Introduction

In September 2010, a feature was published in Materials Evaluation, titled “NDT Education and Training: Today and in the Future” (Allgaier, 2010). It was based on the 2009 ASNT Fall Conference and Quality Testing Show plenary address (Allgaier, 2009). The essence of both the feature and address was that the traditional techniques of nondestructive testing (NDT) education were evolving from classroom and laboratory instructor-led training (ILT), with a manageable number of students engaged into a blend of web-based training (WBT) and ILT. The advantage being that much greater numbers of students could be “instructed” in knowledge factors via WBT in any place, at any pace, and anytime, with greater efficiency and less cost per student. However, it was still necessary to transfer skills via hands-on training with ILT in the lab and on-the-job training (OJT) as a requirement.

This article explores the blended learning progress to date and clarifies some issues that have been misinterpreted or omitted from the basic concepts of this approach.

Challenge

Industry needs more NDT technicians who are trained and qualified more efficiently, using fewer human resources in both instructors and qualified candidates. A 2014 article in Quality Magazine states:
- “New analysis from Frost & Sullivan (www.testandmeasurement.frost.com), Analysis of Global Nondestructive Testing (NDT) Training Services Market, finds that the market earned revenue of $237.6 million in 2013 and estimates this to grow to $293.5 million by 2018 at a CAGR of 4.3%. The most important trend witnessed in the market is a migration from American Society for Nondestructive Testing’s (ASNT) employer-based certification scheme, SNT-TC-1A, to centralized certification schemes that are compliant with International Organization for Standardization ISO 9712, which is predominantly impacting the Middle Eastern, African, South Asian, and Southeast Asian markets.
- “Although there is a huge demand for trained technicians, growth of NDT training service providers is further being hindered by a lack of quality instructors to impart training courses. Growth and revenue for every NDT training service provider depends on the number of instructors available, since there is a maximum threshold on not only the number of courses an instructor can teach, but also the number of students that can be accommodated in a course without compromising on the quality of the training” (Frost & Sullivan, 2014).

Recent ASNT Board of Directors decisions have put ASNT on the path to meeting ISO 9712 requirements through the Society’s ASNT Central Certification Program (ACCP) (ISO, 2012). First, ACCP is a third-party qualification program independently administered by ASNT. Secondly, more hours of training and experience will be required compared to existing SNT-TC-1A or CP-189 requirements (ASNT, 2006; ASNT, 2011).

Additionally, the American Society of Mechanical Engineers (ASME) is making progress on establishing its unique performance requirement for the ASME Nondestructive Evaluation/Quality Control Personnel Certification Program (ASME, 2015). Additional training in both knowledge and proficiency demonstration are not required but may be necessary to achieve central third-party options for qualification and certification.

One advantage to this third-party qualification system is the transportable credentials afforded to the individual. This will meet the third-party certification requirements of some jurisdictions. However, the cost may not be borne by the employer if the individual gains transferable credentials. This is also true of ACCP third-party certifications.
For the time being, many end customers still allow employer-based personnel qualification and certification (PQ&C) programs. These programs are met by employer written practices that comply with SNT-TC-1A (a recommended practice) or CP-189 (a standard). In either case, training content needs to meet CP-105 (ASNT, 2006).

Alternatively, many government contracts and aerospace applications must meet NAS-410: *Certification and Qualification of Nondestructive Test Personnel*, which is technically equivalent to the European Standard, EN 4179: *Aerospace Series – Qualification and Approval of Personnel for Non-destructive Testing* (AIA, 2014; BSI, 2009). Note that NAS-410 does not require central certification even though it meets the technical requirements of the program that in Europe does have central certification (third-party) as a requirement.

The American Petroleum Institute (API) references ASNT documents for PQ&C but additionally requires API QUTE – *Qualification of Ultrasonic Testing Examiners (Detection)*, API QUSE – *Qualification of Ultrasonic Testing Examiners (Sizing)*, API QUPA – *Qualification of Ultrasonic Testing Examiners (Phased Array)*, and API 510 – *Pressure Vessel Inspector certificate holder* to demonstrate their skills in performing ultrasonic examinations. In many cases this meets the customer’s needs.

In most cases, the new training requirements are growing in content, duration, and industry specific qualifications including proficiency demonstrations. Note: some areas are being reduced.

So, how can the needs of the ever expanding and daunting initial NDT training requirements be met without diminishing the ability to provide qualified technicians in the various industries?

**Solution**

To meet the need for a greater quantity and higher quality of NDT inspectors, more flexible training services are needed, that is, blending learning techniques.

Many large NDT service companies recognize a shortage of qualified instructors. Either they are qualified to instruct but are not available due to pressures to be billable, or they may not have additional qualifications desired to transfer knowledge or skills. Some codes also require instructors to have 40 or more hours of instructor training, for example, *ASME Boiler and Pressure Vessel Code*, Section XI (ASME, 2015). CP-189:2006 requires additional experience based on education to be an instructor. Therefore, the specialized instructor resource needs to be utilized more expeditiously and wisely. If formally qualified instructors or Level III personnel are allowed to approve WBT, more instructors can be dedicated to providing ILT with hands-on expertise in a laboratory environment. Note that it is allowed for OJT to be given by Level II or III personnel, as described in SNT-TC-1A and CP-189 levels of qualification, to direct trainees and Level Is. In this way, a broader bandwidth of personnel can provide training at different stages and for different reasons. Professional trainers who are experts at transferring knowledge via computer-based training and/or WBT need not be Level IIs even though it should be required that technical experts, that is, Level IIs in that method, should approve all WBT/ILT.

The benefits of taking this approach are:

- reduced time commitments of Level IIs or qualified instructors;
- reduced costs to the end customers;
- increased flexibility in the utilization of the students’ time.

One large personnel challenge is the difficulty in freeing inspectors from production/billable time to take 100% ILT courses in the traditional format. If students are allowed to take online training, they may take it at any time, anywhere, and at any pace. Once the basic knowledge has been transferred by evidence of online examinations, they can then move on to scheduled ILT with hands-on skill transfer activities.

One of the drawbacks to accepting WBT is the method by which credit hours are granted for online training. Opposing arguments can be made on how to do the calculations. One is the actual time utilized by each student online. Two is to give credit for body of knowledge (BOK) hours per the training tables the WBT was intended to satisfy. Third is an approach that is more reasonable and pragmatic, for example, to grant the hours that on average a student takes to complete the WBT for a given BOK meeting the content requirements of the governing document.

The current process of achieving this goal is represented in the NDT PQ&C typical process flowchart, shown in Figure 1.

![Figure 1. Nondestructive testing personnel qualification and certification typical process flowchart.](image)

Industry qualifies and certifies NDT personnel by a combination of techniques to provide certification:

- Training – ILT classroom/lab;
- Experience – OJT;
- Examinations – hardcopy (paper) or online exams combined with proficiency demonstrations (practical exams).

One of the issues that has been misinterpreted or omitted from the basic concepts of this approach as initially presented is a lack of emphasis on the Level III instructor or qualified NDT instructor confirming and validating that the student has adequately acquired the knowledge indicated by passing the online WBT he or she took prior to coming to the classroom/laboratory for proficiency training.
and demonstrations. It is necessary to ensure that a student has gained the necessary knowledge transfer before proceeding with skill transfer activities. One way to do this is for the instructor to meet with the individual before beginning the WBT to provide an overview of the overall approach to the blended learning concept. At this time the individual taking WBT should be encouraged to study in an area free of distractions similar to a classroom. After WBT has been completed the instructor and the student can review the material to ensure it was understood. Then, any questions the student has can be addressed before proceeding to ILT.

A second point that has not been emphasized previously is the flexibility of scheduling regarding order of training. It is not mandatory that OJT be done after ILT. It is a point of much discussion between Level IIIs and NDT instructors. Some companies prefer that at least Level I training be given prior to sending the trainee into the field to gain OJT. Others argue that field experience is invaluable to helping the student to better understand the classroom presentations if previously exposed to real-world applications.

Thirdly, OJT needs to be structured so as to be “sufficiently organized” as recommended by SNT-TC-1A or CP-189. The new developments still needed in greater detail are “competency qualification” forms, task/sub-task lists, or practical factors, which spell out the various activities that would have been done historically in the laboratory environment as class exercises. If lab exercises are sufficiently structured they can be performed in the laboratory in conjunction with the classroom sessions or in the field with qualified Level IIs or IIIs after completing knowledge training in the classroom through I LT or WBT.

The new blended approach for WBT and many fewer hours of direct I LT allow the following possible scheduling (note: this example assumes a 40 h training outline structure or traditional formal training course for one week, for example, radiographic testing/ultrasonic testing/electromagnetic testing, and so on).

- Day 1: WBT (no instructor/proctor after first meeting with instructor)
- Day 2: WBT (no instructor/proctor)
- Day 3: half-day day WBT (no instructor/proctor)
  
  Note: these first ~20 h of WBT may be taken over any reasonable time frame.
- Day 3: half-day competency qualifications (Level II/III OJT)
- Day 4: procedures and forms I LT (Level II/III instructor)
- Day 5: review and exams, written – proctor (non-Level III) and practical (with Level III)

**Conclusion**

The blended approach to training incorporates some efficiencies, adds flexibility, and allows fewer human resources to accomplish more for a larger target audience. It does this by reducing waiting time for initial training in theory and principles to begin. This approach provides more options when scheduling how and when to conduct hands-on training to transfer skills. Various time slots and changing targets of opportunity for both the instructor and students can be maximized. Structured competency qualifications make the OJT more applicable, standardized, and useful when it can be done in the traditional laboratory setting or in the field conducted by qualified technicians of superior skillsets.

The new emphasis not to be omitted is for the Level III and/or NDT instructor to validate knowledge transfer before proceeding to skill transfer activities. It is at this intermediate stage that remedial training can be provided to shore up misunderstandings or shortfalls in knowledge as evidenced in the exam results. Then the student and instructor can proceed with the skill transfer exercises confident of adequate knowledge levels.

Optimum efficiency would be gained if the instructor ensures adequate transfer of knowledge or skills by conducting student evaluations at the end of each training method prior to proceeding to final written or practical proficiency exams leading to certification.

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**REFERENCES**


