# Course Design Principles
# for **Enhancing** Student Learning

By Leilani Arthurs

Myriad variables affect what and how students learn. An individual instructor has little influence over most of these variables; nevertheless, how an instructor designs a course *is* within his/her sphere of influence. Before we consider course design principles for enhancing student learning, I invite you to close your eyes and imagine the following scenario: You need to get to a conference where you are presenting recent research findings. How are you going to get there? How much time do you have to get there? How much of your budget will cover transportation?

In this scenario, how do you approach getting to the conference? If you are like most conference attendees, the first thing you do is *set the goal* of getting to the conference on time and within budget. Second, you likely implicitly form a mental list of *assessment criteria* that informs an effective travel plan. For example, what constitutes being on time, and what is within budget? Third, you apply that mental list of assessment criteria to *design a plan* of travel that helps you attain the initial goal you set.

We can draw parallels between this kind of planning for a trip and planning for a course designed to facilitate deep student learning. A useful framework for planning such a course is called "backward design" (Wiggins and McTighe, 2005). This concept is grounded in three principles: (1) establish learning goals, (2) determine what constitutes acceptable evidence of learning, and (3) plan appropriate learning opportunities.

This planning scheme is called backward design because instructors often do not begin with defining the learning goals for students in their courses. Instead, they often jump directly to what they will do (e.g., give a lecture, do a demonstration).

Using backward design as a framework for course design requires resisting the temptation to go straight to *doing* things and instead take a step back to first *think* about and explicitly *plan* out what we want students to be able to do and how we will assess their progress. In this way, we are able to design courses whose learning goals, assessments, and activities are well aligned with one another and therefore more effectively support student learning.

After evaluating her own approach to teaching, this description of a poorly aligned course came from a member of the University of Nebraska's Academy of Distinguished Teachers, Christine Marvin, who said:

*I was amazed and embarrassed to discover that I had course learning goals I never taught, I had learning goals I taught but never assessed, I had learning goals I assessed and never taught, and I had material I taught and assessed but never listed as a course learning goal. By reorganizing the learning goals of my course, developing rubrics for evaluating student work, and assessing my classroom activities, I now have a focused approach for linking my teaching to my students' learning.* (Savory, 2012)

Below are brief guidelines for writing learning goals, and resources for assessments and learning activities as a means of providing readers with leads to learn more about these areas.

**Establish learning goals.** Establishing learning goals involves articulating the desired results of learning. That is, what do we want students to be able to do as a product of participating in our courses? Unlike the key concepts listed in a syllabus, learning goals communicate more precisely what students will be able to do with respect to said concepts. A well-articulated set of learning goals is a valuable course design tool for instructors because it provides the foundation for developing appropriate assessments of learning as well as appropriate learning activities that facilitate student attainment of those goals.

Basic guidelines for creating a learning goal include the following:
1. Begin with "At the end of the topic/unit/module/course, students will be able to…"
2. Use specific verbs and language related to the desired result to complete the statement above (i.e., the goal is not vague).
3. Make sure the goal is assessable (i.e., you can think of a corresponding assessment item).
4. Factor in what students will be able to do and at what level they will be able to do it (be sure to include higher-order thinking skills, even in introductory-level courses).

Bloom's taxonomy of the cognitive domain (Bloom, 1956), or its subsequent revision (Krathwohl, 2002), provides a useful framework for writing learning goals (and assessment items). The different levels in the taxonomy of the cognitive domain represent a range from lower-order to higher-order thinking skills (see Figure 1). Keep in mind that learning goals that address higher-order thinking skills are inevitably linked to underlying lower-order thinking skills. For example, it is not possible to make a reasoned weather forecast (higher-order thinking skill) without knowing basic knowledge of weather (lower-order thinking skill).

**Determine what constitutes acceptable evidence of learning.** Once learning goals are established, assessments

that evaluate the extent to which students achieve the learning goals can be developed and/or identified. While Table 1 provides key words that can be used to craft original assessment items, there may already exist assessment instruments that are well aligned with the learning goals of your course and/or that you can adapt to suit your course needs. For example, if your course incorporates physics and/or chemistry concepts to a large extent, you might consider examining the following assessments to determine whether or not they may be appropriate for assessing student learning in your course:

- Force Concept Inventory (FCI): http://modeling.asu.edu/R&E/ Research.html
- Chemical Concepts Inventory (CCI): http://modeling.asu.edu/ModChem_web/Evaluation/CCI-old/ ChemConcepts Inventory-JCE.pdf
- Other field-tested assessments can be found at http://www.flaguide.org/intro/intro.php

**Plan appropriate learning opportunities.** Although lecture is a time-honored tradition in undergraduate and graduate classrooms, research in brain science and the learning sciences indicate that lecture alone is insufficient for deep learning (Schwartz and Bransford, 1998). Other research indicates that as little as 10% of class time dedicated to active learning strategies enhances student learning (Freeman et al., 2014). Useful online resources for learning more about a variety of active learning strategies include, for example:

- Science Education Resource Center at Carleton College: http://serc.carleton.edu/serc/search.html?search_text= oceanography&endpoint= Fserc Fsearch.html
- Digital Library for Earth System Education: http://www.dlese.org/library/query.do?q=oceanography&s= 0&gr=0a&gr=01
- Field-tested Learning Assessment Guide: http://www.flaguide.org/cat/cat.php

The three online resources listed here include a plethora of ideas for activities that involve students in their learning.

A well-aligned course can facilitate deep learning, especially when it includes opportunities for students to actively engage with the course material, peers, and the instructor. In closing, I'd like to leave you with a quote attributed to Benjamin Franklin, "Tell me and I forget, teach me and I may remember, involve me and I learn." ®

**REFERENCES**

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| COGNITIVE ORDER | KEY WORDS |
|---|---|
| **Create** <br> Putting elements together to form a novel and coherent whole or make an original product. | Adapt, anticipate, assemble, collaborate, combine, compile, compose, connect, construct, create, design, facilitate, formulate, generate, hypothesize, integrate, invent, justify, negotiate, plan, produce, simulate, speculate, substitute, support, test, write, validate |
| **Evaluate** <br> Making judgments based on criteria and standards. | Appraise, argue, assess, check, compare, conclude, contrast, criticize, critique, defend, describe, discriminate, estimate, evaluate, explain, interpret, judge, justify, measure, predict, rank, rate, relate, score, select, summarize, support, test, value, verify |
| **Analyze** <br> Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. | Analyze, appraise, break down, calculate, catalog, classify, compare, contrast, criticize, deconstruct, detect, determine, diagram, differentiate, discover, discriminate, distinguish, estimate, examine, explore, identify, illustrate, infer, investigate, observe, order, outline, question, recognize, relate, select, separate, test |
| **Apply** <br> **Procedural Knowledge** – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods. | Apply, carry out, change, choose, compute, construct, demonstrate, discover, dramatize, explain, generalize, illustrate, interpret, manipulate, modify, operate, plan, predict, prepare, produce, relate, repair, schedule, sequence, show, solve, use |
| **Comprehend** <br> **Conceptual Knowledge** – The interrelationships among the basic elements within a larger structure that enable them to function together. | Abstract, classify, comprehend, convert, defend, describe, discuss, distinguish, estimate, explain, extend, extrapolate, generalize, give an example, identify, indicate, infer, interpret, locate, paraphrase, predict, recognize, restate, rewrite, sort, summarize, tell, transform, translate |
| **Recall** <br> **Factual Knowledge** – The basic elements that students must know to be acquainted with a discipline or solve problems in it. | Acquire, arrange, define, distinguish, duplicate, identify, know, label, list, match, memorize, name, outline, recall, recognize, repeat, reproduce, select, state |

*From lower-order thinking skills (LOTS) to higher-order thinking skills (HOTS)*

Figure 1. Taxonomy of the cognitive domain. Key words can be used to articulate learning goals and write assessment items that span a range of cognitive orders. In articulating learning goals, it may be helpful to simultaneously consider what kinds of questions you might ask on an assessment (e.g., exam) to help determine whether or not and to what extent the goal was achieved.