workshop



- Present motivations and models for PBL
- Discuss PBL examples across the curriculum
- Explore ways to form, support, and evaluate student teams
- Help connect your PBL goals with implementation strategies
- Develop next steps for your work


Introductions

Most Important College Learning Outcomes, According to US Employers

1. Ability to communicate orally
2. Ability to work effectively with others
3. Ability to communicate in writing
4. Ethical judgment and decision-making
5. Critical thinking and analytical reasoning
6. Ability to apply knowledge and skills to real-world settings

91% of employers agree that these abilities are more important than the student's major area of study to achieve success in their careers

Source: Hart Research Associates, 2015

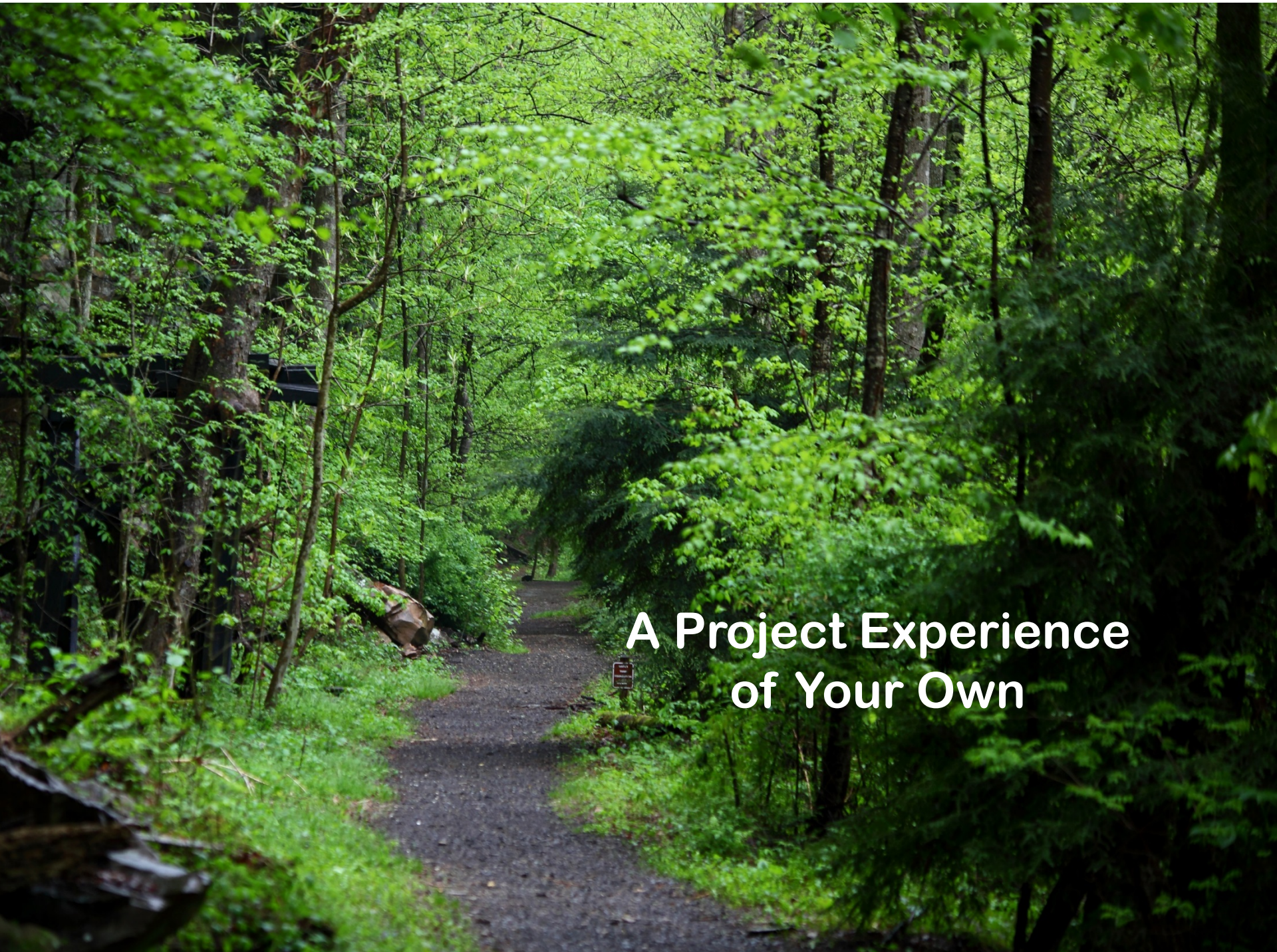
Evidence-Based, High Impact Practices

(Kuh, AAC&U, et al.)

- First-Year Seminars and Experiences
- Common Intellectual Experiences
- Learning Communities
- Writing-Intensive Courses
- Collaborative Assignments and Projects
- Undergraduate Research
- Diversity/Global Learning
- Service/Community-Based Learning
- Internships
- Capstone Courses and Projects
- ePortfolios

Project-Based Learning

- Applying knowledge to address authentic, real-world problems
- Learning new topics independently
- Communicating effectively in written, oral, and visual forms
- Interacting productively with others


A Project Experience
of Your Own

What Happened

- Goal: Determine feasibility; develop recommendations
- The team researched all-persons accessibility standards, trail construction, and previous all-access trails
- Methodology:
  - Questionnaire for Sanctuary visitors
  - Interviews with disability and trail experts
  - Trail mapping using GPS and GIS
  - Developed four options, estimated costs of each
- Delivered report with detailed recommendations for construction, materials, use, maintenance
- Recommendations used by Sanctuary to develop trails

Thinking about the Pedagogy

- What will students learn from tackling this type of project?

- What assignments and activities will keep them on track?

Essential Elements of Project-Based Learning

Buck Institute for Education

- **Key Knowledge, Understanding, and Success Skills** - both discipline-specific and transferrable
- **Challenging Problem or Question** - engaging; appropriately challenging
- **Sustained Inquiry** - an extended process of asking questions, finding resources, and applying information
- **Authenticity** - real-world context, tasks and tools, quality standards, or impact
- **Student Voice & Choice** - students make decisions, including how they work and what they create
- **Reflection** - students reflect on learning, the effectiveness of their inquiry, the quality of their work, and obstacles
- **Critique & Revision** - students receive and use feedback to improve their process and products
- **Public Product** - students make their project work public by explaining, displaying and/or presenting it beyond the classroom

Project Based Learning vs. Problem Based Learning

Similarities
• Focus on an open-ended question or problem
• Provide authentic applications of content and skills
• Emphasize student independence and inquiry
• Are longer and more multifaceted than traditional assignments

Differences	
Project Based Learning	***Problem Based Learning***
Often multi-disciplinary	More often single subject
May be lengthy (weeks, months)	Tend to be shorter
Includes the creation of a product or performance for a relevant audience	Product may simply be a proposed solution, expressed in writing or in an oral presentation
Often involves real-world, fully authentic tasks and settings	More often uses case studies or fictitious scenarios as ill-structured problems
May be almost entirely student-directed	Often includes pre-planned, staged instruction

Source: Buck Institute for Education

Changing Faculty and Student Roles

- Faculty move away from
  - Dispensing information
  - Authority and expert

and toward

- Designing learning experiences
- Coach and facilitator

- Students move away from
  - Listening/watching
  - Dependence
  - *Gaining* knowledge

and toward

- Creating/discovering
- Independence
- *Making* knowledge

Projects Across the Curriculum at WPI

- 1st year: Great Problems Seminar
  - 6 credit hours, interdisciplinary
- 2nd year: Humanities and Arts Capstone
  - Seminar or practicum in chosen area
- 2nd – 4th years: Course Project Work
  - E.g., formative engineering design
- 3rd year: Interactive Qualifying Project (IQP)
  - 9 credit hours, interdisciplinary gen ed
- 4th year: Major Qualifying Project (MQP)
  - 9 credit hours, capstone in major field

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Long-term impacts of projects?
Preparation for career and life?
Experience of different groups?

Methods

- Participants
  - WPI project-based curriculum graduates (‘74-‘11)
  - Non-alumni employers of WPI graduates
- Survey: Demographics + 39 Likert-scale items on project impacts
  - Professional skills and abilities
  - World views
  - Personal impacts
- Interview protocols: Semi-structured

Professional Impacts	% Positive Responses
Responsibility for own learning	89
Develop ideas	89
Solve problems	88
Effective professional interactions	87
Function effectively on a team	86
Effectively manage a project	86
Write clearly and effectively	83
Succeed in business or industry	78
Be an effective leader	78
Speak clearly and effectively	76

Alumni Voices: Preparation for Work

“[Project work] is really a problem-solving and project management education, and that’s something I use constantly at work.”

“It’s close … to what I do now. … Life is projects.”

Alumni Voices: Professional Skills

"You gain so many skills working with other people and you learn to value other people and what they bring."

"I think the [projects] just really mimic, at a very early age—a formative age … in your learning process— … how to work, how to be successful."

"You've got to get used to speaking … and answering questions and being confident, and that was invaluable."

Personal Impacts	% Positive Responses
Stronger personal character	**87**
Feeling own ideas are important	79
Feeling able to make a difference	66
Enriched personal life	64
Feeling connected to WPI	62
Achieving work/life balance	53
Desire to stay connected to WPI	47

Alumni Voices: Personal Impacts

“To have something that really takes you out of your comfort zone … where you can’t predict exactly what’s going to happen … helped me to become a stronger person as I headed out of college.”

Additional Findings

- Women reported more strongly positive impacts from PBL than men in 36/39 areas
- Engineering graduates reported more strongly positive impacts in all 22 areas of professional skills
- “Real world” aspect highly motivational
- Adversity and unpredictability promoted learning, growth, and confidence

Reinforcement from Employers

- Employers who knew WPI had project-based learning believed that project-based learning was responsible for creating individuals who were well-prepared for the workplace
- Employers see particular value in projects that are
  - Long-term, non-trivial in scope
  - Substantive, involve working with industry
  - Authentic, not merely exercises, require students to be self-directed

Employer Voices

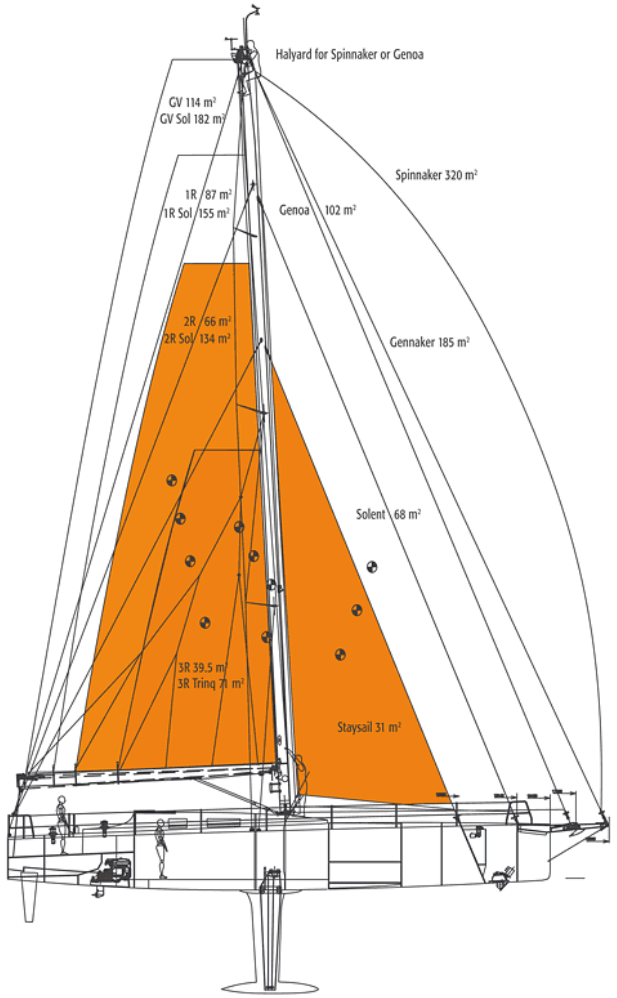
"[When] they're doing those project-based … courses … with teams, they end up … being able to communicate and to articulate … their point of view and what they think is appropriate, having to work through the compromises, all of that. I think … as a result of that type of class work and preparation, they're … better … prepared…"


Break


Examples

Example Project: Materials Science

- Large introductory course (80-120)
- Wide range of years and majors
- Project worth 20% of course grade
- *Recommend and justify a material for the rod rigging of a racing yacht, to reduce its weight*

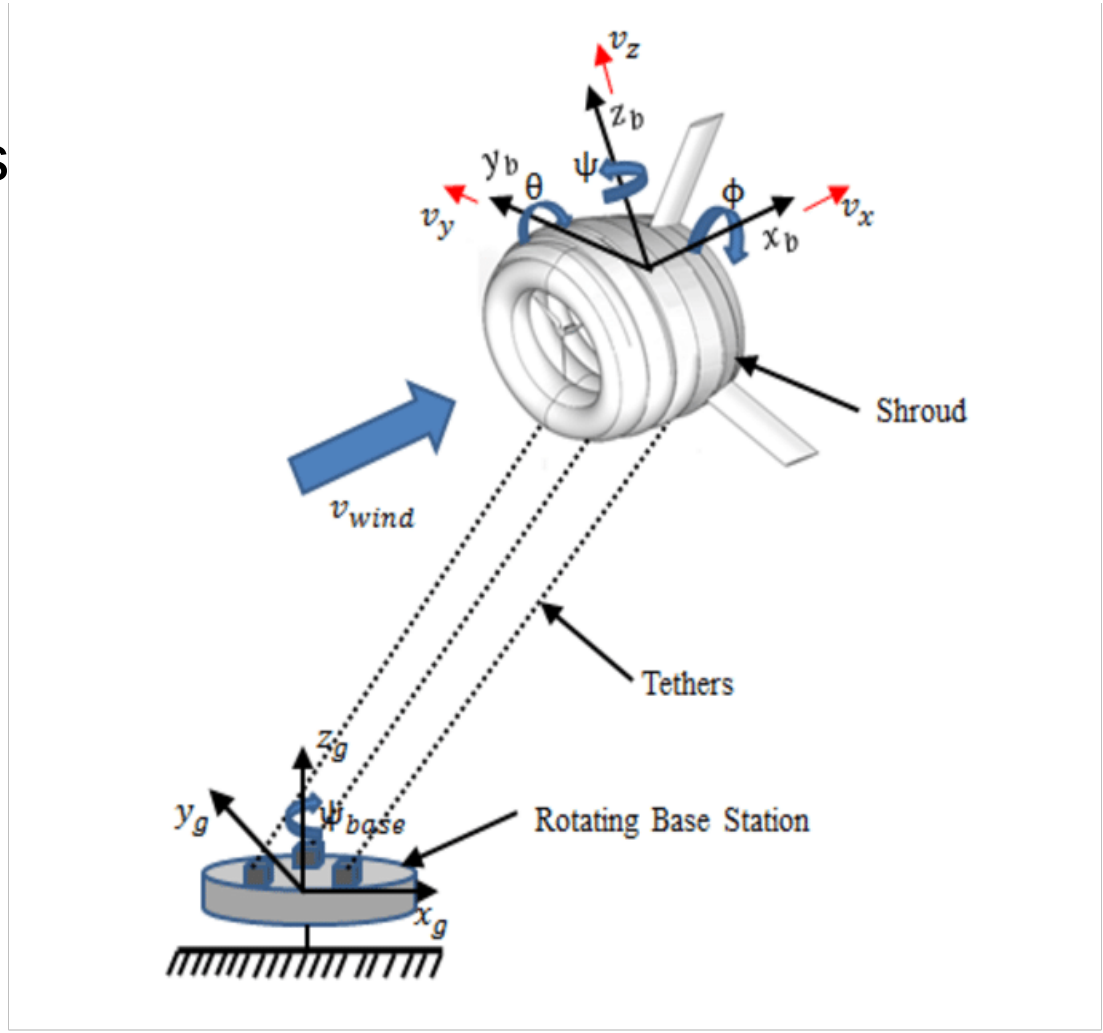


Project Design and Scaffolding

- Fictitious client, realistic scenario
- Open-ended with multiple solutions: some constraints given, students must investigate others
- Deliverable varies: technical memo; video; poster
- Detailed rubric to communicate expectations
- Students assigned to teams that work together throughout course: self and peer evaluation
- Formative feedback before submission: check-ins during class

Example Project: Introduction to Statics

- 90 students, mostly sophomores, various majors
- Two projects, each worth 15% of grade
- Replacement of some HW
- Altaeros hot air balloon wind turbine
- Siting and tethering to electrify a village in Africa



Working with Student Teams

Let's Talk Teamwork

- Why have students work in teams?
- What challenges have you faced?
- What have you found that works?
- What are your biggest concerns?

Impact of Project and Teamwork Experiences: A Closer Look at Specific Student Groups

- Project-based learning has multiple benefits for students, especially for women, students of color, and low-income students[1]
- Women, students of color, and lower income students are often marginalized in team settings[2]

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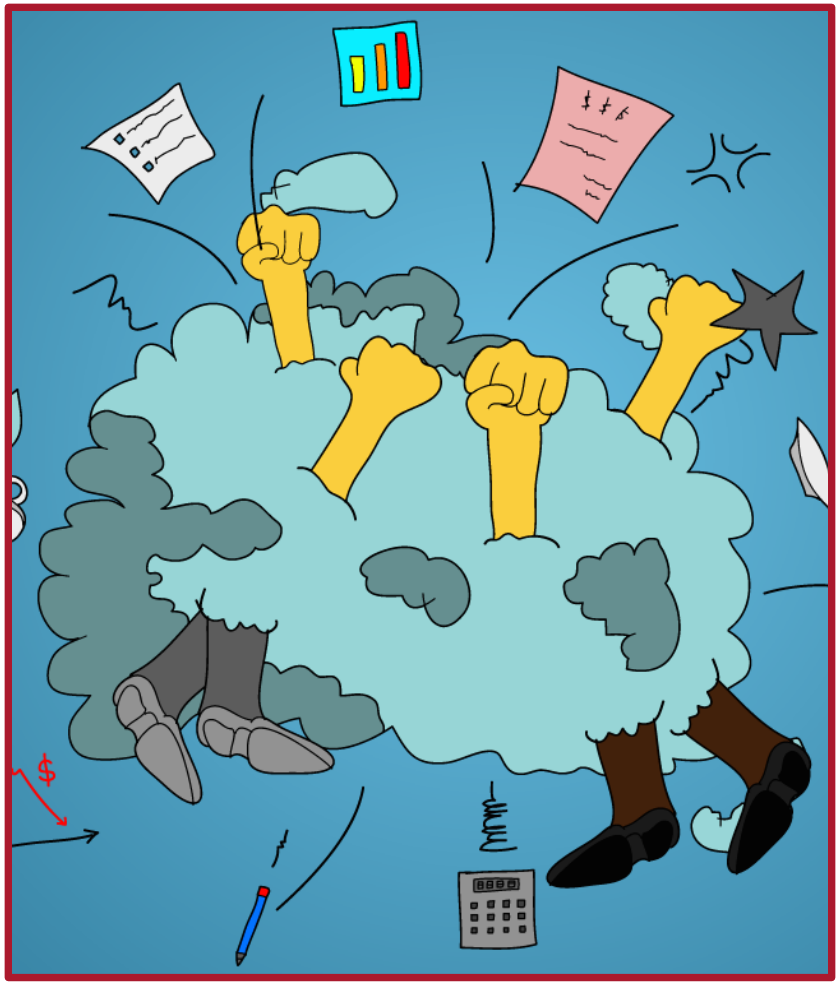
[1]Filkins and Doyle, 2002; Kuh, 2008

[2]Meadows et al., 2015; Wolfe et al., 2016

What Are the Characteristics of Highly Effective Teams?

- Trust and respect
  - Understanding and respecting differences
- Communication
  - Handling conflict, managing disagreement
- Commitment
  - Shared vision, sense of mission
- Accountability
  - Individuals contributing in a team context
- Results

What Are the Characteristics of Ineffective Teams?



- Tension
- Breakdown in communication
- Poor outcomes
- Under-functioning
- Over-functioning
- **Conflict avoidance**
- **Inequity**

Tuckman's Model of Teamwork

Forming	Storming	Norming	Performing	Adjourning
CHARACTERISTICS •Questioning •Socializing •Displaying eagerness •Focusing on group identity & purpose •Sticking to safe topics	CHARACTERISTICS •Resistance •Lack of participation •Conflict •Competition •High emotions •Moving toward group norms	CHARACTERISTICS •Reconciliation •Relief, lowered anxiety •Members are engaged & supportive •Developing cohesion	CHARACTERISTICS •Demonstrations of interdependence •Healthy system •Ability as a team to effectively produce •Balance of task and process orientation	CHARACTERISTICS •Shift from task to process •Sadness •Recognition of team & individual efforts
STRATEGIES •Take 'lead', individual contacts •Clear expectations & consistent instructions •Quick response	STRATEGIES •Normalize •Encourage leadership	STRATEGIES •Recognize individual & group efforts •Provide learning opportunities and feedback •Monitor 'energy' in the group	STRATEGIES •Celebrate •"Guide from the side", minimal intervention •Encourage group decision-making & problem solving •Provide opportunities to share learning across teams	STRATEGIES •Acknowledge change •Provide opportunity for summative team evaluations •Provide opportunity for acknowledgements

Team Formation Strategies

- Student-chosen teams
- Faculty-chosen teams
  - Random
  - Different skills
  - Similar goals
  - Interest in topic
  - Logistics/scheduling
  - Diversity
  - Personality types/learning styles

Team Development and Support

- Explicit discussion of teamwork goals and evaluation
- Teamwork coaching
- Opportunities for reflection and feedback
  - Student to student
  - Faculty to student
  - Student to faculty
  - Self-reflection
- **Team contracts**
- ***Team Writing*, Joanna Wolfe**
- **Asset mapping (Stoddard and Pfiefer, 2018)**

Beginning with the End in Mind

Skills and Abilities →

Evidence →

Assignments and Activities →

Making it Work!

Setting the Frame

On a piece of paper, please list some **salient characteristics of the students and course** you have in mind. Examples:

- About how many students do you expect?
- What year are they? Majors?
- Full or part time?
- Is this a required course? Elective?
- Introductory? Advanced?

Beginning with the End in Mind

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Making it Work!

Brainstorming: Skills and Abilities

- **Discuss:** *What skills and abilities do you want your students to have as a result of their project-based learning?*

- **Suggestion:** *Think in terms of what they will be* ***able to do****, not just what they will know*

- **Report out:** *Which skills and abilities are most important to you?*

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How Will You Know?

- Consider the **skills and abilities** you want your students to develop.

- **Discuss:** *What **evidence** would convince you that your students have acquired those skills and abilities? What would it look like?*

- **Report out:** *Examples of evidence*

Beginning with the End in Mind

Skills and Abilities →

Evidence →

Assignments and Activities →

Making it Work!

Assignments and Activities

- Consider important *skills and abilities*, and the *evidence* you will seek.

- **Discuss:** *What assignments and activities might help your students develop them?*

- **Report out:** *Examples*

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Evidence →

Assignments and Activities →

Making it Work!

Making it Work, Part 1

- **Discuss:**
  - What will be the primary *challenges and barriers*?
- **Report out**

Making it Work, Part 2

- **Discuss:** What *support mechanisms/resources* can help?
- **Report out**
- **Ideas:**
  - Librarians, instructional designers
  - Teaching/Learning Center
  - Student affairs professionals
  - Peer learning assistants
  - Faculty Learning Communities

Next Steps

Create an action plan considering the following:

- Goals for using project-based learning
- Opportunities for support
- How to engage stakeholders
- How to communicate with stakeholders
- How you'll know how well everyone's doing