Train the Trainer
Writing Learning Objectives

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As a part of our quest for continual improvement in Learning and Development, and to more fully become an educational organization, this year NCSLI began asking Conference speakers to submit Learning Objectives along with their brief abstracts. This article provides additional information about what Learning Objectives are, what needs to be included in a well written Learning Objective, and how to identify a good Learning Objective. Why is this important to you? If you are a speaker, the use of Learning Objectives can help improve your focus on what you want an audience to do or know with the information after your presentation. If you are a participant, you can review the expected objectives to determine if the material will meet your learning needs. If you are an employer, you can review stated objectives to see if it is likely that your employees will come back to the laboratory and be better able to perform their jobs.

Here is as an example of a Learning Objective for this article:

After reading this article, you (the learner) will be able to use the references and examples provided here to evaluate your own (and others') stated Learning Objectives to determine whether they comply with the four aspects required of a Learning Objective. You will also be able to review Learning Objectives when provided for a training event or conference session to determine if you want to attend a session and if so, if you learned what was expected during the session.

Reviewing a list of topics covered in a course may not provide the level of detail needed by the speaker, a participant, or an employer. Let's take an example of a course titled "Basic Uncertainties." A list of topics covered might include:

• Guide to Expression of Uncertainties in Measurement (GUM)
• Use of Excel Tools
• Statistics and Mathematics

Let's come back to this course example after we define and consider the standard criteria for Learning Objectives.

What is a Learning Objective?

A Learning Objective or Learning Outcome, is a specific statement, written from the participant's perspective, which provides information about what the participant will gain during a learning event. They are focused on participant performance, not teacher performance.

"Learning objectives: Statements about what a student will gain from a course or activity. These are specific statements about exactly what a student should know, be able to do, or value as a result of accomplishing a learning goal. Learning objectives form the basis for curriculum and course development as well as testing (Reed, 2005)."

Standard Aspects of a Well Written Learning Objective

The ANSI/IACET b standard for continuing education units identifies four categories in Section 5 related to Learning Objectives.

1. They are written from the perspective of the learner, reflecting what the learning will achieve.

2. Learning objectives must be clear, specific, concise, and measurable (with four components):

   1) They state the performance the learner should be able to accomplish. (Behavior)

   2) They specify the conditions under which the learner is to perform. (Conditions)

   3) They specify the criteria for acceptable performance. (Criteria)

   4) They are directly related to the subject matter and content of the learning event.

3. Learning outcomes are established for each session within a large event, conference, or convention.

4. Instructional delivery includes discussion of learning outcomes.

If we expand on category number 2, and consider the four components of a clear, specific, concise, and measurable objective, here are some additional notes to clarify what is meant. Each Learning Objective should begin with: After this session (tutorial, paper, or workshop) the participant will_____

Component 1: This component covers the expected behavior after the training. In previous articles, Bloom's taxonomy, and various levels of learning have been covered (See references on the NCSLI website to review this topic). Think about performance in terms of active verbs related to what you want the participant to know, do, or be, after the training: identify, calculate, assess, present, analyze, and apply. Note the example verbs that are capitalized in Table 1. So, at this point, select an appropriate verb for the level of knowledge or application that is expected.

Component 2: What are the conditions? Can the participant use their notes? Can they use a documented procedure? Can they use a calculator? Are computers allowed? Must they use Excel for calculations? Are there additional reference materials provided? Will they have to be assessed from memory?

Component 3: What criteria will be used to judge acceptable performance? Is an 80 % passing grade acceptable? For Item 2, given in Table 1, would it be okay if they submit their response in text-message format? Must they provide a written response or can it be oral? What will a valid uncertainty statement look like? (Instructors need to make sure criteria for performance is covered in the course!)

Component 4: Learning objectives must be directly related to the subject matter and content of the event. If you haven't covered various types of statistical distributions in a course, you should not evaluate students against the criteria (unless of course it was given as a prerequisite). If knowledge of calculus is a required prerequisite, and you covered partial derivatives in the course, the Learning Objective given in Item 4 would probably make sense. However, if the course is on how to correctly perform pressure calibrations, it wouldn't necessarily make sense to have Learning Objectives related to the laboratory management system. This component should be obvious!

So, let's consider the first three components in a Behavior, Condition, Criteria model. The following Learning Objective uses this model: "Given a set of data the student will be able to compute the standard deviation."

- Condition - Given a set of data;
- Behavior - the student will be able to compute the standard deviation; and
- Criterion - (implied) - the number computed will be correct.

Additional behaviors could include the ability to teach the process to another participant in the course. Additional conditions might include the use of a scientific calculator or a spreadsheet; it might include a step-by-step procedure. Another criterion might state that all steps must be shown.

If Condition and Criteria are omitted, it is often assumed that the conditions involve workplace conditions and standards which are set at perfection (but given the variety in the workplace for potential metrology participants – from technicians to NMI researchers – we ought to carefully consider whether we can assume standard conditions and perfection). The most important component for a valuable objective includes a written statement of the behavior using measurable or observable verbs.

What a Learning Objective is NOT….

A Learning Objective is not written in the form of what the speaker hopes to cover. My objectives as a speaker might be to cover six specific modules over the course of a two day workshop, but as a participant, you probably do not care about that! As a participant, you want to know WIIFM (the wiffem principle) or "What's In It For Me?" When an instructor or speaker provides an overview of the course, you certainly have a map of what the presenter plans to cover, but there is no instruction for what you are supposed to know, be, or do with the materials and informa-

tion. As a participant, I want to know what I am supposed to do with the information. I don't want to leave a session thinking "So, what was the point?"

If a manufacturer has a new product or a National Metrology Institute (NMI) has some new research – sharing information at a conference so that the participant Learns about it or Understands a new technology – is also not an effective Learning Objective. Key phrases such as "learning" and "understanding" are too generic and nonspecific to be effective Learning Objectives and are discouraged.

If we look at our earlier example of the "Basic Uncertainties" course, the following example is not a good Learning Objective.

In this course we will cover the following items:

- Guide to Expression of Uncertainties in Measurement (GUM)
- Use of Excel Tools
- Statistics and Mathematics

There is no behavior stated, no conditions (other than possible required use of the GUM, Excel, and statistics/mathematics) and no criteria for performance specified.

Examples of Learning Objectives

Examples of possible Learning Objectives for our Basic Uncertainties course are given in Table 1. Depending on the level of knowledge that is expected at the end of the learning event, the various Learning Objectives might be too low, too high, or just right. This particular mix also might not be the best mix for a single course. However, written in this way, the instructor will know how best to focus his/her content and a prospective participant or employer will have a better idea of what to expect from the course.

For example, if all Learning Objectives are written at the level of Item 1, where the participant will be able to past a short quiz and list 80 % of the essential items, this might be acceptable for a technician or a manager who is not involved in day-to-day uncertainty analyses as a good high level overview of what is required in uncertainty reporting. However, you probably want the person who reviews your Calibration Reports to get better than 80 % right! Also, a metrologist or engineer who is required to evaluate all uncertainties in the laboratory, and who might perform uncertainty analyses on a day-to-day basis, might need to achieve the kind of Learning Objective given in Item 4.

Let's consider our previous bad examples where we used generic terms for our manufacturer and NMI presentations. A good Learning Objective after a manufacturer's session where they have presented new technology might be "participants will know how to perform accurate calibrations with this instrument." After an NMI presentation, "participants will be able to apply this new research into the development of their next product (or calibration method)."

Activities and Assessments

A Learning Event Planning Worksheet is available on the NCSLI website under Trainer Resources: www.ncsli.org/NCSL/learning/Trainer_Resources.aspx (It is downloadable at the bottom of the page). It contains a table with the three columns as shown in Table 1. For each Learning

Objective (or Outcome) there should be a correlating Activity for providing instruction, and an integrated method for assessing whether the student has learned at the level stated as an expected outcome. Activities and Assessments will be covered in future Train the Trainer columns, but the most commonly known are Lecture (Activity) and Test (Assessment). Of course, these methods are also probably the least effective for effective adult learning. Unfortunately, most Conference papers use a lecture format and have neither expected outcomes nor assessments. You can look at Categories 7 and 8 on the Trainer Resources page for additional information and examples. Think about incorporating an interactive component in a technical presentation as a way to engage participants. Consider how you can gauge whether participants achieve the objectives you set out for them at the beginning of your talk or training session.

Additional References

Trainer Resources are useful for metrology professors and instructors, tutorial instructors, and conference speakers. The NCSLI website has a new section on Trainer Resources that provides additional resources and links that will be helpful as you develop as a speaker or instructor. See: www.ncsli.org/NCSL/learning/Trainer_Resources.aspx

Category 5, of the IACET criteria, is especially applicable for this particular topic on Learning Objectives.

We will also have a ½ day Tutorial on Saturday before the conference on Writing Learning Objectives. We especially encourage any instructors and professors to sign up for this tutorial.

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Item	Learning Outcome	Instructional Method (Activity)	Assessment Method
1	Participants will be able to use the references provided in this lecture, to successfully LIST 8 of the 10 items required in an Uncertainty Statement.	Lecture	Quiz
2	After participating in a brainstorming session, participants will be able to see the captured information and DESCRIBE (in complete sentences, in English) the importance of 3 to 5 key Uncertainty Components.	Brainstorming	Short Essay/ Summary
3	After participating in the case study, using the technical resources provided, participants will be able to EVALUATE examples of Calculated Uncertainties and PRESENT and DEFEND an effective course of action.	Case Study	Presentation to the Group with Feedback
4	After hearing the lecture and seeing a demonstration, using partial derivatives and Excel, participants will be able to follow the step-by-step procedure to IDENTIFY components, CALCULATE results, and REPORT a correct calibration Uncertainty for their measurement that meets requirements of the GUM.	Hands-on Exercise	Evaluation of Calculated Results

Table 1. Example Learning Outcomes, Instructional Methods, and Assessment Methods for a Basic Uncertainties Course.

[i] From the University of Texas at Dallas, glossary: http://sacs.utdallas.edu/sacs_glossary.

[ii] ANSI/IACET: American National Standards Institute, International Association for Continuing Education and Training.