Making the Most of Your Intro Course

Earth Educators' Rendezvous
University of Colorado
July 13-15, 2015

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Making the Most of your Intro Course – Earth Educators' Rendezvous, July 2015

Goals of the Workshop:

1. Identify key the components of an effective course that promotes student learning.
2. Generate a sample lessons that is reasonable in the context of your course and doesn't significantly increase preparation time and grading load.
3. Leave with a template for redesigning lessons that includes strategies to enhance learning before, during, and after class.

Monday

8.30 AM Welcome, introductions, and Ice breaker activity

- Workshop goals, Day 1 objectives
- Topic choice post-it notes
- Intro knowledge survey

9.00 AM What does discipline-based education research tell us about teaching and learning in college science courses? (10)

- Exploration activity (H & H results prediction)
- Introduction to DBER
- Active learning vs. Traditional lecture
  - Prediction Activity
- Student performance data

9.30 AM DBER in the geosciences (11)

- On the Cutting Edge survey results
- Classroom Observation project results
  - Prediction Activity
- Components of successful professional development

10.00 AM Break

10.15 AM Introduction to backward design process and lesson design rubric

- Situational factors? (Examples)
- Steps in backward lesson design process
- Lesson design rubric
  - Assessing learning objectives activity
  - Classifying learning objectives activity

- Write three student learning objectives for your topic. Try to make one of them a higher order objective.
    - Work in small teams (3-4) with peers interested in related topics.

11.15 AM Day 1 Wrap up
- Share examples of learning objectives
- Plan for Day 2
- Reflection activity (minute paper)

11.30 AM End.

Tuesday

8.30 AM Recap and Day 2 workshop objectives

8.45 AM Designing assessments to match learning objectives
- Feedback and assessment
    - Complete "Characterizing Assessment Activity" exercise

9.30 AM Review examples of online resources and identify examples of learning objectives/goals and related assessments at different Bloom's level
- InTeGrate modules
- On the Cutting Edge exemplary teaching activities collection

10.00 AM Break

10.15 AM Review your learning objectives from Day 1 and create appropriate formative assessments to be conducted in class.
    - Work in small teams (3-4) with peers interested in related topics.
    - Identify the Bloom's level for each assessment and estimate how long it will take for students to complete each activity.

11.15 AM Day 2 Wrap up
- Share examples of learning objectives and assessments
- Plan for Day 3
- Reflection activity (minute paper)

11.30 AM End.

Wednesday

8.30 AM Recap and Day 3 workshop objectives

8.45 AM Creating a consistent course structure

- In- and out-of-class teaching and learning
  - Flipped classroom model
  - Complete “Preclass assignment” activity

10.00 AM Break

10.15 AM Student learning: An introduction

- Dunning-Kruger effect and student reflection
  - Student learning strategies activity
- Retrieval practice
- Strategies that support student reflection on their learning (metacognition)
  - Mastery quizzes, knowledge surveys, reading reflections, minute papers/muddiest point
- Continue lesson outline activity on Worksheet

11.15 AM Day 3 Wrap up

- Questions?
- What’s next? Action steps

11.30 AM End.

Lesson Design Rubric

This rubric is designed to guide instructors as they redesign their courses. The rubric is divided into five sections: 1) Learning objectives; 2) Assessment and measurement; 3) Resources and materials; 4) Instructional strategies; and, 5) Alignment. The sections have a total of 10 elements that are equally weighted at 3 points each and are evaluated using the following scoring scheme:

- **3 points**: rubric element explicitly and/or pervasively addressed in lesson's materials
- **2 points**: rubric element addressed in majority of the lesson's materials
- **1 points**: rubric element addressed in some of the lesson's materials
- **0 points**: rubric element not addressed in the lesson's materials

The goal for each redesigned lesson is to earn a minimum score of 25/30 using the rubric.

Learning objectives

1 **Learning objectives are measureable**: Learning objectives are clear statements that describe what students should know or be able to do at the conclusion of the lesson. Learning objectives represent specific competencies, skills and/or knowledge that students are to master or demonstrate. Learning objectives should avoid jargon and technical language unless specific vocabulary terms are required.

Assessment and Measurement

2 **Assessments measure the learning objectives**: Formative and summative assessments (e.g., in class activities, quizzes, home works, exam questions) will provide opportunities to determine the extent to which students have met the learning objectives.

3 **Assessments are sequenced, varied and appropriate to the content**: The sequence and schedule of the assessments match the content. Where possible, assessments should vary in type and duration and build on previously acquired knowledge within the course or in prerequisite courses.

4 **Assessments address goals at successively higher cognitive levels**: If appropriate, assessments progress from lower level knowledge recall to higher order application of knowledge and/or knowledge creation. Feedback from these assessments informs the student of their level of learning.

Resources and Materials

5 **Instructional materials should be sufficiently diverse and contribute to the stated learning objectives**: Course materials (e.g., textbooks, lecture notes, multimedia, web sites) should directly support core concepts reflected in learning objectives and course goals. The

level of detail in supporting materials is appropriate for the level of the course, and provides depth sufficient for students to achieve the learning goals.

Instructional Strategies

6 **Learning strategies and activities support stated learning objectives and goals**: The learning activities promote the achievement of the stated learning objectives and goals. Students should engage with the course content using different types of activities. Activities should be designed to support reinforcement and mastery of concepts in multiple ways.

7 **Learning strategies and activities promote student engagement with the materials**: Where possible, activities should connect to personal experiences of students, motivate and engage students, connect to real world experiences, or build on what students know and address their initial beliefs.

8 **Instructional strategies should encourage student interactions**: Activities should provide multiple opportunities to foster interactions that facilitate students' understanding and mastery of the learning objectives and goals. Activities should foster instructor-student and student-student interactions where appropriate.

9 **Learning activities encourage student metacognition**: The activities should provide opportunities for students to reflect on and assess how their understanding of concepts changes as they learn. Activities should include an opportunities for reflection, discussion, and synthesis. Students should be able to assess their own learning and confirm they are on the right track.

Alignment

10 **Teaching materials, assessments, resources and learning activities align with one another**: A constructive alignment approach suggests that goals, learning activities and assessments within each section of the course align with one another and directly with stated learning objectives and goals. A curriculum map that identifies core skills and content, learning strategies and resources can be used as an effective way to ensure alignment.

(The lesson design rubric was adapted from the InTeGrate material development rubric created by the InTeGrate assessment team lead by David Steer and Ellen Iverson.)

Learning Objectives

1. **Objectives should focus on the work of the students, not the teacher.** For example, it would be difficult to assess student learning in the former objective for an Art History course below:

- Teacher-focused objective: provide survey of art from a particular period.
- Student-focused objectives: enable students to go to an art museum and evaluate the technique of an unfamiliar work of art *OR* evaluate a work in the context of a particular artistic genre, school, or style.

2. **What will students learn and be able to do?** What will students have learned by the end of the lesson that they don't know now?

3. **Objectives should clearly demonstrate student learning.** Write objectives so that student learning will be visible to the instructor. When possible, include an action term that requires that students do something. **Learning should be measurable.** Assignments and activities need to give students repeated, relevant practice related to the objectives that you value. You can't design effective activities if you don't have the objectives in mind. Course goals will be more global than more specific daily learning objectives.

4. **Focus some objectives on higher-order thinking skills and/or authentic tasks.** Higher order thinking skills objectives are those that involve analysis, synthesis, evaluation, and some types of application. Verbs that reflect tasks involving higher order thinking skills objectives include *derive, predict, analyze, design, interpret, synthesize, formulate, plan, correlate, evaluate, create, critique* and *adapt.*

5. **Find an appropriate balance between specificity and generality.** Objectives that are too abstract are difficult to assess, objectives that are too specific may be too trivial. All objectives should be sufficiently concrete and clear for both students and instructors.

6. **Objectives should be appropriate for both students and instructors.** Objectives should take into consideration student preparation and experience as well as time and effort required by both student and instructor. Objectives that require substantial work may be beyond some students and be a significant burden to meaningfully plan and grade for the instructor.

Some of the materials included in this section of the handout have been adapted from resources in the "Cutting Edge Course Design" tutorial ©2005 developed by Dr. Barbara Tewksbury and Dr. R. Heather Macdonald as part of the *On the Cutting Edge* program, http://serc.carleton.edu/NAGTWorkshops/coursedesign/tutorial/index.html.

Assessing Learning Objectives Activity

For each of the numbered objectives listed below, answer the questions (as appropriate) by circling the relevant response:

- Is the objective student-focused or teacher-focused?
- Does the objective focus on higher order thinking skills?
- Could you design an activity/assignment that would allow you to determine whether students have met the objective or not (does the objective have "measurable outcomes")?
- Is the objective concrete, rather than vague and abstract?

1. **I want to introduce students to the fundamental concepts of fluid dynamics.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

2. **I want students to appreciate the awesome power of Nature.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

3. **I want students to understand the scientific method.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

4. **Students will be able to effectively communicate in Spanish.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

5. **Students will be able to identify rocks and minerals.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

6. **Students will be able to analyze historical and geologic records in an area and predict the likelihood of future natural disaster events.**
   Student-focused or teacher-focused? Higher-order or lower-order thinking skills?
   Is the objective measureable? Yes No Concrete or abstract?

Bloom's Taxonomy Action Verbs Learning Objectives Activity

Review the learning objectives below and use information from the table on the next page to place them in the appropriate Bloom's Taxonomy category on the basis of the action verbs used. Write the abbreviation for the appropriate Bloom's level (K = knowledge; C = comprehension; Ap = application; An = analysis; S = synthesis; E = evaluation) to the left of each numbered item.

1. Students will be able to define the term "erosion".
2. Students will be able to create a scale model showing the thickness of Earth's compositional layers.
3. Students will be able to illustrate the reason why the Northern Hemisphere experiences relatively cold weather in the winter while the Southern Hemisphere experiences relatively warm weather in the summer and vice versa.
4. Students will be able to use the relative proportions of parent and daughter isotopes to estimate the numerical ages of rocks.
5. Students will be able to predict how the ages of volcanoes associated with a hot spot will change relative to the hot spot location
6. Students will be able to explain how transportation controls the size, shape and sorting of clastic sediment.
7. Students will be able to interpret the geological history of an area from the information about rock type and configuration of a geologic cross section
8. Students will be able to compare and contrast the properties and processes of Earth's interior to our Sun's interior.
9. Students will be able to sketch and label the three major types of faults.

Bloom's Taxonomy Action Verbs List

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Student recalls, recognizes information	Student demonstrates understanding of information	Student applies information to complete task	Student breaks down information into elements	Student integrates discrete pieces of information	Student uses information to make judgments
Arrange Define Duplicate Identify[1] Label List Match Memorize Name Order Recognize Relate Recall Repeat Reproduce Select State	Classify Compare[3] Contrast[3] Convert Defend Describe Discuss Distinguish Estimate Explain Express Extend Give example Identify[2] Indicate Infer Locate Paraphrase Predict Recognize Rewrite Review Select Summarize Translate	Apply Change Choose Compute Demonstrate Discover Dramatize Employ Illustrate Interpret Manipulate Modify Operate Practice Predict[3] Produce Relate Schedule Show Sketch Solve Use	Analyze Breakdown Categorize Compare[4] Contrast[4] Criticize Diagram Differentiate Discriminate Distinguish Examine Experiment Illustrate Infer Model Outline Question Relate Separate Subdivide Test	Arrange Assemble Collect Combine Comply Compose Construct Create Design Develop Devise Formulate Generate Plan Prepare Rearrange Reconstruct Reorganize Revise Rewrite Set up Summarize Synthesize	Appraise Argue Assess Choose Conclude Defend Discriminate Evaluate Judge Justify Predict[4] Rate Select Summarize Support Value

[1] Something seen before;

[2] Something new

[3] Few items

[4] Multiple items

Summary of Bloom's Taxonomy

Knowledge

Answers to knowledge questions indicate if a student knows and can recall specific information. Examples of questions that assess knowledge are some types of multiple choice questions, true/false questions, definitions, matching questions, or lists. Questions that ask students to define, identify, list, or name are often "knowledge" questions.

Comprehension

Responses to comprehension questions report information or observations. Students must possess some basic knowledge of the subject to correctly answer comprehension questions. Comprehension questions can fall into several categories and may require that students convert, summarize, classify, infer, compare, or explain information.

Application

Application often involves applying rules or principles to new situations, using known procedures to solve problems or demonstrating how to do something. Questions that ask students to solve a problem using a known equation or to select a procedure to complete a new task would be considered application questions.

Analysis

Answers to analysis questions may give directions, scrutinize data, explain how something works, or distinguish fact from opinion. Analysis requires that students break information into component parts to identify its organization. Students are expected to find links between data and interpretations and to discover which material is relevant to a task and which is extraneous. Analysis questions ask students to diagram, illustrate, outline or subdivide information.

Synthesis

Synthesis combines a series of parts into a greater whole. Good answers to synthesis questions may predict the outcome for a particular event and may involve making generalizations and developing a "big picture" view of a phenomenon or feature. Questions that ask students to combine, compile, create, devise, plan, or organize are often considered synthesis questions. Questions may ask students to create multiple hypotheses to explain a phenomenon, to develop a plan to solve a problem or to devise a procedure to accomplish a task.

Evaluation

Responses to evaluation questions make judgments about facts, data, opinions or research results using evidence and scientific reasoning. Good answers require students to analyze and synthesize information and clarify ideas. Evaluation questions might ask a student to appraise, criticize, justify, or support an idea or concept.

Characterizing Assessments Activity

1. Which one of the following persons is the author of "Das Kapital"?
   a) Mannheim b) Marx c) Weber d) Engels e) Michels

2. Draw a diagram that shows the relationships between the principal components of the Earth system.

3. Examine the four illustrations of paintings (not included). Which is an example of cubism?

4. A student was asked the following question: "Briefly list and explain the various stages of the creative process". As an answer, this student wrote the following:
   "*The creative process is believed to take place in five stages, in the following order: ORIENTATION, when the problem must be identified and defined, PREPARATION, when all the possible information about the problem is collected, INCUBATION, when there is a period where no solution seems in sight and the person is often busy with other tasks, ILLUMINATION, when the person experiences a general idea of how to arrive at a solution to the problem, and finally VERIFICATION, when the person determines whether the solution is the right one for the problem*."

   How would you judge this student's answer?
   a) EXCELLENT (all stages correct in the right order with clear and correct explanations)
   b) GOOD (all stages correct in the right order, but the explanations are not as clear as they should be).
   c) MEDIOCRE (one or two stages are missing OR the stages are in the wrong order, OR the explanations are not clear OR the explanations are irrelevant)
   d) UNACCEPTABLE (more than two stages are missing AND the order is incorrect AND the explanations are not clear AND/OR they are irrelevant)

5. What is the best diet plan for an athlete attempting to lose weight prior to a race?

6. Read the assigned article/speech, identify an appropriate title and condense the key points into one or two sentences.

7. Plan an experiment to test if a landfill is polluting water from a nearby well.

8. What is the definition of a “thesis statement”?

9. Calculate the deflection of a beam under uniform loading.

10. Read carefully through the paragraph below, and decide which of the options 1-5 is correct.
"*The basic premise of pragmatism is that questions posed by speculative metaphysical propositions can often be answered by determining what the practical consequences of the acceptance of a particular metaphysical proposition are in this life. Practical consequences are taken as the criterion for assessing the relevance of all statements or ideas about truth, norm and hope.*"

    a) The word "acceptance" should be replaced by "rejection".
    b) The word "often" should be replaced by "only".
    c) The word "speculative" should be replaced by "hypothetical".
    d) The word "criterion" should be replaced by "measure".

11. Who is more important to your well-being, your mayor, your state representative, or your senator?

12. Look at the following table and indicate which countries' statistics are being reported in rows A, B and C.

	GNP per capita 1991 ($ USA)	Growth rate of GNP per capita p.a. 1980-91	Population growth rate 1980-91	Structures of total employment 1980-85 (percentages)		
				Agriculture	Industry	Services
A	500	2,5%	1,5%	51	20	29
B	1570	5,8%	1,6%	74	8	8
S.A.	2560	0,7%	2,5%	17	36	36
C	25110	1,7%	0,3%	6	32	32

Choose your answer from the following list of possible answers:

a) A is South Korea; B is Kenya; C is Canada.
b) A is Sri Lanka; B is Germany; C is Thailand.
c) A is Sri Lanka; B is Thailand; C is Sweden.
d) A is Namibia; B is Portugal; C is Botswana.

Some of these questions were taken from the following sources:
http://164.106.217.32/develop/assessing3.htm
http://www.cce.iastate.edu/courses/ce486/Weekly/ce486f01Bloom%20Taxonomy.htm
http://web.uct.ac.za/projects/cbe/mcqman/mcqappc.html#C1
http://www.humboldt.edu/~tha1/bloomtax.html