The Structural Engineering World in Which We Live

Metrics, reality, and a few stories

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As engineers, we continually seek to measure success by using metrics. Higher education is no exception. For example, in an effort to measure teaching effectiveness, we conduct course instructor surveys. Most certainly, within the confines of the questions asked, those surveys provide useful information during or at the conclusion of a formal course. With that said, we must put those surveys into context and seek for additional metrics, or perhaps others ways, by which we can better align ourselves with the reality of the structural engineering world within which we live. With this article, I would like to share a few of my thoughts on teaching and learning effectiveness and explore the importance of maintaining an effective teaching environment in preparing our students for the real world.

David B. Birrcher, bridge engineer, International Bridge Technologies

"The two most influential elements of the University of Texas program to me have been

- knowledge of code development, both past and current state of the art, and
- practical nature of the laboratory/research projects.

"Code knowledge is a big part of my job. I have really appreciated knowing about the origin of code provisions. It has given me confidence in applying the intent of the code when the language is not clear or when our specific circumstances are not strictly covered or even when applying codes of other countries. When changes are made to the code, it is very important for us to know.

"I work a lot in construction support and construction engineering. We have to make real-time decisions to solve construction problems. University of Texas's research program gave me experience tying reinforcement, building forms, placing concrete, stressing tendons, testing cylinders, and other skills that have helped me solve problems. Obtaining site experience is very valuable as a design engineer and can be difficult to obtain due to limited opportunities. UT's program mirrors the experience that can be gained on site and makes me a better designer as well."

As an instructor, I use a variety of formal and informal techniques to assess student learning. In an effort to structure my views on student learning, I will provide discussions in two different time scales:

- Real-time assessment of student learning
- Long-term assessment of student learning

Real-time assessment of student learning is a key component of knowledge transfer. As I explain concepts, design techniques, or expressions in my class, my number one priority is to stay connected with the class. I cannot accomplish the learning objectives of each lecture if I cannot carry the class with me throughout the classroom discussions. Often, it is possible to read the facial expressions of students. In addition, I use numerous short questions directed to the class to get real-time feedback. When I work on design examples, I engage the classroom in the solutions so that I know that they understand the key concepts. Conversely, by answering those questions and participating in the solution for the design examples, students convince themselves that they are learning what they need to learn in that class period.

Long-term assessment of student learning is just as important as the real-time assessment of student learning. Once students leave the university to face the real world, their education should help them be successful in their chosen careers and establish the foundation upon which they can build to be a leader in their field.

Often we have a reasonably good understanding of real-time assessment of learning because it is much easier for us to gauge teaching effectiveness by looking at the course instructor survey results and the like.

Dr. Robin Tuchscherer, assistant professor, Northern Arizona University

"I had a little more than four years of structural engineering work experience before going to graduate school at the University of Texas. Having professional experience beforehand was extremely helpful in the classroom because it helped me grasp the applicability of what I was learning and how it related to my recent work. This is a powerful way to learn and something I strive to share as much as possible with the students that I now teach. My work in the Ferguson Laboratory provided an additional layer of "real world" experience that helped make engineering concepts more tangible. One thing that I appreciate about the Ferguson Laboratory is that students get to do (almost) everything. This gives context to engineering details and strengthens intuition.

"After graduation, I accumulated an additional three years of structural engineering experience before returning to academia. I was a much different engineer after graduate school than before. The difference was that I had a better understanding of the basis of code provisions. Improved knowledge of the origin of code requirements has allowed me to apply them correctly, sort through the ambiguity, and more effectively assess my work."

Matthew Huizinga, associate, Thornton Tomasetti

"Upon my return to industry after graduate school, and as my career progressed further, the value of my graduate education became clearer. The greatest value was the breadth of technical and nontechnical skills developed, and the holistic approach delivered in coursework.
Coursework at the University of Texas was typically delivered as broader ideas. For example, the earthquake engineering course focused on the theory behind earthquake hazard maps, with less time spent on repetitive design calculations. As my industry design projects began to include site-specific hazard analysis, or time-history analyses, a more theoretical and broad understanding of seismicity, such as the content of my graduate coursework, was important. Similarly, I didn't encounter post-tensioned concrete until later in my career, but had a comfort level with the important design considerations. This is because the prestressed concrete course emphasized a unified understanding of concrete behavior; this was much more valuable than routine training with any specific code, design method, or software package. My graduate education granted me a large degree of flexibility in pursuing challenging professional work.

"Beyond developing practical design expertise, research participation also developed other skills: a greater understanding of proper technical writing, implementation of the scientific method, critical problem solving abilities, and practical hands-on experience. As I advanced within my company, these nonanalytical skills have become increasingly important."

Long-term assessment is much harder to assess through simple metrics. It requires following up with our students and asking what helped them transition into the real world and what must be emphasized in our program. In an effort to do just that, I contacted three former students and asked them to summarize their experience transitioning to the so-called "real world." Responses that I received from three graduates of our structural engineering program are included in the article sidebars.

The approach I took in assessing student learning with a long-term perspective is certainly not scientific nor does it involve a large number of alumni. With that said, the common threads seen in the former-student feedback tell us a story. Coupling the points articulated by the three graduates of our structural engineering program with those I have heard from dozens of other students, I am confident that some aspects of our graduate program have been serving our students well. Those aspects include

- emphasis on in-depth understanding of fundamental concepts and design codes;
- practical, hands-on experience for undergraduate and graduate students;
- breadth of our structural engineering program; and
- emphasis on technical writing.

With a strong understanding of the fundamentals and a desire to remain practical, a typical student graduating from our program faces the real world with some level of confidence. When this is coupled with a good work ethic and professional attitude, transitioning from graduate school to a typical workplace becomes easier. While I say this, I fully recognize the fact that change is never easy. However, change is what makes us grow and change is a great part of the structural engineering world in which we live.