GOOD TEACHING MATTERS

Five teaching practices to improve the quality of a training course

IREC Interstate Renewable Energy Council

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Earlier this year, Dr. Martin wrote a five-part series for the IREC website on important teaching practices that can improve the quality of a training course. These included: know your students; write learning objectives; include practice and feedback in the training; create simple Power Point slides; and design test and evaluation measures that promote transfer. We received so many positive comments on the series, we thought we'd pull them together into one document. Here in this document, Five Teaching Practices to Improve the Quality of a Training Course, are all five parts of Dr. Martin's Good Teaching Matters, plus a new Introduction that links learning and teaching.

> *"I like a teacher who gives you something to take home to think about besides homework."*
>
> *—Lily Tomlin as "Edith Ann"*

ABOUT THE INTERSTATE RENEWABLE ENERGY COUNCIL

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INTRODUCTION

If you want to be a good teacher, you have to know a little about how students learn. Different learning theories focus on different aspects of learning but there are some areas of agreement. Understanding and using some of the key principles of learning can improve your teaching.

Today, we find ourselves in a "learner-centered" culture with respect to training and education. Many theorists agree that it is not teaching that causes learning but rather what the learner does with what s/he is learning that makes the difference in learning outcomes. Wiggins (Wiggins, 1993, quoted in Ambrose, et al., 2010) says that students have to have opportunities to practice what they are learning and to get accurate and timely feedback in order to learn. Herb Simon (2001, quoted in Ambrose, et al., 2010) makes the same point. He says that learning results from what the student does and thinks and *only* what the student does and thinks. The teacher's job is to influence that thinking and doing (italics mine).

In today's learner-centered environment, instruction occurs when teachers take the student from where they are when they enter a course (i.e., their prior knowledge, life experiences, values, attitudes and beliefs, and goals), and influence them in how they interpret, use, organize, apply, and retrieve information. Students must also learn how to adjust to new situations. When students come to class, they arrive with a relatively simple idea about what they are learning, but to be successful, they must leave the class with a more complex and integrated understanding.

In order for teachers to help students make this transition, instructors must understand and use some basic learning principles.

Here are a few important ones taken from *"How Learning Works: 7 Research-Based Principles for Smart Teaching"* (Ambrose, et. al, 2009):

- Students' prior knowledge can help or hinder learning.
- How students organize knowledge influences how they learn and how they apply what they know.
- Students' motivation determines, directs, and sustains what students do to learn. Students need to feel that they can be successful and they must feel that what they are learning has value.
- To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned.
- Goal directed practice coupled with target feedback enhances the quality of students' learning. More practice generally increases the quality of the students' performance.
- Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning. Student development includes all the things that are currently going on in their lives that are competing for their attention.
- To become self-directed learners, students must learn to monitor and adjust their approaches to learning. This is what life-long learning is: to become a self-directed learner.

Linking teaching and learning is key if both instructors and students are to be successful. Based on how people learn, there are several things for you to consider as you design and implement your own instruction. Challenge yourself to see how many of these principles you can incorporate into your own instruction.

1 KNOW YOUR STUDENTS

Your students come to training with different levels of knowledge and experience. It is important for trainers to know the variety of skill sets that students have when they arrive. Trainers need to do an audience analysis before students arrive (if possible) or conduct a brief learner analysis in the first hour of class. Then classes should be arranged so that students of similar backgrounds can work together, that students who already know the content can move ahead, or that more knowledgeable and experienced students can work with other students and help them learn. Knowing students' prerequisite knowledge can make a big difference in how a class or course should be organized.

Knowing your students is really a two-part process:

1) Know what skills, knowledge and attitudes students have when they start your course(s);

The best strategy is for trainers to do an audience analysis before students arrive, or if that is not possible, to conduct a brief learner analysis in the first hour of class. But how? What strategies should we use to gather this information? Here are some options for gathering information about your students:

- Use the existing North American Board of Certified Energy Practitioners (NABCEP) Job Task Analyses to identify the most important skills that your students need to be successful in your course(s). If there is no task analysis, create your own list of critical skills for your students to learn.
- Use that list of skills to write a questionnaire asking students how proficient they are at each skill. Use a five-point Likert scale, e.g., from *not proficient* to *very proficient*, to assess levels of competence. Remember, when asking students to assess their own skill level, you are collecting *self-report data*. Students may or may not have a good idea about how capable they are. Still, a short questionnaire (5-10 items) can be very helpful to help you determine to students' perceived strengths and weaknesses.
- Write a pre-test of skills. This is harder to do, but gives you more accurate data, as you're asking your students to *demonstrate* their skill levels. You can use the same NABCEP task analysis (or your own list of skills) to write *application-based questions* that will help you determine your students' skill levels. (A note of caution: the tendency when writing a pre-test is to ask recall questions rather than problem-solving questions. It is a better strategy to write three or four high-level application or problem-solving questions that reflect behaviors that students will have to do on the job than to ask 15-20 recall and comprehension questions).

2) Decide which teaching and learning strategies to incorporate into the training to ensure student success.

We want to know about our students' experience and competency levels so we can design the best, most effective classes for the largest number of students. Here are some ways that you can design your classes for maximum effectiveness.

- Determine subgroups in the class based on the results of your questionnaire or assessment instruments that you used in #1 (above). Classes could be arranged so that:
  - students of similar backgrounds can work together
  - students who already know the content can move ahead with enrichment activities, or that less competent students can have remediation activities
  - more knowledgeable and experienced students can work with less knowledgeable students and help them learn. Often the best way to learn something is to teach it to someone else.
- Design learning activities and strategies that take into account student knowledge and background include:
  - Prepare pre-readings or additional course work for students who have trouble with English or whose reading level is low. Use chapters from books written at a lower grade/reading level or use a pre-designed course presented on a CD or DVD that students can refer to often.

1 KNOW YOUR STUDENTS CONTINUED...

- Use examples and problems to teach the content rather than relying on lectures.
- Demonstrate how the information can be used on the job. Make the instruction purposeful and job-related.
- Incorporate frequent reviews and summaries to help learners remember important information.
- Group information into small, meaningful categories and link the categories to the larger course objectives.
- Take frequent breaks so that students have time to process what they are learning.
- Use other subject matter experts occasionally to change the pace of the instruction. Sometimes a new perspective helps students better understand the content.
- Encourage students to answer each other's questions. You do not always have to know everything. Often, students come to class with a great deal of knowledge and experience. Take advantage of their expertise.
- Be creative. Lots of things will work, but you may have to take some risks and try some new things.

In summary, knowing students' prerequisite knowledge can make a big difference in how to organize a course. Using that knowledge to plan the best teaching and learning strategies can make you and your students shine!

2 WRITE LEARNING OBJECTIVES

Love them or loath them, learning objectives are a probably the cornerstone of educational quality from an instructional design perspective. While learning (or behavioral) objectives have been applauded for their usefulness and impact when designing and delivering instruction, they have also been much maligned and often misunderstood. Learning objectives were based on the notion that *standards or competencies* could and should be specified for education and training goals. These standards could then be used to design tests or assessments to give students to determine whether or not they reached the competencies.

Learning objectives should be written in terms of what the learner will be able to do when s/he finishes the class and/or what skills s/he needs for the job; *they should not* be written in terms of what the instructor is going to do (i.e., present information about conducting a site survey or give a lecture on electrical design). Learning objectives should also focus on the application and use of knowledge and skills, rather than on rote memory and recall. The Job Task Analyses developed by the North American Board of Certified Energy Practitioners (NABCEP) can be used by trainers and curriculum specialists to establish learner-centered, application-based objectives.

All learning objectives have at least three components:

- **Conditions:** the circumstances (e.g., the situation, resources) under which the student will be tested or assessed;
- **Action or Behavior:** the competency that the student must achieve; and
- **Criteria:** how proficient the learner must be in the competency.

Some objectives add a fourth component, *the audience,* which specifies *who* will be performing the action or behavior.

Here is a task from the NABCEP PV task analysis:
The student will install and provide required labels on inverters, controls, disconnects and overcurrent devices, surge suppression and grounding equipment, junction boxes, batteries and enclosures, conduit and other electrical hardware.

Using this task,here is an example using the objective's components:

- **Conditions**: Specifications for a PV system, a site survey, and a series of 20 questions about a PV installation
- **Action or behavior**: make correct installation decisions
- **Criteria**: answer 19 of 20 questions correctly.
- **Audience**: Each student

And here's how these components look in a sentence:
Given specifications for a PV system, a site survey, and a series of 20 questions about a PV installation, each student will make correct installation decisions by answering 19 of the 20 questions correctly.

We use learning objectives to design a test or assessment. We want students to *apply* their skills and knowledge by figuring out the answers to the questions just as they would if they were performing an actual installation.

Can we use the test/assessment to determine whether or not the student(s) are competent to make installation decisions? If the test items are robust enough, the answer is yes. That is, if the questions on the test mirror or are closely aligned with what an installer or technician has to do on the job, then it is a good way to determine their competencies. If the assessment focuses on low level behaviors like remembering definitions and formulas, then it is not a very good way to determine students' ability to make installation decisions.

In summary, learning objectives are used for many other purposes than just designing assessments; i.e., to guide the instructional process and to guide students. *However, there are the two key things to remember about objectives:*

1) Their purpose is to define how learners will be assessed so that you, the educator, can determine whether or not students have met pre-established competencies and goals. In order to do this, objectives must be both measurable and observable; and

2) Objectives should be written so that you can judge whether or not students who have mastered the competencies can perform a particular job or task after the training or education program has been completed.

3 DESIGN TEST AND EVALUATION MEASURES THAT PROMOTE TRANSFER

In the original columns, this section, Design Tests and Evaluation Measures, was the last entry. We moved it here to make an important point. When you are designing instruction, you first write your objectives and then write the tests and assessment instruments before you plan any learning activities and strategies. The idea is that you want to be sure you assess students on what is stated in the objectives and not what you present in class if what you present deviates from the objectives. However, when you are *implementing* instruction, you give the test last, after the students have finished the course.

There are two key principles related to testing and assessment in training situations that may influence how you write your learning objectives and how you structure assessment in your own classroom. They are *promote transfer* and *less is more*.

Write test items and assessments that promote transfer. In training situations at companies where I have taught testing, instructors will often say to me, "I don't know why my students performed so poorly when they went back to the job. I tested them after the class. They knew the information on the test." After looking at their assessments, what I usually find is that most assessments and tests do not represent job performance.

Rarely are employees asked to state definitions when they get back to their job, nor are they asked to do parts of a problem (i.e., to do a calculation out of context, or find a source in a manual without applying it to a specific situation or problem). While these part skills are important, they are only truly useful if they can be applied in the context of a larger job-related task. Therefore, it is important that students are tested, as nearly as possible, on the entire job performance. We want our assessments to reflect job performance so that we know the students can *transfer* those skills to the job.

Let's take an example from a PV installation. If students have to make decisions about how to do a site survey, place disconnects, size wire, etc. on the job, then the test should reflect those skills in the context of an installation "on paper." *This is called situation-based testing or problem-based testing.* On the test, an actual installation problem is presented and students have to make the same kinds of decisions during the assessment that they would have to make on the job. They have to apply what they learned to a simulated real-life situation(s).

Write fewer test items but more powerful ones. This principle is a corollary to the first. Instructors often get bogged down in writing a lot of test items. They test every definition, every theory and principle, and every calculation. It is an arduous process to write so many items. However, if you assess student learning with situation-based or problem-based items you can write one or two *very important items* that promote transfer to the job rather than writing items that do not put learning into the context of the job.

Remember the objective we presented earlier? Given the specifications for a PV system, a site survey, and a series of 20 questions about a PV installation (conditions), each student (audience) will make correct installation decisions (action or behavior) by answering 19 of the 20 questions correctly (criteria).

On the test, we are going to give at least one example of an installation (a "situation" or "problem") that reflects what the learner will have to do on the job. We are going to ask 20 multiple choice questions about that installation. The students will have to get 19 of the 20 correct to pass the test (i.e., to be competent). We have framed the questions in the context of what they will have to do on the job; therefore, it promotes *transfer*, and we have written one very powerful application-based test question, using the principle that *less is more*.

Each and every class should have a test, quiz, or evaluation instrument that assesses whether or not students have learned the content stated in the objectives. This evaluation is *in addition* to any certification test that might be given. A classroom-based test should measure the stated learning objectives (a certification test measures

3 DESIGN TEST AND EVALUATION MEASURES CONTINUED...

the skills in the job task analysis). These evaluation instruments should re-create what the learners will be expected to do on the job; successful students will demonstrate that they can perform job-based tasks without assistance. This allows the instructor to better determine whether or not the skills learned in the training will transfer to the job. Based on the test results, instructors can do at least two things: (1) tell whether or not students have learned what was intended; and (2) evaluate their own performance (i.e., the class and the instruction) to see what, if anything, needs to be improved.

In summary, remember when you are designing instruction, you want to write your test and assessment items immediately after writing your objectives. This insures that you will assess students on what is required and not on what you teach if you deviate. Presumably, the test and what you teach will be the same. However, all instructors get off track sometimes, or a discussion takes up more time than we planned or anticipated. It is easy to add those off-track segments and discussions into the assessment if you don't pre-write your tests. If they are very important, you can always add additional items. But be sure to assess the objectives first. Do so by (1) writing tests and assessments that promote transfer, and (2) writing fewer but more powerful items.

4 INCLUDE PRACTICE AND FEEDBACK IN THE TRAINING

Learning is a two-way street. Just hearing information rarely helps students learn what they need to know. Students must be actively involved with the content to learn. This does not just mean physically engaged, like hands-on labs, although labs are a good thing to include. It means that the student must be *mentally engaged*. Students should be asked to practice new learning by answering questions, doing problem-solving activities, engaging in real-life or problem-based exercises, and responding to case studies and troubleshooting examples. Instructors can then provide *feedback* to correct mistakes, give additional information to clarify or extend content, or to tell students that they "got it." Using practice and feedback is especially important where a process is complex.

So what is the best way to present information to students? That's a loaded question because there is not one best way. However, there are some principles to keep in mind when planning in-class activities. I've included three as a guide.

Principle #1: ***Students must be actively involved with the content to learn.*** Many times, subject matter and technical experts focus on how much content they must present. They often see instruction as a *one-way information flow* from instructor to student. Even when the instructor encourages questions and involves students in practical labs, the majority of classroom time is often spent *telling* students about the content. This is called the "spray and pray" method of instruction: spray the students with information and pray that they get it. Even labs can focus on demonstration in a one-way flow of information. However, it's always better when learners *interact* with the content. This means students are mentally engaged, but do not have to be physically involved. That is, they must *practice*.

A better strategy than "spray and pray" is to spend a good deal of time developing application and problem-based activities so that students can *try out* their new learning. In-depth content explanations can spring from questions and issues that arise during student practice. For example, rather than explaining what is wrong with a defective PV, solar thermal, or wind system, ask students to identify where the problems are and make suggestions about how to correct those problems. As the instructor, you can use students' strengths and weaknesses about the content to help them learn more.

Principle #2: ***Use examples rather than explanations to teach.*** Let teaching come from students' needs and understandings while they are working with examples in a problem-solving or decision-making mode. A good strategy is to provide lots of examples at all difficulty levels. Remember, when a student fails to understand an idea, an example with explanation is more likely to clarify the issue than an explanation alone.

When you are using examples, encourage students to: answer questions, engage in case studies, do scenario or problem-based exercises, respond to troubleshooting examples, and participate in hands-on labs. All these are designed to let learners practice new skills. When students are actively engaged with content, they tend to learn more *if* they also receive *feedback*.

Principle #3: ***Use both confirming and corrective feedback to insure student learning.*** There are two primary types of feedback: *confirming* and *corrective*. When using confirming feedback, instructors are acknowledging that the student "got it right." Students often already know if they got it correct, but reinforcing the students by saying, "good job," "perfect," "that's right on target," confirms that the student has learned what was intended.

Corrective feedback, is actually a continuation of the teaching process where the instructor points out the student's errors or misunderstandings. This helps students reorganize their knowledge and thinking. Once students comprehend their mistakes, it is important to give them another problem to solve to make sure they can *correctly apply* what they have learned in a new situation.

In summary, *practice makes perfect.* If you want your students to be able to perform correctly on the job, they need the time to practice and learn from their mistakes. Ideally,

4 INCLUDE PRACTICE AND FEEDBACK CONTINUED...

we want their failures to happen in the classroom, not on the job. In providing job-related examples, you are building in time for students to practice what they are learning and to get feedback about how well they are doing, how much they know, and how proficient they are in using analytical skills. Both *practice* and *feedback* are essential for learning.

A wonderful by-product of teaching this way is that instructors, as well as students, are actively engaged. Teaching is not the same as telling! Use practice and feedback as often as you can with a variety of examples at different difficulty levels. Not only will students learn, they will also enjoy the process.

5 CREATE SIMPLE POWER POINT SLIDES

Back in the day when slides and transparencies were widely used, course developers' rule-of-thumb stressed no more than *eight to ten words* on any one slide. Today, we use Power Point instead of slides and transparencies, but it's even more important than ever to hold to the 'less is more' rule in presentations. We've all experienced the 'Death by Power Point' syndrome.

Unfortunately, many instructors cram as much information as they can onto a slide so that it will trigger *their* memory when they are teaching. The tendency is for instructors to *read* the information to the learners rather than to teach it. Students, who generally can read faster than the instructor can talk, are usually ready to move on while the instructor is still reading.

There appear to be two reasons for the 'Death by Power Point' syndrome.

Power Point's 'notes' feature allows presenters to include detailed information about each slide. In effect, the Power Point becomes a de facto instructor manual. Second, the instructor wants to give students a full set of notes—and students want those notes, too. A good strategy to meet these needs without overloading each slide is to make two sets of slides: first, a set with all the detail, for use as lecture notes and handouts; and second, an edited-down projection set containing just the key words and ideas. Using the edited-down set while teaching forces the instructor to *discuss* the information on the slide rather than simply read it to the audience. Some of the best presenters use clear themes and smooth transitions to keep their audience hanging on his/her very words and the material presented.

Presenters are usually very familiar with their content because they've presented it dozens of times. And while most speakers fill their slides with data, text and charts, the best presentations--the ones audiences remember most—are presentations with short sentences (four or five words). There is a trend in public speaking to paint a picture for audiences—or storytelling--by creating more visual graphics. Inspiring presenters are short on bullet points and big on graphics. Remember, we want the instructor to discuss the information on the slide and not simply read too many bullet points.

This model works well in teaching situations. The instructor can still create slides that have fewer bullet points and more graphics, while putting details about each slide in the 'notes' section in Power Point so students can have the details. Using this approach encourages the instructor to *discuss* the information on the slide rather than simply reading too many bullet points to an audience who is furiously trying to write while the presenter reads the slides.

An effective way to build a Power Point slide is to add one concise line at a time, in logical sequence. This is called *progressive disclosure*. It focuses the students' attention on the one idea being discussed and it prevents students from reading ahead.

With these two ideas in mind, progressive disclosure and a "projection" set of Power Point, here are some tips that may help you improve the design and presentation of your Power Point slides.

Design Tips:

- **Use progressive disclosure.** There is a feature on Power Point that allows you to do this quite easily. Under "Animations," use the "Fly in" and "Fade" commands.
- **Keep it simple.** This is applicable for visuals, pictures, lettering and word art, fonts, colors, and the amount of information presented on the slide.
- **Communicate without words** using graphics, photographs, and illustrations whenever possible. However, keep them simple too. Instructors tend to like to use all the Power Point bells and whistles and to include a lot of distracting motion and fade-in features —what software designers call "dancing baloney." Research shows that too many bells and whistles can detract from learning.
- **Ask the students to do something** with the information presented on some slides. For example, ask

5 CREATE SIMPLE POWER POINT SLIDES CONTINUED...

questions about the visuals, present problems that have to be solved, or make "nonsense" statements that students have to correct. This requires the learner to apply what they are learning.

Presentation Tips:

- **Paraphrase** the information on the Power Point slides, don't read it. Remember that students can read faster than you can talk. Use complementary messages (i. e., use different words and phrases) and dual channels (senses), (i.e., visuals, words, and movements) to make the same point.
- **Talk to the audience, not the media**. How many times have you sat in a class or presentation where the instructor was reading the information on the slide and had his/her back to you? Do you really want the audience to remember the back of your head? If you have only a few key ideas on the Power Point, they should serve as a memory jogger. A quick glance at the screen is all you will need to remind you what to teach.
- **Move out of the way of the screen so everyone can see.** Instructors should be very conscious of obstructions, including where they are standing, that block the screen. Get yourself a laser pointer and stand away from the screen so that everyone has a good visual line to the Power Point slide.
- **Turn the projector off** when you are: (1) not using it; and (2) when there is nothing on the screen. This is especially true if you have finished using the Power Point slide and want to make other points. A bright white screen will draw the learners' attention to it. Student will focus their attention there rather than on what you are saying. Use the "B" key on your computer keyboard to make the screen go black. Then move to the front of the room and continue the instruction. When you are finished making the point, push the "B" key again and you will go back to the same slide.

In summary, Power Point can be a terrific teaching tool. However, it has been overused and often poorly used. To make it more effective, remember to keep your Power Point slides and your graphics simple, use progressive disclosure, and ask learners to apply what they are learning. In addition, paraphrase your message, talk directly to your students, make sure everyone can see the screen and turn the projector off when you are not using it.

SUMMARY

As a summary, let's look at how the five teaching practices can influence student learning based on the learning principles presented in the introduction.

Teaching Practices	Learning Principles
Know your students	• Students' prior knowledge of the topic can help or hinder learning. • Students' organizational knowledge structures influence how they learn and how they apply what they know. • Students' motivation determines, directs, and sustains what students do to learn. • Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning.
Write learning objectives	• To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned. (Objectives guide what should be learned and as often as possible should be written at the application level.)
Design tests and evaluation measures that promote transfer	• To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned. (Students should be assessed before they go out into the workplace to make sure they have mastered the high-level application skills required of the job).
Include practice and feedback	• Goal directed practice coupled with target feedback enhances the quality of students' learning. More practice generally increases the quality of the students' performance.
Create simple Power Point slides	All of the learning principals can be incorporated into Power Point. Power Point is a means to an end. You can just as easily use the chalk board, a flip chart or transparencies for instruction. What is most important is not what media you use, but how you use the media. Power Point can be used to promote practice and feedback, to ask questions about students' prior knowledge and organizational structures, to present a pre-test or for a quiz, to show your more expert knowledge structures, to provide examples, to motivate students by using humor and interesting graphics, to show students what a competent performance or product looks like, and to demonstrate how and when to apply information.

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How learning works: 7 research-based principles for smart teaching. (2010). San Francisco: Jossey-Bass.