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The ABET 'Professional Skills' - Can They Be Taught? Can They Be Assessed?

As the title indicates, this paper addresses the six ABET outcomes that comprise the professional skills – functioning on multi-disciplinary teams; understanding professional and ethical responsibilities; communicating effectively; understanding the impact of engineering solutions in global, economic, environmental and societal contexts; engaging in life long learning; and a knowledge of contemporary issues. We have tried to provide some of the historical background that led to the insertion of these skills into the ABET criteria that emerged in the mid-1990s, justify their importance and review some of the more innovative ways that they can be learned and assessed. We note that many of the original drivers - rapidly changing technology, particularly information technology, corporate downsizing, outsourcing, and globalization – continue to impact engineering education. As a result, we argue that the ability of US engineering graduates to successfully function in an increasingly “flat world” requires them to become more innovative and to truly master these six professional skills.

It is this latter issue, how engineering graduates will learn to function on a global basis that is of particular concern here. We argue that among other things, this now requires engineering educators to offer students a wide spectrum of study abroad and work abroad opportunities including the opportunity to work in cross-cultural teams, both in-country and virtual. To support this, we cite a number of innovative examples that are beginning to appear on the national scene. Our bottom line is relatively upbeat – we believe that US engineering educators are beginning to recognize the seriousness of the problem and are developing creative solutions to better enable students to acquire these skills and achieve the requisite international experiences. In addition, faculty are becoming aware of the need to assess student achievement in this area, although we stress that much remains to be done.

Since this paper is primarily an examination of current practices with some speculation about future trends, it should not be viewed as a pure research paper. However, we have attempted to provide a definitive answer to the two questions posed in the title – a “yes, but” to both – the professional skills can be taught and they can be assessed; however, there much remains to be done. Hence, the reader looking for a theoretical underpinning will not find it in this paper. What he or she will find is an extensive review of the literature (135 citations) that document why the professional skills are important and what is being done help students learn to master them.

Our data base is the increasingly rich literature that is emerging in conference proceedings, especially those of the Frontiers in Education and American Society of Engineering Education annual conferences (both of which are accessible on the web) and such archival publications and the *Journal of Engineering Education* and the *IEEE Transactions on Education*. We also relied on a large volume of research that we have conducted that has focused on one or more of these outcomes. While this paper required us to read a large body of work as we addressed these six different skills, it was helpful to begin the project with a relative strong collective body

of knowledge among the three of us.

As noted, we have qualified our positive answer to our two questions. These six skills can be mastered as part of the engineering education experience, although not necessarily in the traditional lecture format. Rather, what is required is a modern engineering education format that utilizes active and cooperative learning, recognizes differences in learning styles, and is cognizant of teaching engineering in its appropriate context. We are especially positive about an emerging learning pedagogy—service learning and its complementary component — global service learning. These provide both an opportunity and a challenge to engineering educators — to determine how to incorporate real-world experiences into the engineering curriculum while providing a valuable service for a nonprofit organization, a disadvantaged community, or a rural village in a less developed country — and to do it all without reducing academic content. If this could be done, then engineering faculty will have found a way to effectively integrate the learning of multiple outcomes into one comprehensive, educational experience. In this manner, the first, second, and third years' course work could fully support a senior-year capstone design experience that would benefit both student and community.

As to the state of assessment, we again offered a qualified yes. While elements of each skill are being assessed to varying degrees, much work left to be done. Indeed, the assessment challenge may be greater than the teaching challenge, but we are encouraged by the number of investigators who are beginning to achieve success.

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