Aligning Content, Assessment, and Pedagogy in the Design of Engineering Courses
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Workshop Presenters
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- Ruth A. Streveler
- 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
“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

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**Design Foundations**

<table>
<thead>
<tr>
<th>Science of Learning (HPL)</th>
<th>Science of Instruction (UbD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
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<tr>
<td>No</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
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</tbody>
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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

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

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?

Content-Assessment-Pedagogy (CAP) Design Process Flowchart

<table>
<thead>
<tr>
<th>Start</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Content</td>
</tr>
<tr>
<td></td>
<td>Assessment</td>
</tr>
<tr>
<td></td>
<td>Pedagogy</td>
</tr>
<tr>
<td>No</td>
<td>C &amp; A &amp; P Alignment?</td>
</tr>
<tr>
<td>Yes</td>
<td>End</td>
</tr>
</tbody>
</table>

Backward Design

Streveler, Smith & Pilotte (2011)

Understanding by Design (Wiggins & McTighe, 2005)

UdB – 3 Stages of Backward Design

- Identify the Desired Results
- Determine Acceptable Evidence
- Plan Learning Experiences

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

UdD 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

3 Stages of Backward Design

Identify the Desired Results

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

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

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

Wiggins & McTighe Curricular Priorities

- Good to be familiar with
- Important to know
- Enduring understanding
Your turn

- Which of these learning outcomes represents the **enduring understandings**?
Filters

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?
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- Are the topics big ideas embedded in facts, skills and activities?

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


3 Stages of Backward Design

1. Identify the Desired Results
2. Determine Acceptable Evidence
3. 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
- What have I been teaching & why have I done it this way?
- I think I know what is most important to teach & how to teach it

Grappling with Enduring Understanding
Identifying Big Ideas*

Engineering Entrepreneurship

Business Concept Creation
Business Plan Development
Financing

What I taught...

Tactics

*Wiggins and McTighe (1998)

Concept Maps help uncover Enduring Understandings

- Linear
- Hierarchical
- Aligned with Textbook

Map #1:
Concept Maps help uncover Enduring Understandings

**Concept Map #2:**

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

![Concept Map #2](image)

Concept Maps help uncover Enduring Understandings

**Concept Map #3:**

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

![Concept Map #3](image)
Enduring Understanding
Entrepreneurship is the intersection of a good idea, a great execution plan, and a self-directed and determined work ethic.

Important to know & Do
- Describe the entrepreneurial role in small business.
- Demonstrate the ability to find credible data and resources necessary to develop detailed marketing, financial, and operational plans.
- Demonstrate the ability to produce a complete business plan.

Worth being familiar with
- Functions of management in small business.
- Forms of ownership, franchising, and related business variables.
- Tax laws and small business implications.
- Identifying location and determining operational layout.
- Business controls as they relate to purchasing, inventory, and loss control.
- Computer uses in small business.
- Personnel functions as they relate to the entrepreneurial firm.
- Marketing concepts including sales and distribution.
- Government laws and regulations.

Aligning Learning Objectives with Curricular Priorities
Aligning Learning Objectives & Enduring Understanding

Measurement of Learning Objectives

Allows for Interpretation of 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.

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 relevant facts and information and develop a complete written business plan for their desired business.

6. Participate in an entrepreneurship community of student learners, using the distance learning (DL) on-line course tools, discussion board forums, etc.
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 Fink’s Taxonomy (Fink 2003)...

How does each objective advance learning along the lines of...

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

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<table>
<thead>
<tr>
<th>Kinds of Learning</th>
<th>Objective #1-2: Identify &amp; Explain the Value of Developing Self-Directed Work Habits</th>
<th>Objective #4-5: Locate &amp; Synthesize Info to develop and complete a written Business Plan</th>
</tr>
</thead>
</table>
| 1. Foundational Knowledge | • What are the personal and behavioral attributes on an entrepreneur?  
  • How are such attributes and ethics developed?  
  • How do these 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

Example:

Learning Goals and Assessments

<table>
<thead>
<tr>
<th>Learning Goal #4</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 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.</td>
<td>• General: Written formative assessment</td>
</tr>
<tr>
<td>Claims: Students will be able to locate facts and information relative to their business proposals through the use of the &quot;V-Cat&quot; Internet library, physical library, local SBA and other small business contacts and resources.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>Evidence: Students will respond to the weekly e-discussion board within the prescribed time frame, with a written response. Their 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.</td>
</tr>
</tbody>
</table>

*Shanna Daly 2008*
References


- Pellegrino – Rethinking and redesigning curriculum, instruction and assessment: What contemporary research and theory suggests.
  [http://www.skillscommission.org/commissioned.htm](http://www.skillscommission.org/commissioned.htm)