TECHNICAL TRAINING: *HIT THE GROUND RUNNING*

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Engineers may need training for any number of reasons: to operate equipment, to understand new process technology or to more effectively do their jobs. But implementing a training program is no easy task. There are several approaches you can take, each with its own advantages and drawbacks.

For example, you could select a trainer from inside the company. One of your employees may already know the process or technology you wish to teach. But if the employee lacks the time to train others, or is not completely up-to-date on the technology, he or she cannot be an effective trainer.

Going outside the company, you might opt for an outside consultant. You can run into a problem with this choice, however. Though technically solid, the consultant may lack good communication and teaching skills.

As a third option, you might turn to a professor. An academic professional will certainly have experience in instructing students. You may find yourself very dissatisfied with the training, however, if it turns out that your professor has never set foot in a plant.

The right instructor plus proven teaching methods yield the best results

What makes a trainer good?

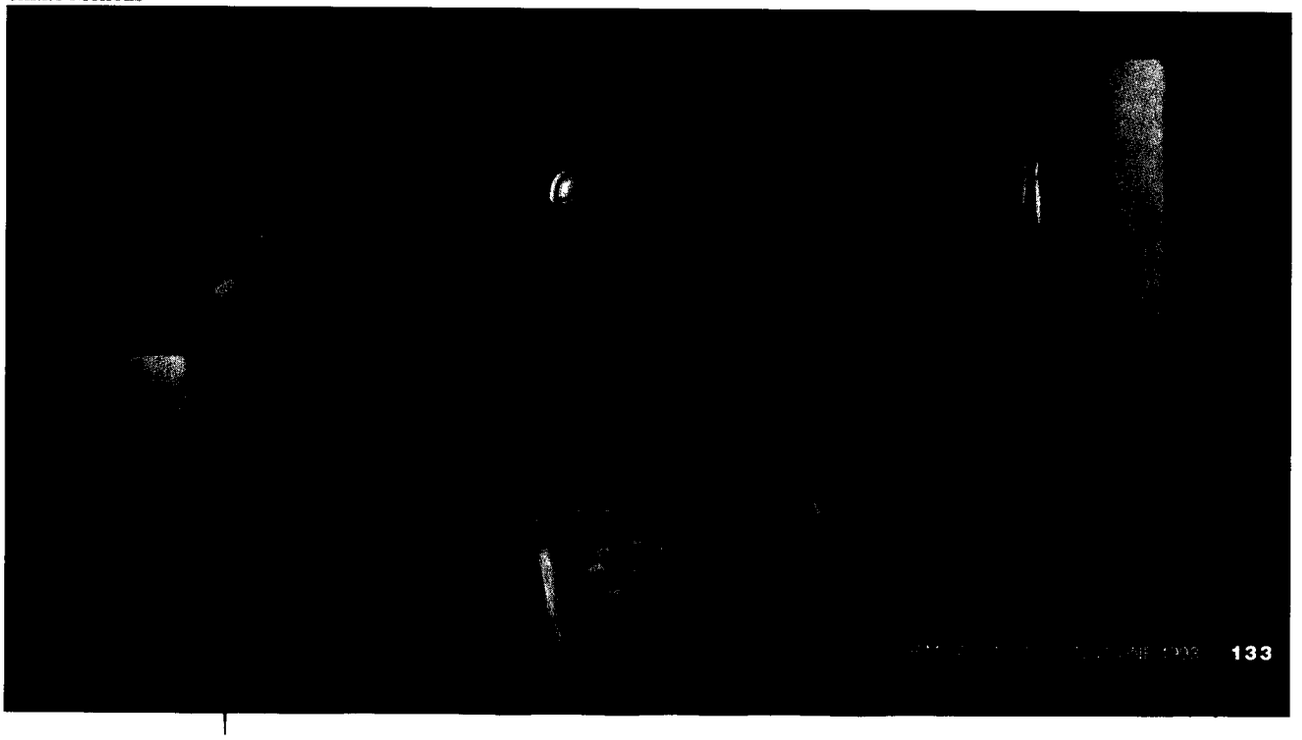
To be effective, a technical trainer must meet several criteria:

Practical knowledge. A good trainer must understand the trainees' systems and problems on a practical level. Many college professors can quote chapter and verse when discussing a subject, but can't connect that theory with what actually goes on in the plant.

Fundamental knowledge. While practical knowledge is a necessary condition for effective training, it alone is not enough. It's fine to list rules of thumb for handling possible scenarios, but sooner or later you'll get a problem you haven't been able to predict — and for which the rules don't work.

"We don't know how to scale up the stirred tank reactor," your engineers

GARRY NICHOLS



say. Or, "The extruded polyethylene film keeps coming out with black spots." How can a trainer address these problems if he or she has never seen them before?

Solving real problems requires a good understanding of the basic chemistry, transport phenomena, and dynamics of the process system. Plant engineers with a practical knowledge of the process may lack this basic understanding, or may have forgotten the theory because they never use it (how long has it been since *you* solved a differential equation?).

Ability to communicate. Not everyone who knows a subject can explain it to others. Most process engineers know how their process works and some know the theory behind it, but few can present their knowledge in a way that nonexperts can understand. If a trainer cannot communicate clearly and effectively, the training wastes trainees' time and company money.

How do you choose a trainer?

Check out prospective trainers as you would any prospective employee. If the candidate has prior experience as a trainer, get references from past clients and, if possible, past trainees. Have the candidate explain a technical point that you don't already understand and see how clearly he or she communicates.

If you're considering someone who works in your plant, ask the candidate's coworkers for their opinions. If you're thinking about a professor, check on his or her industrial experience. In addition, make sure the candidate gets some background on your plant and processes before he or she begins training.

What makes training work?

Unfortunately, even a knowledgeable and articulate trainer cannot guarantee effective training. Cognitive and educational psychologists have shown that people learn best when they:

- Feel a need to know the material
- Can connect new knowledge with prior learning or experience
- Get information in a variety of ways (seeing, hearing, writing, repeating)
- Participate actively in the learning process, as opposed to merely observing and taking notes

1. Make training sessions as relevant as possible to your trainees' work and experience
2. Use easily digestible visuals-such as flowcharts, sketches and pictures-to get your points across
3. Don't overwhelm trainees with math. Ensure that your students understand the reasoning behind, and use of, a theory or formula
4. Involve trainees. Have them solve problems together in groups
5. Get traditional enemies working together. They may drop their habitual distrust long enough to see each other's points
6. Give trainees complete notes. If they're straining to catch every word you say, they may miss some of the important points you're making
7. Allow your class enough time to recharge. They won't learn much if they're too tired to listen
8. Make sure that trainees understand they're not expected to become instant experts on the training material

Although some trainers instinctively understand these points, most do not. Most instructors simply lecture and show transparencies for hours on end. Even if the trainer lectures well and trainees find the course entertaining and enjoyable, little learning is likely to take place under these conditions.

Fit training to the trainees

The more connections trainees perceive between course material and their own experience, the more motivated they will be to learn the material and to use it after the course is over. Find out as much as possible about the plant as far ahead as possible. During the course, include processes and problems like those in the plant.

If you can't get advance knowledge of the plant, survey the participants at the beginning of the course and ask them to talk about their processes and their problems with design, scaleup, equipment operation, quality control, materials handling and waste management.

Ask them to provide as much detail as they can without violating proprietary restrictions. This survey information can help you to choose which course topics to cover in detail and which to skim or skip.

Use lots of visuals

Most people are visual (as opposed to verbal or auditory) learners. The more you use visuals in training notes and transparencies — sketches, flowcharts, schematics, plots, live demonstrations — the more the participants are likely to get out of the training. A single process-flow diagram, for example, conveys more information than 10 pages of process description.

Go easy on the math

Before jumping into the development of a theory or a lengthy derivation, give illustrations of what the theory is good for — what phenomena it may help explain, what problems it will help trainees solve.

After describing a procedure or device, illustrate its use. And after presenting or deriving a formula (and sometimes before deriving it), give an example of how to apply it. Make examples practical, with numbers instead of variables to the greatest possible extent. Don't spend much class time on detailed derivations — they're hard to follow and boring. If necessary, put them in the course notes.

Encourage participation

Total passivity in a classroom is deadly to learning. Most trainees will lack the concentration or physical stamina to

remain both passive and attentive for ten minutes, let alone several hours.

Effective training requires active participation from all trainees. An occasional request for questions or comments doesn't work; either nobody responds or only a few participants — generally the same ones — volunteer.

An effective technique for fully involving trainees is to have small groups work on problem-solving exercises. Pose problems periodically and get participants to work in groups of two to four for several minutes. Then collect some or all of the responses and use them as a springboard for discussion or to illustrate points.

There is no limit to the kinds of problems you can pose. For example:

"I have to move a slurry from a storage tank to a reactor. What information do I need to select and size the pump, and where do I find this information?"

"We want to design a continuous-stirred-tank reactor for this reaction. Here are some pilot plant data. See how far you can go with the preliminary design calculations in five minutes."

"Jason has described his process, and says that he keeps getting black spots in his polyethylene. Generate a list of anything that might be causing the problem. Do it in brainstorm mode — there are no wrong answers, and you get bonus credit for unique or far-fetched answers. The team with the most answers wins. You can ask Jason any questions." (Try putting all the chemists into one group of teams and all the engineers into another group — and watch the nonoverlapping sets of responses.)

Exercises like these get the class actively involved. Even if they can't get the answers or don't really have enough time to do so, trainees benefit from the thinking they undergo to formulate answers. Even if these exercises take only five minutes out of every hour of lecturing, they can be energizing enough to keep the group involved for the entire program.

Unite traditional antagonists

Few things are as disruptive to a training program as groups of participants with a history of poor cooperation and mutual distrust, such as chemists and engineers, plant and R&D personnel, production and quality-control personnel, or technical personnel and managers. A powerful device for defusing these conflicts is to pose problems that require expertise from both groups. Have mixed teams work on them. A few such exercises can spark the beginnings of understanding and cooperation.

Provide complete notes

Unless trainees are proficient in shorthand, there is no way they can take notes and keep up with the information flow in a typical technical training program. Even if they could manage it, they could not simultaneously think about the material.

Put hard copies of all transparencies in participant notebooks along with supplementary readings, data tables and reference lists. Since they don't have to concentrate on writing everything down, participants can pay attention to what the trainer is saying. The trainer-provided notes will help supplement the material that trainees absorb in the classroom.

Give frequent breaks

A class that sat through a 50-minute lecture and immediately afterwards took a test on the lecture content. How much information the students remembered depended strongly on when the information was presented [*1*].

Their retention hovered around 70% for material presented during the first ten minutes, and then dropped sharply to 20% or less of the material presented toward the end. You can guess how much of an uninterrupted three-hour lecture they would have retained.

In our training programs, we provide at least an hour for lunch and 20- to 30-minute midmorning and midafternoon breaks with light refreshments. We also try never to let more than an hour elapse without a 3-minute stretch break. Some trainers, particularly new ones, resist taking the time for breaks in their zeal to cover as much material as possible. There's little point in covering it, however, if no one is listening.

Ease trainees' anxieties

Participants in technical training programs, if at all realistic, soon realize that they are only absorbing a small fraction of the material. If they expect to become experts in a few days, they will be seriously disappointed, either in the training program or in themselves.

A valuable part of training is ensuring that trainees understand how the process works — that the real training only begins after the program ends. Let them know that they are being fed information at a rate far greater than the normal human mind can absorb. Tell them that they shouldn't expect to get it all.

Add that they're probably learning more than they think they are now and that they'll really start to get it when (and if) they go back over their notebooks at a more realistic pace. Once they understand that they're not expected to immediately absorb material that normally takes professionals months or years to learn, their tension and frustration are often replaced by relaxation and enjoyment of the program, and the quality of their subsequent learning improves dramatically. ■

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