Technology and Engineering Education Doctoral Students' Perceptions of Their Profession

By Gene Martin, John Ritz, and Michael Kosloski

ABSTRACT

The growth and vitality of both technology and engineering education professions rely on the quality of contributions of its new and emerging leaders. Many of these leaders are currently enrolled students in doctoral programs. These students will be challenged to assume leadership roles in which they are not currently engaged (Ehrenberg, Jakubson, Groen, So, & Price, 2007). Some students may choose to focus their careers in developing new curricula; some will become active in grant writing and grant procurement; some will choose to serve as officers in their professional organizations; and others will contribute to the body of literature in their discipline. Wherever these future leaders decide to focus their efforts, they will likely have an impact on their profession. This study reports on currently enrolled doctoral students' perceptions related to the focus of content taught in formalized K-12 technology and engineering education programs, methods used to prepare future technology and engineering teachers, characteristics of their planned professional involvement, and future forecasting for their school subject. This is the second study by the authors focusing on doctoral students' perceptions.

Key words: Doctoral Students, Perceptions, Professions, Technology and Engineering Education

INTRODUCTION

University faculty work to pass on knowledge of their disciplines and some add to this knowledge through research and development activities. This amalgamation of knowledge is a result of synthesizing one's own ideas, others' ideas, and concepts generated through practice and research. Universities that offer doctoral degrees educate students in best research practices, as well as the knowledge of their disciplines. These same university professors also mentor doctoral students as they guide them through their classes and research projects. Some faculty have expectations that students will present at conferences, write professional papers, and become active members within the professions that operate to support their disciplines (Campbell, Fuller, & Patrick, 2005; Wright, 1999).

In the area of technology and engineering education, there are fewer programs for the preparation of teachers and university faculty (Moye, 2009; Ritz & Martin, 2013). New doctoral students have many tasks ahead of them as they graduate and move into professorships. One area of their work will be to recruit and teach students to become future teachers. Depending upon their employment (e.g., research universities), some will be required to design and undertake an active research agenda. In this task, they will develop research proposals for funding and publish manuscripts on the data they collect. Depending on whether they are employed with a teaching or a research university, some will provide service to school systems, their K-12 state departments of education, and state and national professional associations.

The content for technology education, now called technology and engineering education, emerged from ideas considered in the 1940s that translated to the knowledge that needed to be taught to students, so they might achieve technological literacy (DeVore, 1968; International Technology Education Association [ITEA], 2000; Warner, 1947). With ideas and research produced through the National Center for Engineering and Technology Education (Householder & Hailey, 2012), and the research and development efforts of others, engineering content and processes have moved into the technology and engineering curriculum. In addition, STEM educational reform has added additional attention to science and mathematics within technology and engineering curriculum and instruction (Banks & Barlex, 2014).

With the reformulation of the content for K-12 technology and engineering education, a change has occurred in the focus of activities taught in this school subject. Projects made from templates have been replaced with open-ended design problems where engineering design is the focal point of instruction. Along with the development of new content and instructional practices, changes are emerging in how future teachers will be prepared. Digital technologies now allow courses to be delivered online using various instructional delivery methods.

Professional associations that support the teaching of K-12 programs are also changing. How are associations meeting the needs of professionals teaching technology and engineering education? Will associations also change as the content, methods, and the delivery of teacher education programs change within our school subject? How will new Ph.D.s provide leadership to these organizations as they professionally mature in the 21st century? This research seeks answers to questions of those educators who should emerge as the new leaders of the professions for technology and engineering education. The researchers wanted to further explore the perceptions of current doctoral students in technology and engineering education to determine their views on the content and methods that will be used to deliver K-12 education, strategies to be used to prepare future teachers, if and where they plan to publish, and if they plan to take on an active role in service to their professions.

RESEARCH PROBLEM

This study seeks to identify and provide a better understanding of the perspectives of graduate students currently seeking the doctoral degree on the future of the K-12 school subject of technology and engineering education and the professions that aid in guiding its practice. It was guided by the following research questions:

RQ_1: What are doctoral students' opinions concerning the focus of content to be learned in K-12 technology and engineering education?

RQ_2: How do these scholars believe technology and engineering teachers will be prepared in the near future?

RQ_3: What is the commitment level of these scholars to their technology and engineering teaching professions?

RQ_4: What does this population expect to happen in the future to the technology and engineering teaching professions?

LITERATURE REVIEW

Literature related to doctoral education, professionalism and professional associations, and the future of professional education associations will be reviewed to provide the reader with a context for understanding the purpose of this study.

Doctoral Education

Debate exists regarding a singular specific purpose of doctoral education, although most descriptions share overlapping characteristics. Though a broad common ground is that doctoral education is intended for the formation of scholars (Walker, Golde, Jones, Bueschel, & Hutchings, 2008), discussion exists concerning the differences between professional and Ph.D. doctorates, how they will be used once completed, and in what type of setting (Neumann, 2005; Sweitzer, 2009; Walker et al., 2008). Although it may vary from field to field, a traditional viewpoint of a Ph.D. is that it primarily prepares scholars to conduct research in an academic setting (Boyce, 2012; Ehrenberg et al., 2007; Shulman, Golde, Bueschel, & Garabedian, 2006). At the other end of the spectrum, a traditional viewpoint of a professional doctorate is that it prepares practitioners who integrate scholarship in applied decision-making (Campbell, Fuller, & Patrick, 2005). Others posit that research theory and applied, practical scholarship should not be examined separately (Evans, 2007; Walker et al., 2008).

Some of the commonalities in most descriptions of doctoral education are that such programs are intended to develop citizens who are technical experts in their fields, contribute knowledge to their respective fields, and also contribute to their profession (Shore, 1991; Walker et al., 2008). In a five-year study sponsored by the Carnegie Initiative on the Doctorate, Walker et al. (2008) developed three broad-based categories in which all competent doctoral programs should be founded. First, doctoral education should provide scholarly integration, which includes not only basic research, but also integrative research and teaching. Walker et al. (2008) and Golde (2007) determined that because approximately one-half of Ph.D.s find careers in higher education, teaching is also an element that should be an integral part of doctoral education.

The second element consistent among doctoral programs is that they develop a sense of intellectual community, which includes the development of a culture within a program and the profession. In other words, it helps to identify one's professional identity and fosters a continuous exchange of ideas in the development of new knowledge (Gardner, 2010; Walker et al., 2008). The third intended purpose of doctoral education is to develop stewards of their professions. Completers are expected to consider uses and applications of their work in their respective fields and exercise responsible application of their knowledge, skills, and principles (Evans, 2007; Walker et al., 2008).

Professionalism and Professional Associations

Professional associations exist for the purpose of supporting and enhancing individuals and groups within their respective professions. However, although members of such associations are bound by a common profession in broad terms, individual members' professional roles may vary widely, posing a challenge for associations to serve all of their members in the same way (Berger, 2014; Jacob et al., 2013). Professional associations, regardless of individual differences among their members, work to unite individuals toward a common purpose and provide the members with a sense of belonging (Patterson & Pointer, 2007).

In the field of education, Berger (2014) believes that professional associations provide leadership for the field, professional development, advocacy, and resources. Jacob et al. (2013) identified a key role in providing specialized networking and collaborative opportunities, facilitating individual interaction, the exchange of ideas, and intellectual growth within a chosen profession. In a study of nursing professionals, Esmaeili, Dehghan-Nayeri, and Negarandeh (2013) identified the purpose of professional associations to include professional support, legislative advocacy, contending with professional problems, and providing clear explanations of their objectives. Patterson and Pointer (2007) stated that associations unite individuals with a common purpose, promote the profession, advocate on behalf of the profession, and offer numerous miscellaneous benefits to its members. Another key role identified is the cultivation of future leadership, as many professional associations are challenged in maintaining both leadership and membership (Shekleton, Preston, & Good, 2010). Blaess, Hollywood, and Grant (2012) held that effective leadership begets membership and growth. Though there are many varying descriptions for the purposes and benefits of professional organizations, some of the common threads among them are mentoring, leadership development, advocacy, and scholarship.

Professional organizations provide benefits to their constituencies in line with their purpose and mission. For example, an effective professional organization nurtures a culture whereby information is evaluated and shared throughout the organization and the profession (ASAE & the Center for Association Leadership, 2006). They tend to foster a sense of community and provide opportunities for professional collaboration, both formally and informally (Jacob et al., 2013). This type of collaboration allows individuals to better internalize not only the nature of their respective fields, but also allows them to congregate with others who share similar specific interests within that field (Berger, 2014). ASAE & The Center for Association Leadership (2006) identified seven benefits of successful professional associations, categorizing each of those benefits into one of the following categories: a sense of purpose, a commitment to analysis and feedback, and a commitment to action. Schneider (2012) studied the importance of the concept of social capital, which he described as aiding membership into understanding that associations and professions have their own unique culture that is dependent on "reciprocal, enforceable trust that develops over time" (p. 205).

Future of Professional Education Associations

As has been noted, professional associations exist to support the development of those who practice in professions. There are associations for most occupations (e.g., professional organizations and unions), and many people who advocate for individual groups (e.g., disabled persons, retired people, sport teams). Some individuals learn of these organizations from family members, teachers, and professors. *Professions* are defined as a collection of self-selected, self-disciplined individuals (professionals) who share a common identity and characteristics. The common "thread" of a profession as used in this study is a collection of individuals who identify themselves with furthering the mission of the technology education school subject (technology education, technology and engineering education, design and technology, etc.).

Professional organizations exist to support the aspirations of members. Some reasons for establishing professional organizations include (a) tackling professional problems, (b) attempting to increase the power of legislative authorities, and (c) clearly explaining their objectives for enhancing organizational power (Esmaeili, Dehghan-Nayeri, & Negarandeh, (2013). Phillips and Leahy (2012) believed professional associations (a) provide for the professional development for their members, (b) set standards for educational practice, (c) organize and host forums on issues important to the members, and (d) attempt to unify political action campaigns to better position the profession. These reasons closely align with the purposes of organizations that support technology and engineering professions (Epsilon Pi Tau, 2013; ITEEA, 2011).

Professional education organizations also debate the changing content and roles of their school subjects. Ritz and Martin (2013) found that new doctoral students consider professional associations as platforms for publishing (in their journals), as providing opportunity to make presentations at international conferences, and as providing professional development opportunities. However, the group studied by Ritz and Martin projected that only 37.5% of the new Ph.D.s would participate in leadership roles in teacher education professional organizations.

Martin (2007) explained the decline in memberships in professional associations. He noted that 9/11 and the resulting effect of tightened organizational budgets have contributed to membership declines. This is especially true of education organizations. The economic decline that began in 2008 has kept K-12 teachers away from conferences, because school systems do not have the funds to support teachers' absences (paying for substitute teachers). In addition, school systems do not have budgets to support teachers and administrators who want to attend conferences. Ritz and Martin's (2013) study found that new Ph.D.s do not see themselves holding leadership positions in professional organizations. Mellado and Castillo (2012) found low levels of satisfaction when the organization's performance has kept some members from choosing to participate in leadership roles. Could it be that new Ph.D.s see slippage in the contributions that these associations have made to members as a reason why they elect not to lead? Do they feel that too much investment of time and effort would be required to "right the ship"?

Although new Ph.D.s do not seek to lead, they do see professional organizations providing "specialized networking and development opportunities to a specific profession, group of individuals or field of study" (Jacob et al., 2013, p. 141). They perceive networking as contributing to their recognition and making partnerships in developing ideas and furthering research agendas. They consider such opportunities as important to their development to achieve tenure and promotion in higher education. However, if these highly educated technology and engineering teacher education students do not seek leadership positions in professional associations, who might fill these voids? This study seeks to provide a better understanding of current doctoral students and their perceptions of the technology and engineering education professions.

RESEARCH DESIGN

The survey method is a quantitative non-experimental research design selected by the researchers for this study. A potential internal threat to validity in survey research is attitudes of subjects. The researchers addressed this threat using a nomination process to select their sample. Lead professors at selected universities were contacted and asked to nominate currently enrolled Ph.D. students for the study. Thus, a purposeful sample of nominated technology/ engineering education students became the population for the study. Though the researchers did not attempt to generalize the results of their study to a larger population, they believe that a potential threat to external validity of population generalizability is addressed because the purposeful sample is or very closely resembles the actual population of Ph.D. students. The value of conducting survey research is widely supported in the literature. McMillan and Schumacher (2010) described survey research as a method that is used to "learn about people's attitudes, beliefs, values, demographics, behavior, opinions, habits, desires, ideas, and other types of information" (p. 235). Clark and Creswell (2010) referred to survey research as a method to "determine individual opinions" and a way to "identify important beliefs and attitudes of individuals at one point in time" (p. 175). McMillan (2012) underscored the popularity of survey research because of its "versatility, efficiency, and generalizability" (p. 196). Creswell (2012) addressed the advantage of using cross-sectional survey designs because they have the "advantage of measuring current attitudes or practices" (p. 377).

PROCEDURES

The researchers administered a structured 12-question survey that also contained 5 additional demographic questions. The survey was administered anonymously using a web form in October 2013 with one additional follow-up letter sent to invitees. In the letter of invitation to participate, the researchers assured the invitees that (a) their individual responses would not be identifiable by a participant's name, (b) their participation was voluntary (e.g., lead professors who nominated them would not know if they accepted the invitation to participate in the study), and (c) there were no direct benefits to them by participating in the study. When the researchers received a confirmation from the invitees who were willing to participate, they were sent a URL to complete the survey. Thirty-four invitees ($N = 34$) responded that they wished to participate in the study, and all 34 invitees completed the survey for a 100% response rate. The total elapsed time from the initial letter of invitation to their completion of the survey was approximately two weeks.

The researchers followed best practices in designing the survey instrument, including making several assumptions about the participants prior to commencing their study. These assumptions included but were not limited to the following:

1. Participants were capable of identifying the focus of content to be learned in K-12 technology and engineering education.
2. Participants were capable of identifying the way technology and engineering teachers will be prepared in the near future.
3. Participants were capable of expressing their commitment level to the technology and engineering teaching profession.
4. Participants were capable of identifying what they believe will occur in the future to the technology and engineering teaching profession.

FINDINGS

The participants comprised a purposeful sample of Ph.D. students (N = 34) who are currently pursuing their degree in technology education/engineering education. Lead professors at five universities that offer the doctoral degree in technology/engineering education nominated the participants. (Lead professors at two other universities were invited to nominate participants but declined due to a lack of Ph.D. students in their programs.) Lead professors at North Carolina State University, Old Dominion University, The University of Georgia, Utah State University, and Virginia Polytechnic and State University nominated the participants.

Data were collected from 34 participants' responses to a 12-question survey. The participants consisted of 16 females (47.1%) and 18 males (52.9%). For purposes of this study, the researchers used the following categories for collecting data on participants' ages: 20-30 years, 31-40 years, 41-50 years, 51-60 years, and 61+ years. The participants reported their primary area of interest as being post-secondary grades ($n = 15$; 44.1%). When asked to identify their current position, the participants were predominantly classroom teachers ($n = 14$; 41.2%). Two participants chose not to identify their current position. Finally, all participants identified the United States as their home country and all were studying in the United States. A summary of the analyses of the demographic data is provided in Table 1. The following narrative reports on data that relate directly to the four Research Questions addressed in this study. The reported data are also presented following the same categories used in the survey – Part 1 and Part 2. Data collected for Part 1 focused on

Research Question 1 and data collected for Part 2 focused on Research Questions 2, 3, and 4.

Part 1

Part 1 of the survey contained four questions and, as previously noted, Part 1 focused entirely on Research Question 1. The participants were first instructed to respond to the question: "What should be the focus of content taught in formalized kindergarten (primary) through high school (secondary) technology and/or engineering education programs." The participants were instructed to "select all that apply" from a menu containing five possible choices: technological literacy, workforce education, design technology/engineering design, STEM integration, and other. STEM integration was selected most often (n = 27; 81.8%) by the participants, followed by design technology/engineering design (n = 23; 69.7%), and Technological Literacy (n = 21; 63.6%). In addition, workforce education was selected 9 times (27.3%). No participant selected "other" as his or her choice. One participant did not answer this question.

Once the participants identified the "focus of content," the researchers directed them to consider the topic of instructional strategies by posing the following question: "What should be the focus of instructional strategies used in formalized kindergarten through high school technology and/or engineering education programs?" Once again, the participants were instructed to select "all that apply" from a menu containing five choices: project-based activity, design-based/engineering design-based activity,

Table 1: *Population Demographics*

Demographic	Selection	Number	Percent
Gender (n = 34)	Female	16	47.1
	Male	18	52.9
Age (n = 34)	20-30	8	23.5
	31-40	10	29.4
	41-50	8	23.5
	51-60	8	23.5
	61+	0	0.0
Area of Professional Interest (n = 34)	Primary/Elementary	5	14.7
	Middle School	5	14.7
	High School	9	26.5
	Post-Secondary	15	44.1
Current Position (n = 32)	Classroom Teacher	14	41.2
	Supervisor	3	8.8
	Teacher Educator	3	8.8
	Private Sector	2	5.9
	Full-Time Student	10	24.9

Note: N = 34. Two respondents chose not to answer the demographic question related to current position.

contextual learning, conceptual learning, and other. Design-based/engineering design-based activity was selected most often (*n* = 28; 82.4%) by the participants, followed by project-based activity (*n* = 24; 70.6%), contextual learning (n = 23; 67.6%), and conceptual learning (*n* = 20; 58.8%). No participant selected "other" as his or her choice.

"Who should be the primary audience for a formalized instructional program in technology and/or engineering education?" is a question that has been addressed by those in the profession for years, if not decades. This specific question directed participants to identify the primary audience while also being instructed to "select only one" possible audience from the following: (a) elementary aged/primary grade students, (b) middle grades (6-8) aged students, (c) high school students, (d) secondary students (middle grades and high school), (e) post-secondary students, and (f) "all of the above identified populations." The participants clearly believe the primary audience should be "all of the above identified populations" (*n* = 20; 58.8%). The next highest response category was secondary students (*n* = 6; 17.6%).

Technology and engineering educators stay abreast of the results of research conducted by others in their discipline by reading articles in professional journals. The final question in Part 1 focused on determining which professional publications they regularly read. A total of 20 publications were identified by the participants and those most often read were *Technology and Engineering Teacher* (*n* = 22), *Journal of Technology Education* (*n* = 15), *Journal of Engineering Education* (*n* = 6), *Prism* (*n* = 5), *Journal of Technology Studies* (*n* = 4), *Techniques* (*n* = 4), *International Journal of Design and Technology* (*n* = 4), and *Children's Journal of Technology and Engineering Education* (*n* = 4). Their responses reveal several insights into the reading interests of this emerging group of professionals. First, engineering journals (*Journal of Engineering Education* and *Prism*) are being read by Ph.D. students. Second, the *Technology and Engineering Teacher* continues to gain their attention because it was identified most often among the journals they read. Interestingly, this journal is considered a practitioner's journal, not a research journal. Third, the *Journal of Career and Technical Education*, published by the Association for Career and Technical Education (ACTE), once considered a staple in every technology education professional's library, now holds little value to this group of readers. Yet, *Techniques*, also published by ACTE, which purports on its website to bring its readership news about legislation affecting career and technical education and in-depth features on issues and programs, gains the attention of these Ph.D. students. Table 2 summarizes data on doctoral students' perceptions regarding current activities within the technology and engineering education profession.

Part 2 of the survey consisted of eight questions that focused on finding answers to Research Questions 2, 3, and 4. The first three questions in Part 2 addressed Research Question 2. In order to maintain a critical mass of classroom teachers who will teach in the technology and engineering instructional programs, students (future teachers) must be prepared to become classroom teachers. Participants were first instructed to identify the primary characteristic that best describes how technology and engineering students will ultimately become classroom teachers. In addition, they were directed to "select only one" possible characteristic from the following list of characteristics: (a) 4- or 5-year campus-based program, similar to what is most prevalent today in higher education; (b) a discipline degree followed by a teaching diploma (license) taking 4 or 5 years to complete; (c) documenting academic qualifications through professional testing; (d) a combination university-school-based program, and (d) other. The characteristic with the highest reported frequency was a discipline degree followed by a teaching diploma (license) taking 4 to 5 years to complete (*n* = 15; 44.1%) with the characteristic of a combination university-school-based program being the second most frequently selected characteristic (*n* = 13; 38.2%).

The researchers then instructed the participants to identify "where" this education/qualification will be received. The participants were instructed to "select all that apply" from a menu containing six possible choices. Clearly, the participants believe hybrid systems that involve blended methods of instructional delivery, including campus and distance learning will be the delivery of choice (*n* = 30; 93.8%). It also is

Table 2: *Part 1, Current Activity within the Profession*

Item	Selection	Number	Percent
1. Content for K-12 T/E ed. (*n* = 33)	Technological Literacy	21	63.6
	Design Technology/ Engineering Design	23	69.7
	STEM Integration	27	81.8
	Workforce Education	9	27.3
2. Focus of Instructional Strategies (*n* = 34)	Project-based	24	70.6
	Design-based	28	82.4
	Contextual	23	67.6
	Conceptual	20	58.8
3. Primary Teaching Audience (*n* = 34)	Elementary School	1	02.9
	Middle School	5	14.7
	High School	1	02.9
	Secondary School	6	17.6
	Post-Secondary School	1	02.9
	All Levels	20	58.8
4. Journals Regularly Read (*n* = 29)	*Technology and Engineering Teacher*	22	64.7
	Journal of Technology Education	15	44.1
	Journal of Engineering Education	6	17.6
	PRISM	5	14.7
	Journal of Technology Studies	4	11.8
	Techniques	4	11.8
	International Journal of Design and Technology Education	4	11.8
	Children's Journal of Technology and Engineering Education	4	11.8

Note: *N* = 34. These numbers exceed the N value and 100%, since respondents could select more than one choice for these questions.

clear that participants had an interest in two other choices provided in the survey: brick and mortar university classroom/laboratories (*n* = 15; 46.9%); and via distance learning technologies (*n* = 10; 31.3%).

Professional development of educators at all levels continues to be a growing concern among educators, administrators, and professional association members. The researchers sought to determine the participants' perceptions of "who" will be the service providers of professional development activities. The participants were instructed to "select all that apply" from a menu containing six possible choices with the sixth choice being "other." However, no participant selected the other category. Teacher education institutions received the highest frequency of responses (*n* = 26; 78.8%), followed by professional associations (*n* = 23; 69.7%), distance learning providers (*n* = 18; 54.5%), and national/regional/district supervisors (*n* = 17; 51.5%). The remaining choice (commercial vendors) recorded the lowest frequency (*n* = 10; 30.3%).

The researchers explored the participants' "commitment" to their profession through a series of four questions that addressed Research Question 3. First, the lifeblood of professional associations comes about through people who choose to hold membership and participate in an association's plan of work. Participants were instructed to identify the professional technology and engineering education associations that they would be members of in 2025. They were instructed to "select all that apply" from a menu containing eight possible choices. No participant selected the eighth and final choice, which was "other." Even though the possible choices represented a breadth of associations that serve the technology and/or engineering education professions, the International Technology and Engineering Educators Association recorded the highest frequency (*n* = 30; 90.9%) among the participants, followed by STEM associations (*n* = 21; 63.6%), American Society for Engineering Education (*n* = 20; 60.6%), and national- and state-level technology and engineering associations (*n* = 19; 57.6%). The participants gave little attention to the European Society for Engineering Education (*n* = 1; 3.00%) and the Design and Technology Association (*n* = 1; 3.00%) as both associations' primary membership service areas are outside the United States.

Another measure of the participants' commitment to their profession is identified by professional conferences they will be regular attendees in 2025. The participants were instructed to "select all that apply" from a menu containing eight possible choices. No participant selected the eighth and final choice, which was "other." Though the possible choices represented a breadth of professional conferences that serve the technology and engineering education professions, the International Technology and Engineering Educators Association recorded the highest frequency/percent (*n* = 26; 81.3%) among the participants followed by national/regional/state level technology and engineering conferences (*n* = 20; 62.5%), and the American Society for Engineering Education conference (*n* = 16; 50.0%). Few participants envisioned attending conferences sponsored by the Design and Technology Association (*n* = 1; 3.1%), Pupil's Attitudes Toward Technology (*n* = 7; 21.9%), Technology Education Research Conference (*n* = 4; 12.5%), and Pacific Rim Technology Education Conference (*n* = 1; 3.1%). It is understandable why these four international conferences might have a low frequency rate as they are typically hosted in countries other than the United States.

Professional publications provide a scholarly venue for professionals to report the findings of research investigations. When technology and engineering educators publish in refereed publications they are, among other things, extending or adding to the body of knowledge in this discipline. The researchers' goal was to determine if the participants planned to publish in the future (presumably after being graduated with the Ph.D.) and if so, in which journals they would be seeking to publish their manuscripts. The participants were instructed to "select all that apply" from a menu containing eight possible choices. No participant selected the eighth and final choice, which was "other." It is clear that our Ph.D. students plan to publish in what may be thought of as traditional United States-based technology education journals – *Technology and Engineering Teacher* (*n* = 27; 84.4%) and *Journal of Technology Education* (*n* = 27; 84.4%). The *International Journal for Technology and Design Education* was selected by 11 (34.4%) participants. A review of their responses to this question and their previously reported responses to the question related to the publications they read most often reveals that though they read engineering-related journals (e.g., *Journal of Engineering Education* and *Prism*), they do not plan to publish in those journals in the future. (See Table 3 for a listing of the most often identified journals that they plan to read and publish manuscripts in the future.)

Finally, the participants were instructed to project to the year 2025 and identify their planned involvement in their professions. They were directed to either check that they would or would not be contributing professionally to technology and engineering education organizations. In addition, if they planned to be active in professional organizations, they were instructed to explain their planned involvement. Clearly, participants (n = 30; 88.2%) plan to be actively involved in their professional organizations, while four (11.8%) participants indicated they would not be actively involved. It remains unclear why four participants would not be contributing members.

"What do you see happening to the technology and/or engineering education profession by the year 2025?" was the final question posed to the

Table 3: *Currently Read and Plan to Publish Manuscripts*

Journal	Currently Read Number	Percent	Plan to Publish Manuscript Number	Percent
Technology and Engineering Teacher	22	64.7	27	84.4
Journal of Technology Education	15	44.1	27	84.4
Journal of Engineering Education	6	17.6	0	00.0
PRISM	5	14.7	7	21.9
Techniques	4	11.8	0	00.0
Journal of Technology Studies	4	11.8	5	15.6
International Journal of Design and Technology Education	4	11.8	11	34.4
Children's Technology and Engineering Journal	4	11.8	0	00.0
Design and Technology Education	0	00.0	6	18.8

Note: N = 34. Respondents could have more than one response to questions posed.

participants to address Research Question 4. Participants were instructed to "select only one of the following" choices: (a) the profession will look very similar to what it looks like today, (b) the profession as we know it today will be integrated in a STEM organization, (c) the profession will be integrated into the science profession, and (d) technology and engineering education will disappear as a teaching profession. Clearly, the participants believe the profession will be integrated into a STEM organization (n = 30; 88.2%) and only two (5.9%) participants believe the profession will look very similar to what it looks like today. Will the profession disappear by the year 2025? Only one (2.9%) participant believed the profession would no longer exist in 2025.

SUMMARY

What did the researchers learn from undertaking this study? Data show that efforts to bring engineering design and STEM principles into the technology and engineering curriculum are now reshaping the content focus for this school subject. These shifts are evident in courses colleges and universities are now offering, publications shared among professionals, and presentations delivered at professional association meetings. This leads educators to ask if the focus of our curriculum and profession will move closer to the engineering or science disciplines in the near future. If this direction is sought, teacher preparation will also need to be transformed. How might new and existing teachers be prepared? Because conference expenses are critical to all school systems' budgets, will distance learning become the modality to update the knowledge and practices of this profession's teachers? With fewer universities and faculty available to provide professional development enrichments for practicing teachers, distance-learning technologies might provide a practical way of learning.

The professional commitment level of current doctoral students is high. This group is committed to the technology and engineering professions. Many plan to become teacher educators. They plan to publish, to attend and present at professional meetings, and to become leaders in their professional organizations. However, what will the profession they plan to lead look like in the future? Many envision moving technology and engineering education practices into engineering, science, or STEM educational communities, where they see themselves practicing their profession. This might change the focus and nature of the technology and engineering education professions. As this study has shown, future leaders are analyzing the content and delivery of technology and engineering concepts for K-12 populations. Time will provide evidence of how this group might reshape our professions in the near future.

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