Creating and Using Effective Learning Goals

CU-SEI and CWSEI

An important first step in course transformation has been to define explicit learning goals for each course which then shape the instruction and assessment. Here we briefly describe the process and benefits of writing learning goals. Learning goals explicitly communicate the key ideas and the level at which students should understand them in terms of what the students should be able to *do*. Learning goals take the form: "**At the end of this course, students will be able to...**" followed by a specific action verb and a task. For each course, faculty typically define five to ten course-level goals that convey the major learning themes and concepts, as well as topic-level learning goals (also known as "learning outcomes" or "objectives") that are more specific and are aligned with the course-level learning goals. Below are examples of learning goals from an introductory genetics course and a 2nd year physics course. A variety of other examples are available at the SEI learning goals resources link given below.

Examples of learning goals from an introductory genetics course (Univ. of Colorado-CU)

Course-level learning goal:

Deduce information about genes, alleles, and gene functions from analysis of genetic crosses and patterns of inheritance.

Topic-level learning goals:

a) Draw a pedigree based on information in a story problem.
b) Distinguish between different modes of inheritance.
c) Calculate the probability that an individual in a pedigree has a particular genotype or phenotype.
d) Design genetic crosses to provide information about genes, alleles, and gene functions.
e) Use statistical analysis to determine how well data from a genetic cross or human pedigree analysis fits theoretical predictions.

Examples of learning goals from a 2nd year physics course (Univ. of British Columbia-UBC)

Course-level learning goal:

Be able to argue that the ideas of quantum physics are true and that it is useful for engineers to know about them.

Topic-level learning goals:

a) Given a simple physical system, be able to draw the relevant potential energy curve needed to model dynamical behaviour.
b) Be able to explain the essential role of the quantization of light as demonstrated by the photoelectric effect in the operation of a photomultiplier tube, a solid state photodetector such as used in motion sensors, and the human eye.
c) Be able to design an experiment for determining the composition of an unknown pure metal based on the photoelectric effect.
d) For an unknown material, be able to analyze whether it is a conductor, insulator, or semiconductor, and then predict what electron energy distribution it must have.
e) Qualitatively design a semiconductor diode that will only allow current to flow in one direction.

The following process of developing learning goals has worked well for course transformations in the SEIs: A working group composed of faculty members who have previously taught a course and those who teach subsequent courses is formed. These working groups typically include a facilitator whose role is to review and synthesize materials, and create learning goal drafts. Learning goals are drafted by referring to materials used by instructors who previously taught the course, with emphasis on homework assignments, exams, and other materials that demonstrate what instructors want students to be able to do. Faculty members who teach subsequent courses communicate what they expect students to know coming into their course. The members of the working group discuss and revise these learning goals until a consensus list is generated, which for any instructor teaching the course would typically cover 70-80% of the class time. One of the most critical aspects of writing learning goals is choosing a verb that describes exactly what students should be able to do. Many faculty are tempted to use the verb "understand," but this is not specific – two faculty members could both say "understand" but have completely different expectations as to what students should be able to do. We recommend creating learning goals that convey the relevance and usefulness of any particular content to students. Use everyday language and applications when possible, and minimize the use of technical jargon. Many courses at CU and UBC include goals that focus on skills, habits of mind, and affective outcomes such as: "Students should be able to justify & explain their thinking and/or approach to a problem or physical situation."

Based on our experiences, we formulated a check-list to help instructors create and critique learning goals.

Check-list for creating learning goals:

- ☐ Does the learning goal identify what students will be able to do after the topic is covered?
- ☐ Is it clear how you would test achievement of the learning goal?
- ☐ Do chosen verbs have a clear meaning?
- ☐ Is the verb aligned with the level of cognitive understanding expected of students? Could you expect a higher level of understanding?
- ☐ Is the terminology familiar/common? If not, is knowing the terminology a goal?
- ☐ Is it possible to write the goal so it is relevant and useful to students (e.g. connected to their everyday life, or does it represent a useful application of the ideas)?

We also aligned the verbs with the cognitive level expected of students. The table below shows levels of learning and examples of verbs that match each level, based on Bloom's taxonomy of the cognitive domain.

Levels of cognitive understanding and corresponding verbs

Level	Description	Representative Verbs
Factual Knowledge	Remember & recall factual information	Define, List, State, Label, Name
Comprehension	Demonstrate understanding of ideas, concepts	Describe, Explain, Summarize, Interpret, Illustrate
Application	Apply comprehension to unfamiliar situations	Apply, Demonstrate, Use, Compute, Solve, Predict, Construct, Modify
Analysis	Break down concepts into parts	Compare, Contrast, Categorize, Distinguish, Identify, Infer
Synthesis	Transform, combine ideas to create something new	Develop, Create, Propose, Formulate, Design, Invent
Evaluation	Think critically about and defend a position	Judge, Appraise, Recommend, Justify, Defend, Criticize, Evaluate

Benefits

Writing learning goals requires effort and time, but carries multiple benefits. Faculty use learning goals as they plan class time, develop homework, and create exams. All aspects of the course become better aligned, and focus on what faculty most want the students to achieve. Faculty using learning goals report that writing good exam questions becomes easier. At CU and UBC, we have seen that the cognitive level of exams often increases as faculty align the questions with the higher cognitive level of the learning goals.

Sharing the learning goals with students improves faculty-student communication. Learning goals are often posted online and each lecture begins with the relevant learning goals for the day. Surveys reveal that students are overwhelmingly positive about having access to learning goals. The greatest reported benefit is that learning goals let students "know what I need to know," which helps students focus on important ideas and study more effectively.

For departments, writing learning goals has informed, shaped, and aligned the departmental curriculum. By considering the learning goals from multiple courses, departments have discovered that some concepts were taught in an identical manner in multiple courses and other critical concepts were omitted entirely. As a result faculty members who teach different courses have begun to work together so that their goals complement each other and encompass what every student should be able to do by graduation. For instance, some fundamental evolution concepts were added to the CU biology curriculum after this process revealed their absence.

Resources:

www.cwsei.ubc.ca/resources/learn_goals.htm – compilation of learning goals and other resources from the CU and UBC SEIs

"At the end of my course, students should be able to …": The benefits of creating and using effective learning goals, Michelle Smith & Kathy Perkins, Microbiology Australia, pp. 35-37 (2010). http://microbiology.publish.csiro.au/?act=view_file&file_id=MA10035.pdf

What is the Value of Course-Specific Learning Goals?, Beth Simon and Jared Taylor, Journal of College Science Teaching, Vol. 39, pp. 52-57 (2009).

A Thoughtful Approach to Instruction: Course transformation for the rest of us, Stephanie Chasteen, Katherine Perkins, Paul Beale, Steven Pollock, & Carl Wieman, Journal of College Science Teaching, Vol. 40, pp. 24-30 (2011).