Soft Skills in the Technology Education Classroom: What Do Students Need?

By Kara S. Harris and George E. Rogers

There is more to preparing a student to enter into a college-level program in technology or engineering than is covered by national standards.

Soft skills, such as the ability to work as a team and communication skills, are considered desirable attributes of incoming engineering and technology students at the post-secondary level.

Technology education teachers assist students in becoming technologically literate through teaching hands-on applications of technology and designing curriculum and learning activities that follow *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA, 2000/2002/2007). These standards define the content for the study of technology education in Grades K-12; however, after graduating from high school and leaving the technology education classroom, some students continue to pursue further study in technology, engineering, and related fields at the postsecondary level.

There is more to preparing a student to enter into a college-level program in technology or engineering than is covered by national standards. Students must also possess "soft skills" in order to be successful at the postsecondary level. Soft skills have been defined by various authors as personal characteristics such as: work ethics, positive attitude, social grace, facility with language, friendliness, integrity, and the willingness to learn (Bancino & Zevalkink, 2007; Coll & Zegwaard, 2006: Hmelo-Silver, 2007; Lewis, 2007; Lorenz, 2005; Lucci, 2005). Soft skills typically complement a student's hard or technical skills.

Soft skills are an integral part of careers in technology and engineering. Therefore, there is a need to include these skills in career and technical education program areas (Bancino & Zevalkink, 2007). Bancino and Zevalkink noted that:

> The more soft skills training can be integrated directly into technical training programs, the more successful the graduates will be in the increasingly demanding global economy. While some people consider soft skills the intangibles, these skills are quickly becoming a requirement that drives tangible and measurable increases in personal productivity and directly translates to sustainable competitive advantage in a global marketplace (p. 22).

Infusing these soft skills into education should begin at an early age. However, which soft skills do secondary technology education teachers need to infuse to help prepare their students for their college careers in technology or engineering? Are some soft skills considered to be more valuable at the postsecondary level than others? Coll and Zegwaard (2206) and Lorenz (2005) have indicated that a positive work ethic, a willingness to learn, a positive attitude, language proficiency, flexibility, self-discipline, and teamwork are soft skills that employers desire in college graduates. However, are these the same soft skills that university faculty desire for their incoming freshmen engineering and technology majors? The study described here was designed to help answer that question.

Research Questions

The following research questions were addressed in this study.

1. Which nontechnical competencies or soft skills related to technology education do university engineering faculty indicate should be developed by high school students?

2. Are these identified technology-education-related competencies/attributes already included in existing national K-12 technology education standards?

The ability to effectively present ideas to groups is a desired trait of incoming freshmen in post-secondary engineering and technology programs.

Methodology

This study used a three-round modified Delphi technique as noted by Paige, Dugger, and Wolansky (1996) and Wicklein (1993). Farmer (1995) indicated that the selected Delphi technique is "the most appropriate method for attaining consensus" (p. 2) from a large sample group related to student competencies. The Delphi panel for this study consisted of engineering and engineering technology professors from South Carolina State University, Clemson University, and Purdue University, as well as Project Lead The Way (PLTW) affiliate professors. Faculty from Clemson University and Purdue University were selected because of the strong engineering and engineering technology programs at those land-grant institutions. South Carolina State University was selected to insure that faculty from underrepresented groups were included. Scott, Washer, and

Demographic Descriptions of the Panel

	N = 16	
Gender		
Female	1	(6.2%)
Male	15	(93.8%)
Age level		
40 years or less	2	(12.5%)
41 to 50 years of age	6	(37.5%)
Over 51 years of age	8	(50.0%)
Educational level		
Master's	11	(68.8%)
PhD	5	(31.3%)
Years in higher education		
Less than 10 years	3	(18.8%)
11 to 15 years	3	(18.8%)
16 to 20 years	5	(31.3%)
Over 21 years	5	(31.3%)
Field of engineering		
Civil	3	(18.8%)
Electrical/Computer	3	(18.8%)
Mechanical/Industrial	4	(25.0%)
Engineering Technology	6	(37.5%)
Type of institution		
Research-intensive/Land-grant	7	(43.8%)
State/Community College	9	(56.2%)

Table 1

Wright (2006) indicated that the section of panelists should insure "individuals actively engaged in the field" (p. 47). Therefore PLTW affiliate professors were selected based on their demonstrated commitment to infuse engineering and technology into secondary education.

From this population of professors, a group of 16 agreed to participate as the panel in this Delphi study. The panel covered a range of engineering fields, including civil engineering (18.75%), electrical or computer engineering (18.75%), and mechanical or industrial engineering (25.0%), plus professors of engineering technology (37.5%). Professors from research-intensive or land-grant universities comprised 43.75% (n = 7) of the panel, while professors from smaller state colleges, technical institutes, or community colleges comprised 56.25% (n = 9) of the panel. The demographic description of the panelists can be viewed in Table 1. The same 16 panel members were used throughout the study's three rounds.

In the study's first round, the participants were instructed to identify the basic competencies that they foresee a secondary student needing in order to be successful in their college-level engineering or engineering technology program. Round one findings were then grouped into like competencies and attributes. Round two of the Delphi survey consisted of asking participants whether the competencies and attributes that emerged from round one should be included as a component of high school technology education. A four-point Likert-type scale was used for this rating, with 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree. Using the Likert-type scale was suggested for the second round of this type of study by Farmer (1999), Zargari (1996), and McCall (2001).

Nontechnical Competencies and Affective Domain Attributes

Competency/Attribute	M	SD
Students should be able to communicate effectively through writing (proper grammar).	3.89	0.33
Students should possess a high level of reading comprehension.	3.78	0.44
Students should demonstrate honesty.	3.78	0.44
Students should possess a willingness to learn.	3.78	0.44
Students should be open-minded to new concepts and ideas.	3.78	0.44
Students should demonstrate problem-solving skills.	3.78	0.44
Students should be able to follow directions.	3.78	0.44
Students should be able to communicate effectively through speech (public speaking).	3.67	0.50
Students should demonstrate a strong work ethic.	3.67	0.50
Students should demonstrate effective interpersonal communication skills.	3.56	0.53
Students should possess a high level of organizational skills.	3.56	0.53
Students should be able to effectively communicate technical data.	3.44	0.53
Students should possess a high level of computer literacy.	3.44	0.53
Students should have a basic understanding of technical terminology.	3.33	0.50
Students should understand aspects of group dynamics.	3.22	0.44
Students should be able to perform basic research.	3.00	0.53

Table 2

Round three of the Delphi study consisted of a validation of the second round findings that received a mean score of 3.00 or higher. Items that received a mean rating below M = 3.00 were not considered to be a requisite soft skill of high school technology education students. From the study's third round, 16 nontechnical competencies and affective domain attributes emerged.

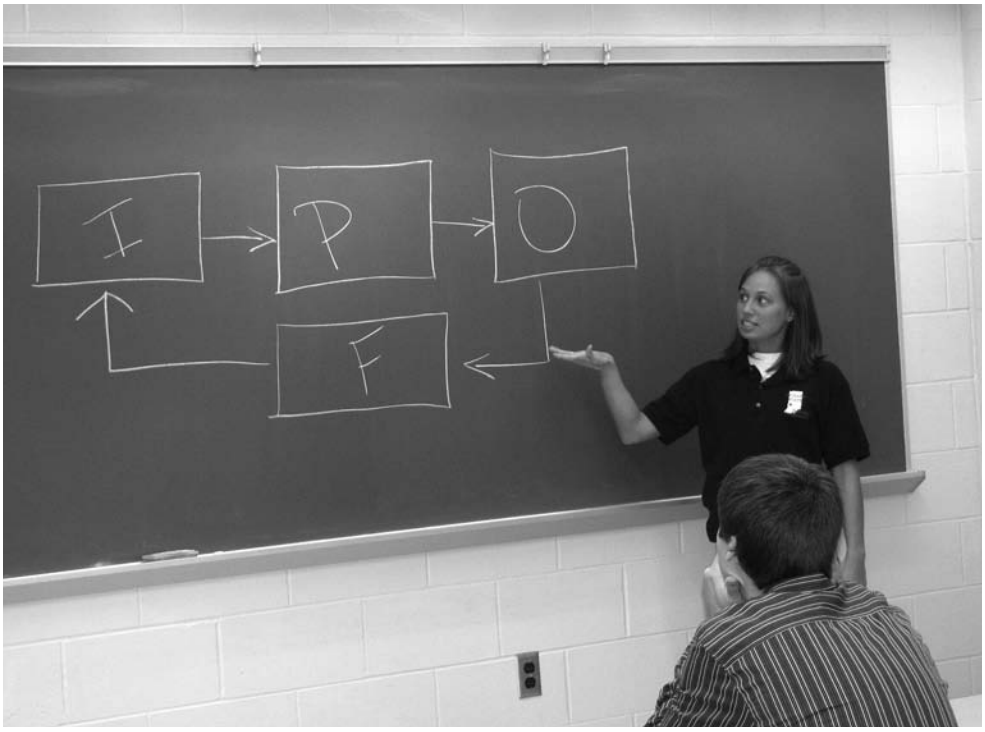
Findings

Table 2 presents the mean ratings for the 16 validated nontechnical competencies/soft-skill attributes. Eleven of these competencies were rated at a mean of 3.50 or higher. The highest rated of these soft skills was the students' ability to communicate effectively through writing (M = 3.89, SD = 0.33). Next on the ratings were students possessing a high level of reading comprehension, demonstration of honesty, a willingness to learn, being open minded to new ideas, problem-solving skills, and the ability to follow directions (M = 3.78, SD = 0.44). A student's ability to communicate effectively through speech and their demonstration of a strong work ethic were both rated at 3.67 (SD = 0.50).

Table 3 presents the soft skills that were mentioned above and how these skills align with current national standards for secondary education. It should be noted that all affective domain attributes or soft skills that participants indicated were desirable in engineering and technology students at the postsecondary level are currently being included at the secondary level by either *STL* (ITEA, 2000/2002/2007) or the *Secretary's Commission of Achieving Necessary Skills (*SCANS*): A SCANS report for America 2000* (U.S. Department of Labor, 1999). This SCANS report divided the foundation skills in to three skill sets: basic skills, thinking skills, and personal skills. In addition, some attributes are being addressed by both SCANS and *STL*; for instance, that students should demonstrate problem-solving skills, and students should be able to perform basic research.

Implications for the Technology Education Classroom

As noted by the U.S. Department of Labor (1999) and Rogers (1995), affective domain personal attributes must be a key component of any technology education program. Communication skills were also noted as an essential competency for high school graduates entering engineering or technology programs. Programs must require in their students competency in written communications, verbal communications, reading, honesty, strong work ethics, and a willingness to learn. Technology education teachers can structure a design activity that requires the students to 1) work in teams, 2) organize their thoughts, 3) communicate with team members, 4) solve a problem, 5) present their findings orally, and 6) evaluate their success through a written document. This type of learning activity should also cause students to work outside of their comfort zone, thereby stretching soft-skill development. These types of problem-based learning activities should also be formulated across discipline lines and must be an essential and integrated expectation from day one through graduation and beyond.



The ability to effectively present ideas to groups is a desired trait of incoming freshmen in post-secondary engineering and technology programs.

Competency/Attributes and their Corresponding National K-12 Standards

Competency/Attribute	Standard
Students should be able to communicate effectively through writing (proper grammar).	SCANS: *Foundation Basic Skills Writing*
Students should possess a high level of reading comprehension.	SCANS: *Foundation Basic Skills Reading*
Students should demonstrate honesty.	SCANS: *Foundation Personal Qualities Integrity/ Honesty*
Students should possess a willingness to learn.	SCANS: *Foundation Thinking Skills How to Learn*
Students should be open-minded to new concepts and ideas.	SCANS: *Foundation Personal Qualities Sociability*
Students should demonstrate problem-solving skills.	*STL*: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. SCANS: *Foundation Thinking Skills Problem Solving*
Students should be able to follow directions.	SCANS: *Foundation Basic Skills Listening*
Students should be able to communicate effectively through speech (public speaking).	SCANS: *Foundation Basic Skills Speaking*
Students should demonstrate a strong work ethic.	SCANS: *Foundation Personal Qualities Responsibility*
Students should demonstrate effective interpersonal communication skills.	SCANS: *Foundation Basic Skills Listening* SCANS: *Foundation Basic Skills Speaking*
Students should possess a high level of organizational skills.	SCANS: *Foundation Personal Qualities Self Management*
Students should be able to effectively communicate technical data.	SCANS: *Foundation Basic Skills Writing*
Students should possess a high level of computer literacy.	*STL*: Students will develop the abilities to use and maintain technological products and systems. *STL*: Students will develop an understanding of and be able to select and use information and communication technologies.
Students should have a basic understanding of technical terminology.	*STL*: Students will develop an understanding of the core concepts of technology.
Students should understand aspects of group dynamics.	SCANS: *Foundation Personal Qualities Social*
Students should be able to perform basic research.	SCANS: *Foundation Personal Qualities Reasoning* *STL*: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Table 3

In addition, Bancino & Zevalkink (2007) suggested using real-world examples that are directly related to the field of technology to help integrate soft skills into the technology education curriculum. Using these real-world examples will aid in getting individuals who are "more linear-thinking" or have "task-oriented personalities" involved in the incorporation of soft skills into the classroom.

Conclusions

The results of this study clearly indicate that university-level engineering and engineering technology professors rate students' interpersonal, communication, and work ethic competencies as desired attributes in students entering into postsecondary engineering and technology programs. Similarly Rogers (1995) noted that "instructors perceived the affective domain competencies as more important benefits of technology education programs than competencies in the cognitive or psychomotor domains" (p. 68). These affective domain competencies and communication skills therefore need to be a vital component of the high school technology education program.

This study's findings also support the U.S. Department of Labor (1999) report *Skills and tasks for jobs: A SCANS report for America 2000.* The U.S. Department of Labor noted foundation skills like responsibility, honesty, reading, problem-solving, and writing were essential for high school students to develop.

References

Bancino, R. & Zevalkink, C. (2007). Soft Skills: The new curriculum for hard-core technical professionals. *Techniques, 82*(5), 20-22.

Coll, R. & Zegwaard, K. (2006). Perceptions of desirable graduate competencies for science and technology new graduates. *Research in Science and Technological Education, 24*(1), 29-58.

Farmer, E. I. (1995). *A Delphi study of tech prep initiatives in higher education: Research priorities in teacher education*. State College, PA: The Pennsylvania State University. (ERIC Document Reproduction Service ED 392471).

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark. (2006). *Educational Psychologist, 42*(2), 99-107.

International Technology Education Association. (2000/2002/2007). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

Lewis, C. D. (2007). Get ready, get set, get to work! *Techniques, 82*(5), 18-19.

Lorenz, K. (2005). *What are soft skills?* Retrieved September 26, 2007, from http://msn.careerbuilder.com/Custom/MSN/CareerAdvice/532.htm.

Lucci, W. (2005). Stafford Technical Center: Designing a future for architects and builders. *Tech Directions, 64*(6), 14-16.

McCall, C. H. (2001). *An empirical examination of the Likert scale: Some assumptions, development and cautions*. Paper presented at the annual meeting of the CERA Conference, South Lake Tahoe, CA.

Paige, W. D., Dugger, J. C., & Wolansky, W. D. (1996). Essential components of doctoral program for industrial technology education. *Journal of Technology Studies, 22*(2), 15-20

Rogers, G. E. (1995). Technology education curricular content: A trade and industrial education perspective. *Journal of Industrial Teacher Education, 32(*3), 59-74.

Scott, D. G., Washer, B. A., & Wright, M. D. (2006). A Delphi study to identify recommended biotechnology competencies for first-year/initially certified technology education teachers. *Journal of Technology Education, 17*(2), 44-56.

U.S. Department of Labor. (1999). *Skills and tasks for jobs: A SCANS report for America 2000.* Washington, DC: Author.

Wicklein, R. C. (1993). Identifying critical issues and problems in technology education using a modified Delphi technique. *Journal of Technology Education, 5*(1), 54-71. U.S. Department of Labor. (1999). *Skills and tasks for jobs: A SCANS report for America 2000*. Washington, DC: Author.

Zargari, A. (1996). Survey results guide total quality management (TQM) course development in industrial technology. *Journal of Technological Studies, 22*(1), 60-61.

Kara S. Harris *is an assistant professor at Indiana State University in Terre Haute, Indiana. She can be reached via email at kharris28@isugw.indstate.edu.*

George E. Rogers *is a professor at Purdue University in West Lafayette, Indiana. He can be contacted at rogersg@purdue.edu.*

This is a refereed article.