

# A Perspective on Welding Engineering Education—Confessions of a PhD Who Can Actually Weld

*A researcher and educator offers his opinions on the challenges of welding education today*

**BY YONI ADONYI**

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*Based on the Plummer Lecture, delivered Nov. 13, 2012, Las Vegas, Nev.*

*The Plummer Lecture was dedicated to the memory of my wife and best friend for 41 years, Anne Marie Adonyi, who was an accomplished artist. Several of her sketches and paintings inspired by weld microstructures illustrate the text.*

**T**his personal opinion paper deals with some perceived, as well as real, contradictions between education vs. training in teaching, accreditation vs. certification, engineering vs. engineering technology, and teaching vs. research. These thoughts come from 17 years of experience as the Welding/Materials Joining program coordinator at the School of Engineering, LeTourneau University, and are intended for welding educators, instructors, and the public.

## Introduction

As more manufacturing jobs return to the United States and the American Welding Society tries to address the welder shortage by improving the image of welding, it appears that there is a need to change the essence of welding first. This can mostly be done by better teaching at every training and educational level and creating scientific breakthroughs by well-taught and educated engineers and scientists.

However, because teaching (instruction) often involves vocational training,

education is sometimes confused with training. Similar misunderstandings persist in the welding community between accreditation and certification, practical training vs. theoretical teaching, and so forth. This paper attempts to clarify some of these contradictions and propose a harmonious approach to improving the quality and essence of welding, not only its image.

This is a very personal perspective on the topics discussed, and the hope is that these thoughts will not hurt anybody's ego, but instead will spark a healthy debate in the welding engineering community, and new solutions will be found to these long-lasting contradictions.

## Education vs. Training

In teaching and improving professional competence, I believe that education should not be confused with training, as they address different aspects in developing the welding professionals our country needs. The etymology of the word "education" clarifies the difference. According to *Webster's Dictionary* (Ref.

1), the word comes to us from the Latin "educare," meaning "to rear, to lead forth, to draw out something of potential or latent talent." It can also mean "to persuade or condition to feel, believe or act in a desired way." The implication is that education can be practiced at home, and in primary, secondary, and postsecondary schools. Education shapes the mind and character of students and might also involve training.

On the other hand, the etymology of "training" is rooted in the vulgar Latin word "traginare" (Ref. 1) and means "to undergo instruction, discipline or drill." Webster's also defines training as "the act, process or method to impart knowledge or experience to acquire or to teach as to make fit, qualified, or proficient." This teaching type refers to a particular set of skills.

All this does not mean that one is better than the other, it just means that education is more comprehensive than training in teaching a subject. For example, if applied to the culinary arts, training means to teach someone to cook by following recipes, while education is



**Anne Marie Adonyi, Chatting Women, copyright BeauxArtsbyAni@. This is how a heat-affected zone seen in an orientation imaging microscope became a work of art.**

equivalent to cultivating in someone the talent to create new recipes and write cookbooks, even when not all ingredients are available. It is clear that the cooking industry could not work without good chefs and line-cooks working well together.

Applied to the welding industry, this differentiation shows that well-educated welding engineers and scientists need well-trained technicians and operators to do their jobs. On the other hand, confusing the roles can potentially cause serious problems in our industry. Imagine a world where welders are trying to design new products without knowing calculus and differential equations, and welding engineers trying to make good welds on production lines after having only welded 30–40 hours in their entire lives. In reality, we need each other, but will have to better understand our roles. As someone who has experienced both training and education, I will continue to be part of the solution and bring harmony between the educated and the trained.

## Accreditation vs. Certification

In the same way education differs from training, accreditation is different from certification, yet the two terms are often used in the wrong context.

The word accreditation comes from the Latin word for “Accredere,” meaning ‘to give credence to (to believe, a set of fundamental beliefs), or to give official authorization, to provide with credentials’ (Ref. 1). This process is applied to educational institutions in order to recognize maintaining standards that qualify graduates for admission to higher institutions of professional practice. In the United States, the Accreditation Board of Engineering and Technology (ABET) is the recognized body that pe-

riodically reviews compliance at universities. The maximum length of ABET accreditation is six years to ensure that the programs maintain high quality educational standards.

The word certification comes from the Latin word “Certus,” or certain and means “to attest authoritatively as, to attest as being true or as meeting a standard.” Webster’s also adds the meaning “to testify to the truth or genuineness of something — applies to a written statement, carrying signature and seal.” In our field, the Certified Welding Inspector (CWI) program comes to mind, as certified by a professional organization, the AWS.

As an example, LeTourneau University is accredited by SACS (Southern Association of Colleges and Schools) and the engineering program is accredited by ABET, hence we do not issue certificates, but diplomas. On the other hand, the AWS, Sysco, Linux, etc., issue certificates, but not diplomas. It should be obvious that university programs cannot be certified and training programs cannot be accredited. Yet, terms such as “Caterpillar University” or “ESAB University” are being used, making the above distinction difficult to the public. At the same time, terms such as Certified Welding Engineers become questionable, as they imply a mix between education and training at the national level.

Currently, the only legal way an educated engineer can become certified on a state-by-state basis is the Professional Engineer (PE) registration. This requires passing the Fundamentals of Engineering comprehensive exam and completion of five years minimum work experience as an Engineer in Training under the supervision of an experienced PE.

## Engineering vs. Engineering Technology

Another concept that needs explanation is the four-year Engineering Technology Bachelor of Science degree, which is often misunderstood, and its graduates considered technicians by some employers. Note that this degree can also be accredited by the Engineering Technology Accreditation Committee (ETAC), administered by ABET.

An excellent review paper on the subject (Ref. 2) showed that more than 75% of engineering technologists perform engineering job functions. Nevertheless, some companies have a ban on hiring engineering technologists because they consider engineering technologists “glori-

fied” technicians, a fact that cannot be further from the truth. In the case of LeTourneau University, the Engineering Technology program had been an excellent safety net for those engineering students who could not master advanced math and science classes, but learn well by application of scientific principles.

A special recognition note is needed here on the recently ABET/TAC accredited Engineering Technology program at Ferris State University. Although this program is mostly focused on the automotive industry needs, its growth and delivery of high-quality education during the past decade has been spectacular.

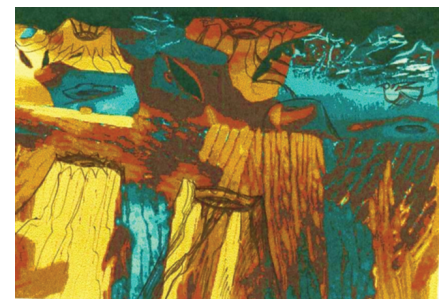
## Theory vs. Practice in Education and Training

The above description of Engineering Technology (learn by doing teaching paradigm) and Engineering (learn by applying fundamental scientific principles paradigm) brings up a basic question: how important is it to have practical knowledge (training) in order to practice engineering (education)?

The obvious answer is — very much so. Being comfortable with using dangerous and difficult manufacturing processes such as thermal cutting, brazing, and welding is very important for engineers to understand process capabilities and limitations. Moreover, they become appreciative of the skilled welders’ performance, and attempt to make their work safer and easier by introducing automation and robotics, as well as by designing for easier use of the equipment.

However, overemphasizing the role of practical experience can be detrimental to the career of a welding engineer. Repeating the same welding exercise many times may improve skill, but will not further scientific knowledge.

Accordingly, only two of those who went through ten-plus years of welding practice were able to graduate from Le-



**Anne Marie Adonyi, Volcano. Inspired by epitaxial growth macro in a titanium bead-on-plate weld.**



**Anne Marie Adonyi, Angel Coming, copyright BeauxArtsbyAni@. Inspiration provided by a two-sided, partially penetrated butt joint weld macrostructure.**

Tourneau's Engineering Technology program in the past 17 years. In my experience, those who dropped out after one semester or two were put off by the difficulty of science and math classes, and by not seeing the relevance in their understanding basic principles of welding (which they mistakenly thought they already understood at a phenomenological level).

Therefore, I believe that the level of academic rigor should be strengthened at the two-year community college level, mostly by sending instructors back to school or by providing them with high-quality training material, instead of commercial propaganda received from their donors. One such nationally accepted program exists already, the National Excellence in Materials Joining Engineering and Technology (NEMJET) program developed in the late 1990s under an NSF grant by Ohio State, Edison Welding Institute, and AWS.

## Teaching vs. Research

A different, but difficult contradiction faced by academics and practicing engineers alike is how to handle teaching and research at the same time. These activities require a different set of talents and have different customers. Yet, I believe

the two activities are complementary, and an effort should be made by each individual to balance them in their lives.

The reality of academic life in search of tenure is that raising external funding and publishing peer-reviewed papers remain the basic criteria for evaluating faculty in tenure reviews. The so-called "publish-or-perish" expression reflects this reality, when teaching is often neglected by young faculty in order to remain employed and receive tenure, whereby consequently more and more, sometimes repetitive and irrelevant papers are published.

On the other hand, welding practitioners do not typically understand this reality academics face and treat papers from the "Research Supplement" of the *Welding Journal* with mild disgust. Accordingly, the chasm between the scientific elite in our industry and the majority of welding professionals tends to deepen, with many practitioners being even unaware of the existence of Technical Paper Sessions during the annual welding exhibition at FABTECH.

With so many contradictions and misunderstandings facing welding engineering education and training, a few suggested solutions to these problems follow.

## Proposed Solutions

With less than 30% of welding engineers being graduates of specialized programs at four universities as of 2012 (The Ohio State University, LeTourneau University, Ferris State University, and Weber State University) (Ref. 3), there is a need for training engineers going into welding from different areas such as mechanical, electrical, materials, and industrial engineering. This training is already being successfully performed at EWJ, at AWS conferences, etc., but is fragmented by different industry groups such as nuclear, shipbuilding, etc.

It seems that a more standardized training should be made available for engineers through the AWS using distance learning. Free copies of the NEMJET teaching modules developed in the 1990s by AWS/EWI/OSU should be made available to qualified instructors. However, The Ohio State University still holds the copyright on these NEMJET modules and a purchasing license is costly. Therefore, very few people use these excellent teaching materials. If these modules would be made available for free, they could greatly aid in teaching correct concepts. Waiving licensing fees on these modules for community college instructors would improve their re-

sources and reduce the knowledge gap between two- and four-year programs.

Finally, more face-to-face exchanges between the above communities are encouraged during the welding exhibition at FABTECH. Perhaps the AWS Foundation would sponsor a formal dinner on Sunday or Monday night of the show, with a well thought out program that would initiate collegial conversations between instructors of all levels of education and training.

## Conclusions

This paper attempts to clarify terms and apparent contradictions relevant to welding engineering from a national as well as an international perspective and 35 years of professional experience in the field. These clarifications are intended to harmonize different groups involved in teaching welding and open a candid conversation about future cooperation. As long as instructors do training and leave education to professors, there will be less misrepresentations detrimental to the welding industry overall. It would also be beneficial to have training seminars for educators to help improve their self-confidence when facing practical problems.

At the same time, the current chasm between welding practitioners and scientists should be bridged through intentional efforts such as seminars, meetings, visits, tours, etc., perhaps under the sponsorship of the AWS Foundation. Finally, free use of the NEMJET modules by all levels of college and universities would greatly improve teaching at two- and four-year colleges. ♦

## Acknowledgments

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