Train the Trainer

Five Steps of Adult Learning Activities

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Why are activities important for adult learning?

An easy answer to this question is "death by PowerPoint" or the fact that we generally hate the lecture/test approach to learning (and it's not very effective anyway). We also often leave lectures or even training seminars saying "what was the point?" The harder answer requires some study on effective practices in adult education.

As Justin Beller said in an article on effective training, *"Training is more than just standing in front of a crowd and telling your audience something about a given topic. It's standing in front of crowd, working one on one with another person or creating a deliverable with information your audience can use and act on. In other words, they learn."*

There's a saying in the training field that states "Telling Ain't Training." It's also the title of a popular book by Harold Stolovitch and Erica Keeps [which NIST recently purchased for a workshop as a part of our training redesign efforts]. When it comes to adult learners, everyone is different in terms of personal preferences and learning styles. It's what makes us unique as individuals. By understanding adult learners, you'll be able to create training that is engaging and meaningful. As you do more and more training, you'll be able to measure your successes by knowing what works and what doesn't work when it comes to training. In the end you'll become a better trainer. So, let's consider how we can apply this concept in five easy steps by taking a look at a real case study.

Case Study

In our NIST Basic Mass Metrology seminar we have an activity on the first day that I'd like to describe to you in the context of Adult Learning methodologies. We call it the Flask Exercise.

First, we set up the exercise. We have a balance, pure water, a clean 200 mL volumetric flask, gloves, and several meniscus reading devices set out in the laboratory before students arrive. We tell the participants that we want them to fill the flask to the graduation line, using whatever procedure seems appropriate to them, and then weigh and record the value from the balance. We tell them to be observant and take careful notes of what they see, but not to discuss their observations with other students at the time.

Next, participants fill the flasks, make measurements, and record their observations. Sometimes we observe the participants modifying their planned approach based on watching others in the class.

Now, while the exercise is going on we might have a number of events occurring such as (but not limited to) the following (depending on the creativity of the instructors):

- Instructors will sit on a chair quietly observing the students and lean on the back part of the table where the balance is located, possibly put their feet on the bottom of the balance table stabilization bar, sometimes adjusting the level on the balance, often opening or closing side doors on the balance that are not in use.
- Co-instructors might subtly open and close the laboratory door; distract participants by talking to them while they are making measurements, participate in the measurements by intentionally doing something that is inappropriate (e.g., not drying off the outside of the flask or intentionally spilling water on the flask or dripping it on the balance pan).
- Sometimes the set-up might include intentionally adjusting the span of the balance to offset the readings from usual values or even putting a small amount of ethanol in some of the source water.

After we complete the exercise, we use the data to calculate mean and standard deviation values and apply what we have already covered in an introductory statistics lecture. But, after performing the calculations, we also begin to talk about "variability" and "sources of error" in our measurement processes. We ask questions like:

- What did you observe during the measurement processes?
- What was frustrating during the exercise?
- What questions did you want to ask?
- What was your reaction when you observed the instructor doing _____?

That evening students are given a homework assignment to read a Good Measurement Practice (GMP) about good weighing techniques. The next morning we use their knowledge from reading the homework exercise, their previous laboratory experience, and the experience from the Flask Exercise to create a cause and effect diagram related to mass measurements and influence factors in categories such as Facility, Equipment, Standards, Staff, and Operations. We go around the room and ask for items to go onto the list and ask participants to explain why they think that item is important. This helps them identify concepts

from their study and experience to answer questions such as:

- How does the information from the GMP relate to your experience in the Flask Exercise?
- What else is important in the process?
- What principles are important to remember?
- How can good technique or bad techniques contribute to good/bad measurement results?

Finally, we ask some additional questions such as the following:

- How can you apply this approach as we continue making measurements and as you make measurements back in your laboratory?
- In what situations might some of these principles be important in your laboratory?
- What are the consequences of not paying attention to some of these good measurement principles?
- What improvements might you make in your laboratory based on our review and discussion?
- How do you think we might quantify some of these factors (which later leads into our discussions of measurement uncertainty)?

"Tell me, and I will forget.
Show me, and I may remember.
Involve me, and I will understand."
- Confucius, circa 450 BC

Five Easy Steps

During a Train the Trainer session we held at NIST for our team in February, we received a hand-out called "How To Process Five Steps of Adult Learning" and I realized through discussion that our Flask Exercise followed the five steps, and that we needed to make some improvements in how we ask the questions in the final stages. I also realized that when we cover some other topics we often only set up the exercise and have participants perform the activities. (We use a homework, lecture, demonstration, plus hands-on measurements model, without necessarily processing what was learned and what can be applied.)

To recap the Flask Exercise using the five-step framework:

Step 1: We set up the activity ahead of time in the laboratory with the items I mentioned earlier.

Step 2: We conduct the activity. Instructors aid in causing variability. Students take notes. We perform calculations with the data to follow up on our Statistics lecture (a hands-on application for that lecture). Then, they also have the homework reading assignment (with note taking required).

Step 3: Learners share and interpret their reactions during the creation of the cause and effect diagram.

Step 4: Participants identify concepts to understand the importance of variability and sources of error in their measurements.

Step 5: Participants consider and share how they will apply these concepts back on the job.

Learning Objectives – Review

Well, let's think back to my previous articles on Training Trainers… what do you think the possible learning objectives are for our Flask Exercise? Ultimately we want people to be able to ASSESS causes of error and IDENTIFY sources of variability in the measurement process. We want them to be able to THINK about the impact of variations in their processes and not just FOLLOW a step-by-step approach to PERFORM calculations and CREATE an uncertainty budget. Getting new metrologists to THINK and ANALYZE how influence factors can contribute to good/bad measurement results is our primary goal.

A good Learning Objective might be:

By completing this exercise and the homework assignment, using their observations and notes, participants will be able to accurately CALCULATE the mean and standard deviation of a data sample, IDENTIFY sources of measurement variability, and ANALYZE the causes and impact of measurement variability and errors.

In all honesty, we never had a learning objective documented for this exercise until recently. We also never fully followed all five steps of adult learning during the Flask Exercise until reviewing this formal instructional approach. One of the biggest frustrations for most instructors is getting people beyond the knowledge level of Bloom's taxonomy where they can LIST or DESCRIBE what they've learned to where they are actually APPLYING and ANALYZING processes and concepts in their own laboratories.

Five Steps – Review

The five steps are designed to get us to the higher levels of adult learning and processing. The bottom line is that people want to make good measurements. It is our job as instructors to help participants think through all the steps and take the concepts we present and independently APPLY and ANALYSE them in their laboratories. Table 1 is a summary of these five steps that might help you prepare and reflect on activities in your training sessions to ensure we get our students to the highest level of learning possible. I am hoping that you will consider how your participants learn and realize that "Telling Ain't Training" and design some engaging activities to help participants process and apply new concepts back on the job. Let's all make death by PowerPoint a thing of the past!

Table 1. Five Steps of Adult Learning

1	Set up the Activity	The set up of measurement activities will ideally include something that is interactive and selected to get to the right level of Bloom's taxonomy. Be sure to clearly tell participants what they are to do, how they will or won't work in teams, what the ground rules are, and why the activity is important (without giving away the intended discovery).
2	Participants Perform the Activity	Adults need to be as involved as much as possible and use as many senses as possible. In fact, many demonstrations or videos that do not allow adults to actually do something themselves only use sight and sound, but not touch or smell. NOTE: we will have a future article on activities and assessment that align with learning objectives. Additional activities can include entering data into a spreadsheet, working in teams to come up with a list or assess a procedure, having a group brainstorming discussion, reviewing a case study.
3	Participants Share and Interpret Their Reactions	This step helps learners identify what happened to themselves and others. It is intended to help them understand the exercise and its point. I gave examples of questions earlier: • What did you observe during the measurement processes? • What was frustrating during the exercise? • What questions did you want to ask? • What was your reaction when you observed the instructor doing _____? Here are some more: • What additional information did you need to know to successfully complete the measurement? • Did you observe others doing something different that could impact their measurement or yours? • Identify one or two challenges in following this procedure.
4	Participants Identify Concepts	This helps participants reflect on "what was learned." This will help them get beyond doing a fun exercise to considering how the effort might be important for other tasks. Questions I asked earlier included: • How does the information from the GMP relate to your experience in the Flask Exercise? • What principles are important to remember? • How can good technique or bad techniques contribute to good/bad measurement results? Additional questions might include: • What principles did you observe? • What other procedures might use this principle? • How can you integrate this concept into the overall laboratory operation?
5	Participants Apply Concepts to Situations in Their Laboratory	This is the WIIFM principle in action (that's "What's In It for Me"). Adult participants need to be able to apply these concepts back on the job and see the relationship between the activity and what is important about being successful as a manager or in the laboratory. Questions I posed earlier included: • How can you apply this approach as we continue making measurements and as you make measurements back in your laboratory? • In what situations might some of these principles be important in your laboratory? • What are the consequences of not paying attention to some of these good measurement principles? • What improvements might you make in your laboratory based on our review and discussion? • How do you think we might quantify some of these factors (which later leads into our discussions of measurement uncertainty)? Additional questions could include: • In what situations could the application of these concepts improve your measurement results? • What changes will you make in your procedures as a result of this activity? • How does this fit with your experience?

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