Aligning Content, Assessment, and Pedagogy in the Design of Engineering Courses

ASEE/IEEE Frontiers in Education
Rapid City, SD
Session S2A, October 15, 2011

Workshop Presenters

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- Purdue University

Workshop objectives

1. Articulate an integrated approach to course design which aligns content, assessment and pedagogy (CAP)
2. Critically describe the research-based features of CAP
3. Apply CAP principles to a learning environment (course, module, etc).
4. Use reflection and discussion to deepen your learning.

Overview of this session

- What is this session about?
- What do you already know about course design?
- CAP model of curriculum design
  - Apply to a project
- Example from Mary's work
- What are your next steps?

What do you already know about course design?

[Background Knowledge Survey]

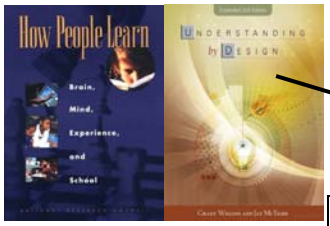
- What is your experience in course design?
  - 1-3 never done (1) it to very experienced(3)
- What do you feel are important considerations about course (re) design?
- What are challenges you have faced with course (re) design?
- Do you have a course in mind you would like to [and have the opportunity to] (re) design?
  - Yes/No

Framing

*"It could well be that faculty members of the twenty-first century college or university will find it necessary to set aside their roles as teachers and instead become **designers** of learning experiences, processes, and environments*."

James Duderstadt, 1999
Nuclear Engineering Professor; Dean, Provost and President of the University of Michigan

Design Foundations



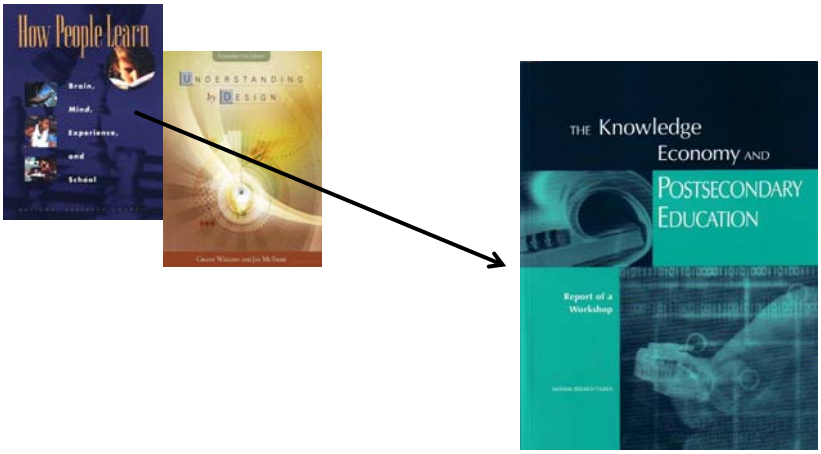
Science of Learning (HPL)

Science of Instruction (UbD)

	No	**Yes**
Yes	Good Theory/ Poor Practice	Good Theory & Good Practice
No		Good Practice/ Poor Theory

Sources: Bransford, Brown & Cocking. 1999. *How people learn.* National Academy Press.
Wiggins, G. & McTighe, J. 2005. *Understanding by design, 2ed*. ASCD.

Foundational Documents



- Bransford, Vye and Bateman – Creating High Quality Learning Environments

Understanding by design

Course design model

3 Stages of Backward Design

Identify the Desired Results

What should students know, understand, and be able to do?

Three categories of learning outcomes:
(1) **Enduring understandings**
(2) Important to know
(3) Good to be familiar with

3 Stages of Backward Design

Identify the Desired Results

↓

Determine Acceptable Evidence

How will we know if the students have achieved the desired results? What will be accepted as evidence of student understanding and proficiency?

3 Stages of Backward Design

Identify the Desired Results

↓

Determine Acceptable Evidence

↓

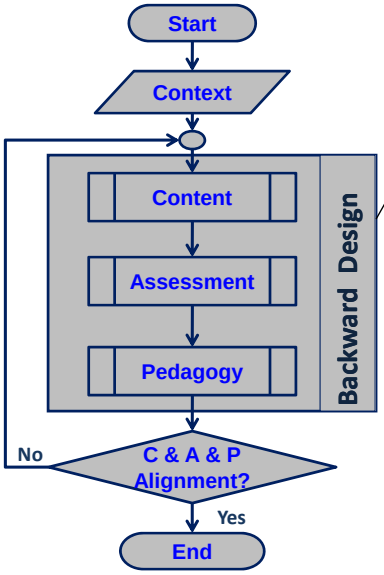
Plan Learning Experiences

*What **activities** will equip students with the needed knowledge and skills?*

*What **materials** and resources will be useful?*

Are the desired results, assessments, and learning activities ALIGNED?

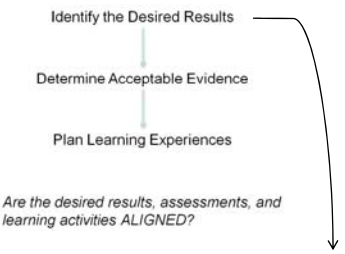
Content-Assessment-Pedagogy (CAP) Design Process Flowchart



Streveler, Smith & Pilotte (2011)

Understanding by Design (Wiggins & McTighe, 2005)

UdB – 3 Stages of Backward Design



UbD Filters for Curricular Priorities

- Are the topics enduring and transferable big ideas having value beyond the classroom?
- Are the topics big ideas and core processes at the heart of the discipline?
- Are the topics abstract, counterintuitive, often misunderstood, or easily misunderstood ideas requiring coverage?
- Are the topics big ideas embedded in facts, skills and activities?

Your turn

Using a course you would like to (re)design

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3 Stages of Backward Design

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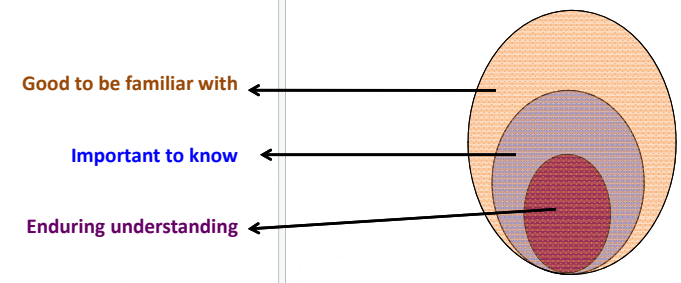
Wiggins & McTighe
Curricular Priorities



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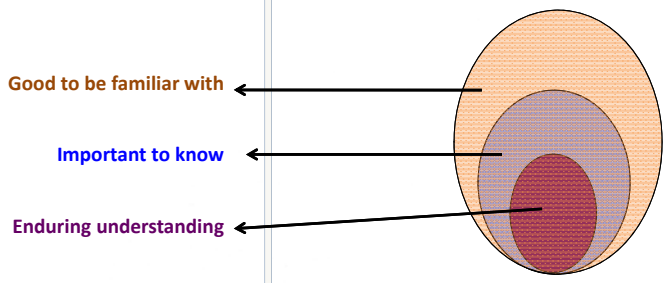
Your turn

- What are your intentions for student learning?
  - Individually make a list

Your turn

- Which of these learning outcomes represents the enduring understandings?

Wiggins & McTighe
Curricular Priorities



Filters

UbD Filters for Curricular Priorities

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Understanding by Design, pp. 10-11

Your turn

- Share your list with a partner
- Discuss each other's list for enduring understanding.
  - Questions?
  - Clarifications?

3 Stages of Backward Design

Identify the Desired Results

Determine Acceptable Evidence

*How will you **know** if the students have achieved the desired results?*

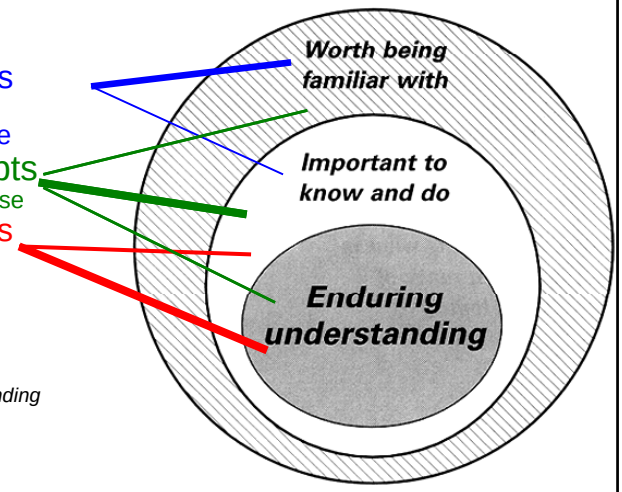
*What will be accepted as evidence of student **understanding** and **proficiency**?*

Your turn

- Are you measuring what is most important?
  - Is enduring understanding assessed?
  - Are assessment measures appropriate for enduring understanding?

Curricular Priorities and Assessment Methods

- Assessment Types
  - Traditional quizzes and tests
    - Selected-response
  - Academic Prompts
    - Constructed-response
  - Performance tasks and projects
    - Open-ended
    - Complex
    - Authentic



McTighe & Wiggins (1999) *Understanding by design handbook.* ASCD.

3 Stages of Backward Design

Identify the Desired Results

↓

Determine Acceptable Evidence

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Plan Learning Experiences

*Are the desired results, assessments, and learning activities **ALIGNED**?*

*What **activities** will equip students with the needed knowledge and skills?*

*What **materials** and resources will be useful?*

Your turn

- How will you help students master the enduring understanding?
- What kind of learning opportunity can you design?

Mary's example

CAP Course Development
It's a Journey, not a Destination

Reconsider, Improve, Iterate & Regroup

I know exactly what I want to teach & how to teach it

I think I know what is most important to teach & how to teach it

What have I been teaching & why have I done it this way?

Grappling with Enduring Understanding

Identifying Big Ideas*

Engineering Entrepreneurship

Enduring Understanding

What I taught…

Business Concept Creation

Business Plan Development

Financing

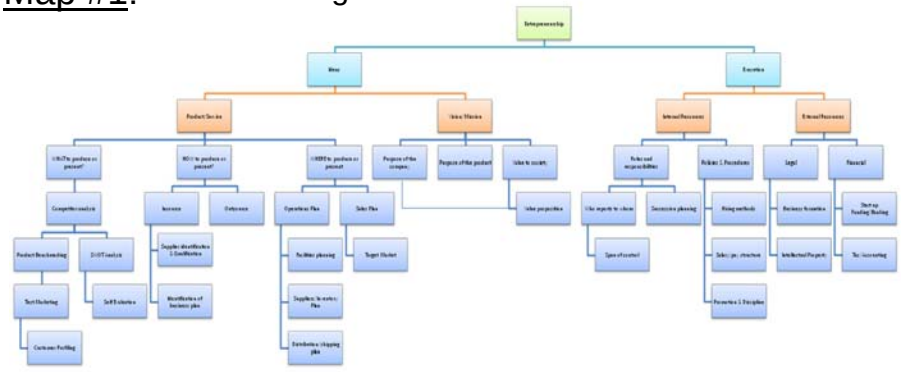
Tactics

*Wiggins and McTighe (1998)

Concept Maps help uncover Enduring Understandings

Concept Map #1:

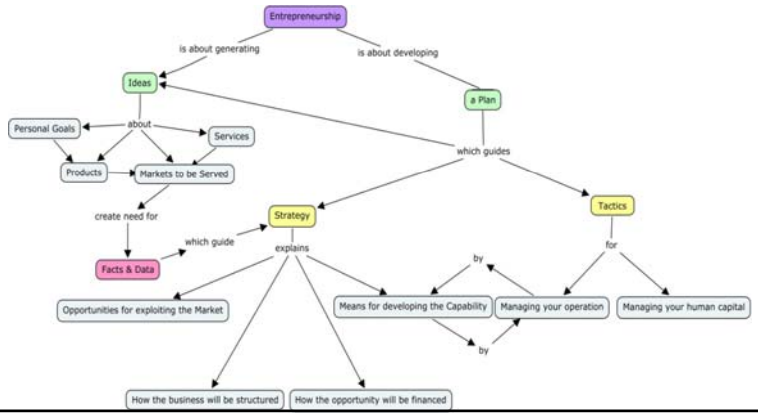
- Linear
- Hierarchical
- Aligned with Textbook



Concept Maps help uncover Enduring Understandings

Concept Map #2:

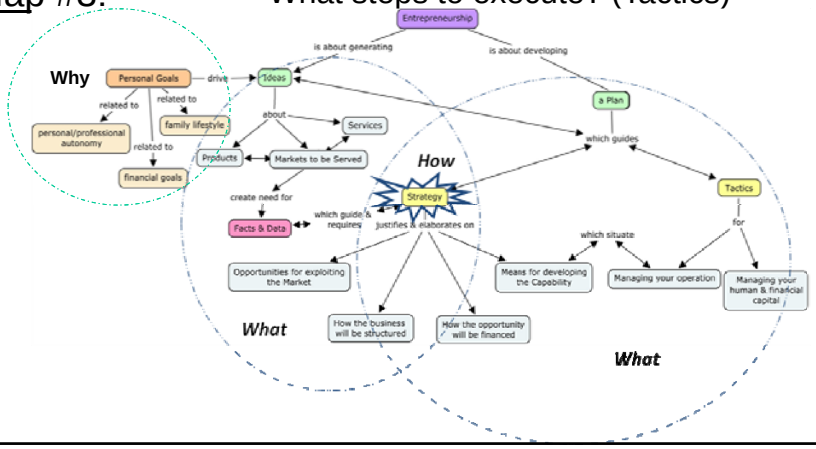
- Improved content inter-relation
- Elements of enduring understanding
- *Missing* personal motivation in learning

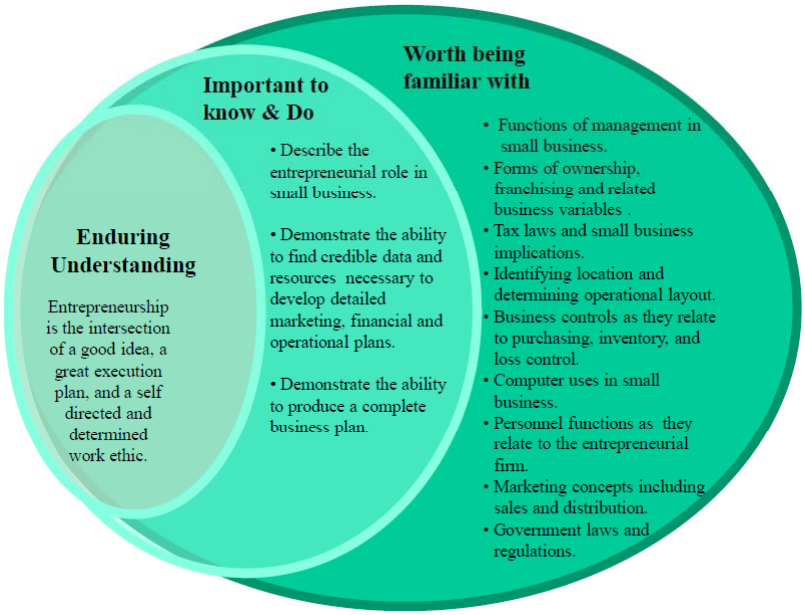


Concept Maps help uncover Enduring Understandings

Concept Map #3:

- Why Entrepreneurship? (Personal)
- How to roadmap success? (Strategy)
- What steps to execute? (Tactics)





Aligning Learning Objectives with Curricular Priorities

Aligning Learning Objectives & Enduring Understanding

Measurement of Learning Objectives

Allows for Interpretation of

Enduring Understanding

Aligning Learning Objectives & Enduring Understanding

1. Identify the **key characteristics** of an entrepreneur.
2. Identify the **self-directed work habits and positive attributes** frequently found in successful entrepreneurs.
3. **Explain the value** of developing self-directed work habits and positive attributes frequently found in successful entrepreneurs.

Foundational Knowledge

4. **Exercise basic primary and secondary research skills**, necessary to locate and acquire credible industry/task specific information necessary to support each section within a standard business plan template.
5. **Synthesize** collected data/information and develop a complete written business plan for their desired business.

Foundational & Interactive Learning

6. **Participate in an entrepreneurship community** of student learners, using the distance learning (DE) on line course tools, discussion board forums, etc.

Situated & Self Learning

Check Appropriateness of LO's for the Course Design

Mapping learning objectives to a Taxonomy…

How does this objective advance significant learning along the taxonomy's dimension?

In the case of Finks Taxonomy (Fink 2003) …

How does each objective advance learning along the lines of…

- foundational knowledge
- application
- integration
- caring
- human dimension
- learning how to learn.

Check Appropriateness of LO's for the Course Design

Mapping learning objectives to a Taxonomy*…

Example:

Kinds of Learning	Objective #1 2, & 3 Identify & Explain the Value of Developing Self-directed Work Habits	Objective #4 & 5 Locate & Synthesize Info to develop and complete a written Business Plan
	Questions supporting the course learning objectives	
1. Foundational Knowledge	• What are the personal and behavioral attributes on an entrepreneur? • How are such attributes and ethics developed? • How do those attributes display themselves in entrepreneurial settings? • Can you learn to be entrepreneurial?	• What does a business plan template look like and what do they consist of? • What are the types of data/information required to build a business plan? • Where can such data/information be found? • What role does trade associations play in providing valuable business plan data/information? • What role does local economic development corporations play in providing data/information?

*Fink's Taxonomy (2003)

Aligning Curricular Priorities & Assessments

Aligning Content & Assessment

Example:

Learning Goals and Assessments

Learning Goal #4	Assessment
• Students will be able to **exercise basic primary and secondary research skills, necessary to locate and acquire credible industry/task specific information** necessary to support each section within a standard business plan template.	• General: Written formative assessment Claim: Students will be able to locate facts and information relative to their business proposals through the use of the "V-Cat" internet library, physical library, local SBA and other small business contacts and resources. Task: Given questions via the e-discussion board, students will respond to these weekly discussion board questions focused on providing information gathered which is related to the specific section of the business plan presented in that week's readings and e-lecture. Evidence: Students will respond to the weekly e-discussion board within the prescribed time frame, with a written response. The student response will include a description of the facts and information they find important toward the specified section of the business plan, why they feel this information is relevant and contributes towards their business plan section and the reference location and complete citation from which they collected the information.

*Shanna Daly 2008

References

- *Streveler, R.A., Smith, K.A. and Pilotte, M. 2011. Aligning Course Content, Assessment, and Delivery: Creating a Context for Outcome-Based Education – http://www.ce.umn.edu/~smith/links.html*
- *Bransford, Vye & Bateman. 2002. Creating High Quality Learning Environments -- http://www.nap.edu/openbook/0309082927/html/*
- *Pellegrino – Rethinking and redesigning curriculum, instruction and assessment: What contemporary research and theory suggests. http://www.skillscommission.org/commissioned.htm*
- *Smith, K. A., Douglas, T. C., & Cox, M. 2009. Supportive teaching and learning strategies in STEM education. In R. Baldwin, (Ed.). Improving the climate for undergraduate teaching in STEM fields. New Directions for Teaching and Learning, 117, 19-32. San Francisco: Jossey-Bass.*