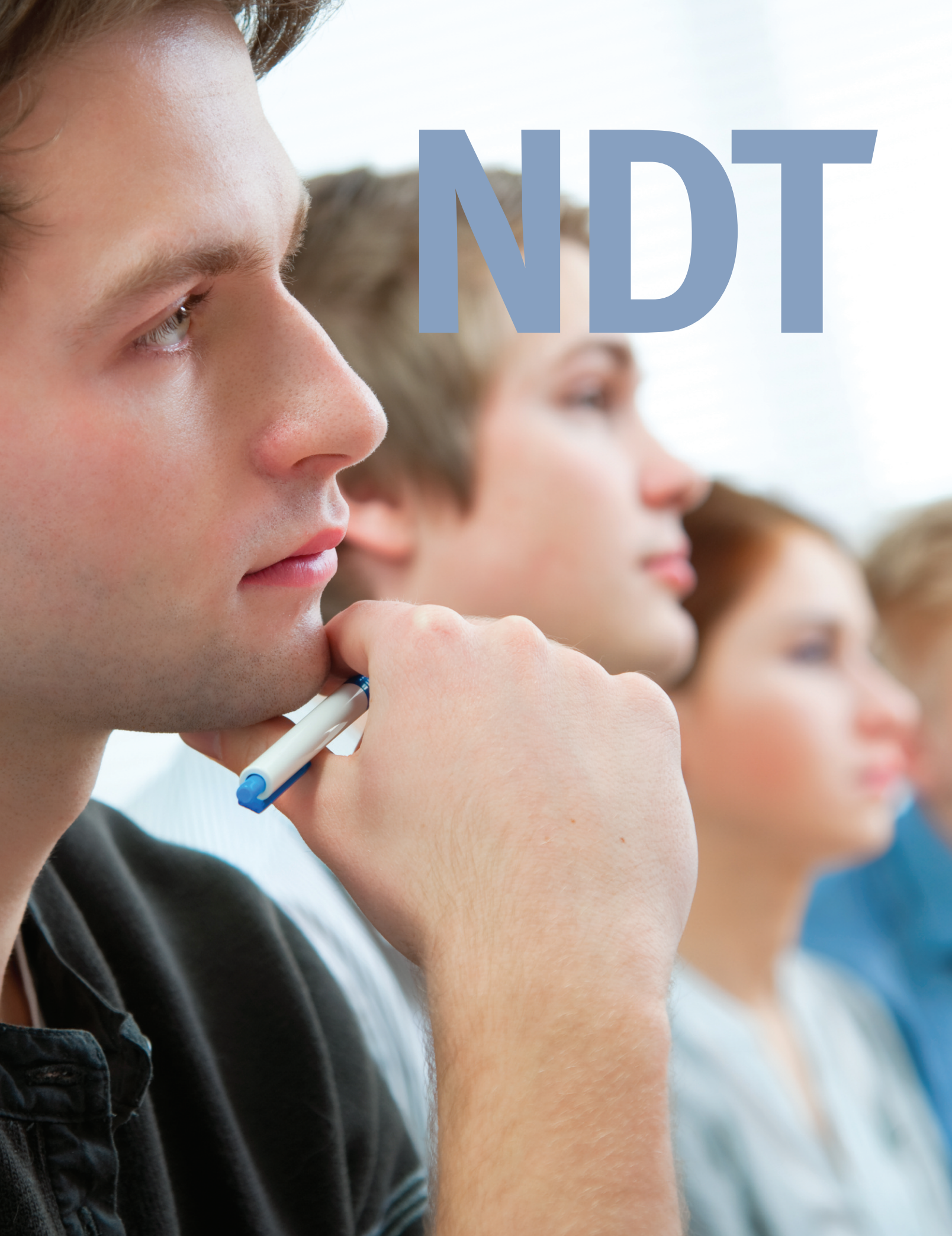

NDT

INTRO

Introducing Young People to NDT

by Phillip W. Trach

As the current population of nondestructive testing (NDT) practitioners ages, it becomes necessary for the industry to recruit and train new practitioners. Most potential NDT professionals have little or no direct connection to NDT, and many NDT personnel report that they entered the field "by accident," without knowing much about it in advance or really seeking it out. Therefore, active recruitment of young people into NDT is necessary.

One challenge presented by this requirement is that of giving NDT presentations to young people. "Young people" as used in this paper means children of elementary school age through undergraduate university students. This paper gives an overview of how to prepare, practice, and present an introductory lesson in NDT suitable for a school classroom with students who are not currently actively preparing for an NDT career. Three cases from the author's experience are examined.

how to prepare, practice, and present an introductory lesson in NDT suitable for a school classroom

Background

In a recent study, it was found that the average age of an NDT technician is 48 years old with 21.6 years of experience (PQNDT, 2013). This puts the average starting point for an NDT career at age 26. At 48 years old, this average technician is 17 years from a typical retirement age of 65, well past the halfway point in his or her career. This also indicates that, on average, technicians are starting their careers well after their school careers end. This indicates a lack of information within schools; a student who learned about the NDT industry and had an interest in it would not wait until his or her mid-20s to begin a career in NDT.

Numerous papers and editorial columns in NDT publications have highlighted the need to recruit new personnel (Allgaier, 2010; Peloquin, 2013). However, there has been little activity in educating or training existing NDT practitioners to present NDT information to young people. Furthermore, the skills and experience of a skilled NDT practitioner do not usually include classroom teaching beyond conducting specialized training classes for existing employees, usually in a workplace setting. These classes also do virtually nothing to generate public interest in the field. In short, training a new hire, no matter how well it is done, does not generate interest in NDT by students outside the workplace.

Furthermore, by the time a student has entered high school, he or she has already made a number of choices regarding his or her education, which will have a strong influence on available options later on. Ninth or tenth grade, or sooner, is not too early to introduce a young person to NDT (Sander, 2014).

Composing the Proposal

Nearly every professional teacher uses a lesson plan. A lesson plan is an outline of the content of the day's lesson, along with specific information regarding the objective of the lesson, the core information of the subject for that day, the materials and activities that will be used, and usually some kind of assessment for how well the students understood and retained the lesson.

The author does not intend to give comprehensive instruction in lesson planning. Knowing the essential elements of a lesson plan will allow an NDT professional to begin crafting an NDT lesson according to a format that a professional educator can understand, and from which a workable lesson plan can be made (with some assistance from the classroom teacher). Furthermore, following an existing template can help ensure that nothing gets missed.

The following is a typical lesson plan structure (Sander, 2014).

- Lesson: what you intend to teach
- Grade: obtain student grade level from the teacher
- Overview: explain why it is important and how it relates to the subject
- Objective: why your lesson is important
- Essential question: what your lesson answers
- Materials: equipment and supplies you need
- Activities: things you and the students will do as part of the lesson
- Assessment: how you will know the students understood your lesson

The initial goal for constructing this lesson plan is to be prepared to discuss your proposal with a teacher. It is far more productive to discuss a concrete plan with a teacher and make changes to it, than to begin the conversation with only a vague idea of giving a lesson on NDT, particularly when the teacher knows little more about NDT than the students.

The goal of this initial discussion is to answer the question, "Why is it worthwhile to me to have my students learn about it?" (Sander, 2014). The better prepared you are to answer this question, the better your discussion will go. It has been the author's experience that teachers are generally receptive to having guest lecturers, especially when the guest brings real-world applications of the subject into the classroom. This puts an NDT practitioner in the position of giving a concrete answer to the constant student question, "Why do we have to learn this?"

The author has found that taking a "Six W's" approach to crafting an NDT lesson works well for completing a lesson plan form such as the aforementioned one. The Six W's are:

- Who
- What
- When
- Where
- Why
- How (the author counts the "w" at the end)

Who will you be teaching? You will take a different approach to a third-grade science class than you would with a high school social studies class. In general, older students, and mathematics and physical science classes allow a more technical approach.

What will you be teaching? This is more than the NDT method you choose; this will include how you intend to connect your NDT experience to the classroom subject.

When will you teach it? You may need to be flexible. For example, an ultrasonics lesson with lots

of trigonometry will need to wait until the students have developed the mathematics skills to perform the calculations. You will also need to work within the available class time.

Where will you teach it? Some portions of your lesson may not lend themselves to a typical classroom. You will also need to know what equipment is available in the classroom, what equipment you will need to bring, and how to set up your equipment in the room.

Why will you teach it? This question should be answered in terms the teacher understands and can apply to the students.

How will you teach it? You, as a potential guest lecturer, need to display the connection between NDT and the subject; the teacher will want details on how you intend to do that. This will generally be the longest portion.

Once these questions are answered, any lesson plan form can be at least partially completed. Once that is done, the details of the lesson can be discussed with the teacher and modifications can be made. The more prepared you are for this initial discussion, the more likely your proposal will be well received.

Proposal to the Teacher

Ideally, you should get a copy of a typical lesson plan from the teacher of the class you intend to visit, or discuss your intentions with the teacher, being open to suggestions on how best to fit your ideas into the existing curriculum. This allows you to adapt your initial answers to the Six W's to best meet the needs and objectives of that specific teacher.

Be prepared to give an introductory explanation of both the importance of NDT in today's world, as well as a brief overview of any NDT method(s) you intend to use (Trach, 2013). In the words of one teacher, "We're not technical people. We like pictures" (Sander, 2014).

Also be prepared to adapt your lesson to any specific needs the teacher has. Keep in mind that you will be an interruption to the teacher's curriculum. While the author's experience has been that teachers are generally quite willing to have guest lecturers, you will be making some extra work for them. Be ready to accommodate their needs. Be ready to both ask and answer the question, "Are there other ways NDT can be tied to the curriculum?"

Preparing the Lesson

Once you and the teacher have worked out the basics of your approach to your lesson, you can begin crafting the details of your lesson. You will refer often to your lesson plan, always keeping in mind the central question: "Why is this important?"

The central theme of your lesson will be the answer to this question. The author has found that a single sentence is most effective for focusing the other parts of the lesson. Each statement or activity can then generally be linked to this sentence (Trach and Trach, 2012).

A comprehensive description of all the possible lesson approaches is beyond the scope of this paper; indeed, it would be tantamount to several semesters' work in educational theory and curriculum development. However, a few simple approaches are worth mentioning.

Telling Stories

Particularly with younger students, or with older students who would benefit from "real-world applications," telling stories of your experiences can generate interest in your lesson. The challenge here is to be exciting. Your story is familiar to you, but brand-new to your class. Be lively; emphasize the skill and technology in your story, especially to older students. Even the most technical paper is, at its base, a story.

Demonstrations

Demonstrations can be very effective, especially when the students can try the equipment for themselves. However, this requires additional time; make certain you will have enough time both for demonstrations and for the explanation of what you show the class. The danger here is to give merely a demonstration of "cool science stuff" without connecting it to the world in which the students live.

It is important when considering a demonstration in a classroom to remember the limitations of the classroom. For example, it may not be possible to get a classroom dark enough for a fluorescent penetrant test to be easily visible. Radiography using a portable source would be extremely difficult (if not impossible) to perform inside a school building. The small screen on most portable ultrasound units may not be visible to the entire class.

Consider also the time it takes. Waiting 15 minutes for liquid penetrant to dwell on a part may not be the best use of time. In general, you will be illustrating principles more than conducting NDT training, so it may be better to have specimens prepared for viewing without spending classroom time performing processing.

First Principles

Starting with the basics and showing how a few simple physical phenomena can be connected to

make a system that reveals amazing material conditions can be effective and thorough, provided you can keep the students' attention. Particularly in a mathematics class, showing the expressions that govern certain aspects of a nondestructive test, then explaining the effects when various variables are manipulated, can give a compelling aspect to otherwise dry equations, especially when combined with a demonstration.

Coordination With the Existing Curriculum

No matter how the lesson is crafted, it is important that the lesson generate specific outcomes. "What will the students learn?" is the key question. "How will you know?" is an important secondary question. Your task is to make sure that what the students learn from your presentation is a natural extension of what they are already learning in their regularly scheduled class.

This is an area where flexibility on your part combined with communication with the teacher will help. Be open to suggestions; the teacher is the expert at teaching. Use that expertise and rely on it, but do as much preparation as you can beforehand to help. If necessary, review the subject so that you can better craft your own lesson to match what the students have already learned and will learn in the lessons following yours.

Organizing the Lesson

Once you have answered the Six W's and have some idea how you want the lesson organized, you must expand your lesson plan to include the specific details of your lesson. This includes elements such as:

- Introductory statements
- Stories
- Questions for the class to attempt answering
- Demonstrations
- Participatory exercises

You must plan each step of your lesson from the teacher's introduction of you all the way to answering the last question from the last student. You will lose the attention of your audience if you are unprepared or disorganized.

Each step should have some connection to the previous step and to the next step. The nature of these connections will depend on the steps themselves, your teaching style, and other factors that will be specific to a particular lesson and presenter. It is far more important to have a systematic and logical progression in place than to adhere to any particular style of progression. Have a plan, even if it is not an optimum plan.

Presenting the Lesson

The lesson plan at this point is essentially complete. Discussion with the classroom teacher has happened, ideas have been investigated, and the Six W's have been answered in an organized format.

The task then becomes answering, in person, the core question that the students (ideally) will have: "Why is this important?"

The novelty of a guest lecturer helps with gaining attention at the beginning of the lesson. A lively and energetic delivery can help to hold the students' attention, though it is important not to sacrifice content for the sake of being merely entertaining. Practicing the lesson, even to an empty room, will help with timing and delivery.

Practicing also includes practicing any demonstrations you may have. Do not skip over them or merely rehearse them in your mind. Pick up and use each tool, prop, and system you plan to use. This will show you if anything is missing, or if anything should be prepared beforehand, and allow you to get used to how your lesson flows when you start demonstrating instead of merely talking.

Above all, know your material, know your plan, and then follow the plan.

Demonstrations can be very effective, especially when the students can try the equipment for themselves.

Figure 1. Sixth-grade students were taught how a basic equation ("distance equals rate times time") could be used for nondestructive testing.

Figure 2. Aided by a guest nondestructive testing presenter, sixth-grade students carried out a basic ultrasonic thickness test.

Examples

The author presents three examples of classes he has taught, at the elementary, junior high school, and undergraduate levels. Each presented its own challenges. In all three lessons, ultrasonic testing (UT) was the NDT method used.

Elementary Lesson

The lesson was presented at an evening boys' group at a local church. The one-sentence summary of the lesson was "What's inside counts." Several aluminum blocks, some with holes drilled in varying orientations, were covered with tape to obscure the hole locations. A portable UT system was used to demonstrate the differences between a "good" block (with no holes drilled in it) and a "bad" block (that had holes drilled in it). The kids saw that even though several items may look identical on the outside, it is the things inside that really make the difference.

Junior High School Lesson

The lesson was presented in a sixth-grade mathematics class at a nearby private school (Figure 1). The one-sentence summary of the lesson was "Word problems happen in real life." The basic equation, "distance equals rate times time," was presented as a common word problem about a car driving from one place to another. Each aspect of the word problem was replaced by an element of ultrasonic thickness testing until the students saw that this common word problem had a real-world application that is used every day. Students then performed a thickness test (Figure 2), including manually calculating the part thickness from the acoustic velocity of the material and the measured time of flight of the ultrasonic signal.

Undergraduate Lesson

The lesson was presented several times at a nearby university. The one-sentence summary of the lesson was "How to make a living doing NDT." A number of short stories of the author's experience in NDT, from initial training to developing new internal practices, were told. Additionally, classroom descriptions and demonstrations of typical materials testing situations were displayed. These acted as an adjunct to and extension of the students' work on system calibration earlier in the semester.

Conclusion

In order to foster and encourage the next generation of NDT practitioners, educational presentations in the classroom by experienced NDT practitioners are needed at all grade levels. Thorough and thoughtful preparation is extremely important, both for a practitioner to be welcomed into a teacher's classroom, and for the practitioner to effectively introduce young people to NDT. ◐

AUTHOR

Phillip W. Trach: ASNT NDT Level III; Laboratory Testing, Inc., 2331 Topaz Dr., Hatfield, Pennsylvania 19440; (800) 219-9095; fax (215) 997-8294; e-mail ptrach@labtesting.com.

ACKNOWLEDGMENTS

The author wishes to acknowledge the support of the following: Laboratory Testing, Inc.; Michael Sander, social studies department, William Tennent High School, Warminster, Pennsylvania; Vladimir Genis, Ph.D., engineering technology department head, Drexel University, Philadelphia, Pennsylvania; New Life Presbyterian Church, Glenside, Pennsylvania; and Calvary Christian School, Fairless Hills, Pennsylvania.

REFERENCES

Allgaier, M., "NDT Education and Training: Today and in the Future," *Materials Evaluation*, Vol. 68, No. 9, 2010, pp. 972–977.

Peloquin, E., "Education Fosters Growth in Nondestructive Testing's Future," *Materials Evaluation*, Vol. 71, No. 10, 2013, pp. 1034–1039.

PQNDT, "Salary Survey 2013," PQNDT, Arlington, Massachusetts, 2013.

Sander, M., interview by author, Hatboro, Pennsylvania, 24 June 2014.

Trach, P., "Introducing NDT to Visitors," ASNT Fall Conference, Las Vegas, Nevada, 4–7 November 2013.

Trach, F., and P. Trach, "Developing Presentation Training Skills," ASNT Fall Conference, Orlando, Florida, 29 October–1 November 2012.