TETe feature article

UMES graduate students Derrick Krumholtz, Neddie Guthrie, Chris Clancy, and Dawn Shuster review ITEEA standards books.

Standards for Technological Literacy revision survey: preliminary results

The STL standards were written twenty years ago based on then current technologies. In 2019, ITEEA initiated a plan to revise STL, and an ITEEA 2018 survey was part of that process.

by Thomas Loveland, DTE

Introduction

The International Technology and Engineering Educators Association is making plans to revise *Standards for Technological Literacy: Content for the Study of Technology* (*STL*) (ITEA/ITEEA, 2000/2002/2007). Technology and engineering content and practices have changed measurably since *STL* was first published almost 20 years ago. In the last few years, the *Technology and Engineering Teacher* journal debated this in three special issues: "Who Are We?" in December/January 2017, "Computational Literacy" in December/January 2018, and "*Standards for Technological Literacy*" in April 2018. In order to provide direction to the process of revision, ITEEA conducted a survey in fall of 2018 find out if there was consensus on whether and how to update the technological literacy standards to include content that will most effectively prepare students for tomorrow's known and unknown challenges. ITEEA's Council on Technology and Engineering Teacher Education (CTETE) is taking the lead in bringing together leaders from the field this summer to do this important work, some of which will be based on the results of the national survey.

Standards for Technological Literacy

In 2000, ITEA released *Standards for Technological Literacy, Content for the Study of Technology*, with K-2, 3-5, 6-8 and 9-12 benchmarks to be implemented in technology education curriculums and content. The major categories for the standards are:

- Nature of Technology
- Technology and Society
- Design
- Abilities for a Technological World
- The Designed World

Twenty standards were covered in these five categories, all based on what was relevant in the late 1990s and foundational curriculum work done in the Maryland Plan, Jackson's Mill, Industrial Arts Standards Project, and others. Two modest revisions were completed in 2002 and 2007, but the original *STL* standards essentially remain as they were written and disseminated in 2000. As a result, some state departments of education are moving away from *STL* as their basis for state curriculum frameworks. Since the standards are essential for developing and delivering content in technology education, there is a very real need to determine if they are current and relevant, matching the demands and trends of technology and engineering in 2019 and beyond. This need led to the development of a research study (Krumholtz, 2019) that posed nine questions, the initial findings of which will be presented later in this article:

1. Is there a difference in the use of the *STL* standards dependent on what level and content a teacher is teaching?
2. Are there differences by teachers in the level of use of the 20 specific standards in their programs?
3. How are the *STL* standards being used by state and district supervisors?
4. Are university professor views on the *STL* standards dependent on the university level being taught and the professor's program name?
5. Are beliefs about the *STL* standards dependent on the ITEEA Region in which one works?
6. What are the beliefs of professors, classroom teachers, and supervisors about whether the standards should remain content guides or become more prescriptive objectives?
7. What are the beliefs of professors, classroom teachers, and supervisors about inclusion of new standards into *STL*?
8. What are the beliefs of professors, classroom teachers, and supervisors about whether the name of the *STL* standards should be changed?
9. How does the teaching of the 20 specific standards at the undergraduate postsecondary level compare to the use of the standards by classroom teachers?

Table 1. Region Location by Category

Type	Region I	Region II	Region III	Region IV	International
Classroom Teacher	50.07%	10.64%	19.49%	16.19%	3.6%
Supervisor	61.84%	13.16%	5.26%	13.16%	6.58%
University Professor	34.69%	18.37%	18.37%	8.16%	20.41%

Figure 1. Content Taught by Classroom Teacher Respondents

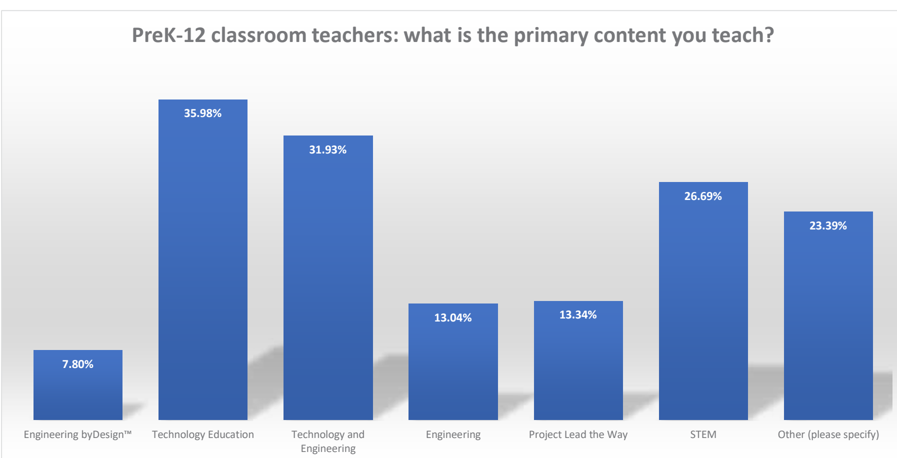


Table 2: Classroom Teacher Use of STLs

ITEEA STL Update National Survey

PreK-12 classroom teachers: How are you using the 2000/2002/2007 STL standards now?

Answer Choices	Responses	
Linking to lesson plans.	37.93%	253
Reference for curriculum development.	46.03%	307
Reference for assessment.	26.99%	180
Not using at all (never).	21.89%	146
No longer using (used them in the past).	12.59%	84
Comment(s)	11.54%	77
	Answered	**667**

Survey

The survey was developed during the summer and fall of 2018 by leaders of ITEEA and its Council on Technology and Engineering Teacher Education (CTETE). A pilot survey was sent to eight classroom teachers, eight university professors, and eight state or district supervisors in October. Based on the results of the piloted survey, additional changes were made in content and formatting. In November, the national survey link was disseminated to 60,000 ITEEA members and stakeholders. By the December 2018 deadline, responses were obtained from 1,443 individuals. Of current ITEEA members, 13.4% responded to the survey. Survey question #1 asked what the person's role was in technology and engineering education. The response was 68% classroom teachers, 8% supervisors, 13% university professors, and 11% "other."

Classroom Teacher Responses

The location of the classroom teachers showed Region I (East coast USA) at 50% with Region II (East Midwest) at 10.6%, Region III (West Midwest) at 19.5%, Region IV (West coast) at 16.2%, and 3.6% International (Table 1). Fifty-seven percent of the teachers taught at the high school level, 33% at the middle school level, 15% at elementary, and 4% listed "other." There was variety in the content the classroom teachers taught (Figure 1), with technology education listed at the highest, 36%, Technology and Engineering a close second at 32%, and 26.7% teaching STEM.

In answering the survey question about how classroom teachers are currently using *STL*, the highest percent responses referenced curriculum development (46%) and as a link to lesson plans (38%). Twenty-two percent of teachers have never used the standards, and 12.6% had stopped using them (Table 2). Please note that the survey takers could select more than one response.

In a subsequent question, classroom teachers were asked to indicate their level of use of the individual standards. The results ranged from 4.11/5.0 use of Standard 11, *Apply Design Processes*, to 2.09/5.0 for *STL* 14, *Medical Technologies*. Average use was 3.203, with a standard deviation of .4954. The complete use of specific standards is indicated in Figure 2.

Supervisor Responses

Responding supervisors were concentrated in Region I (Northeast U.S.) at 61.6%, with all other regions modestly represented: Region II, 13%, Region III, 5.2%, Region IV, 13%, and International, 6.6% (Table 1). Supervisor responses to the question about how the *STL* standards/STLs are currently being used showed the highest percentage (47.37%) answer was "partially embedded in state frameworks." Unfortunately, concern about states moving away from using *STL* was confirmed by the 14.5% of supervisors who stated the STLs were used in the past but now are minimized or have been dropped. Figure 3 indicates the results of asking supervisors the

Figure 2. Level of Use of Individual STLs by Classroom Teachers

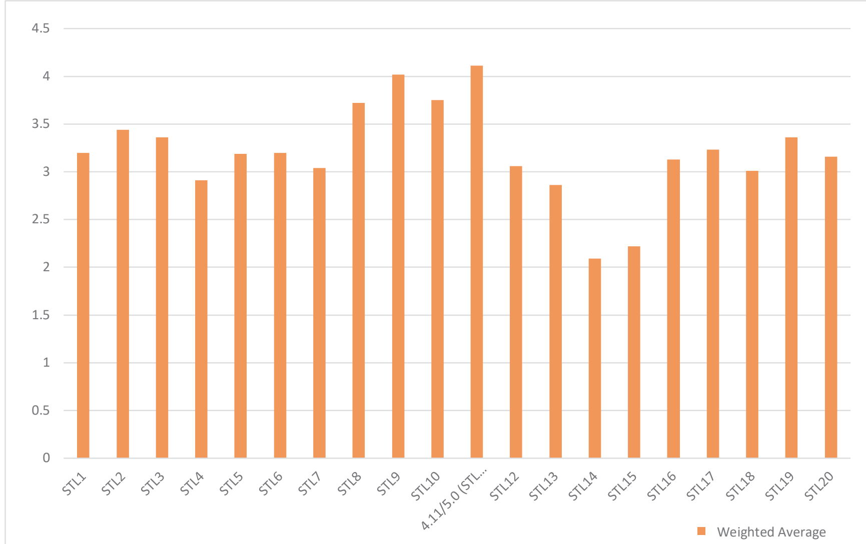


Figure 3. Supervisor Level of Use of STLs in Their States or Districts

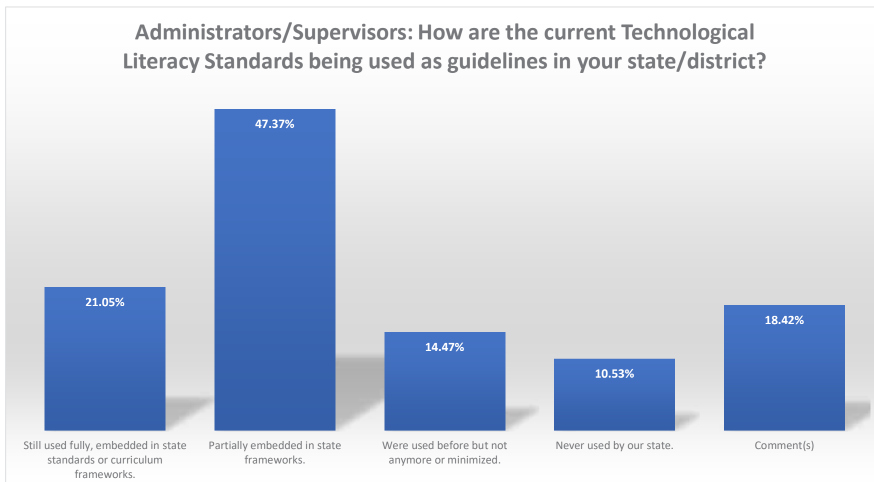


Table 3. Supervisor Use of STL in Their States.

Administrators/Supervisors: How is your state/district using the 2000/2002/2007 STL standards now?

Answer Choices	Responses	
Linking to lesson plans.	22.37%	17
Reference for curriculum development.	55.26%	42
Reference for assessment.	22.37%	17
Not using at all (never).	17.11%	13
No longer using (used them in the past).	11.84%	9
Comment(s)	13.16%	10
	Answered	**76**

Table 4. Content and Level Taught by Post-Secondary Educator.

Postsecondary educators: What levels/subjects do you teach?

Answer Choices	Responses	
Undergraduate Technology Education	33.67%	33
Graduate/Post-Grad Technology Education	33.67%	33
Undergraduate Technology and Engineering Education	42.86%	42
Graduate/Post-Grad Technology and Engineering Education	29.59%	29
Undergraduate Engineering Education	16.33%	16
Graduate Engineering Education	6.12%	6
Other (please specify)	23.47%	23
	Answered	**98**

level of *STL* use by their states. As a follow-up question, supervisors were asked how they are using the STLs specifically (Table 3).

Postsecondary Educator Reponses

Reviewing results of the university professors or postsecondary educators showed that the regional spread was flatter than the other two groups (Table 1). Region I was still the highest at 34.7%, while the second highest concentration was International at 20.4%. Both Region II and Region III came in at 18.37%, while Region IV was at 8.16%. The level and programs taught by university professors reveal that some professors teach more than one subject or at more than one level (Table 4). Table 5 indicates how the professors are using the standards in their programs. The results indicate that professors use the STLs as a reference for curriculum development (65.3%), linking to lesson plans (47%), or as a reference for assessment (42.8%).

The level of use of the 20 specific standards was fairly even compared to classroom teacher use (Figure 4). *STL* 11, *Abilities to apply the design process*, was used the most at 4.33/5.0, and *STL* 14, *Medical Technologies*, the least at 2.61. The total use by professors of specific standards averaged 3.619, with a standard deviation of .469. Compared to the classroom teachers, the professors used the STLs more and with less variation.

Table 5. Use of STLs by Postsecondary Educators

Postsecondary educators: How are you using the 2000/2002/2007 STL standards now?

Answer Choices	Responses	
Linking to lesson plans.	46.94%	46
Reference for curriculum development.	65.31%	64
Reference for assessment.	42.86%	42
Not using at all (never).	12.24%	12
No longer using (used them in the past).	9.18%	9
Comment(s)	11.22%	11
	Answered	**98**

Figure 4. Level of Use of Individual STLs by University Professors

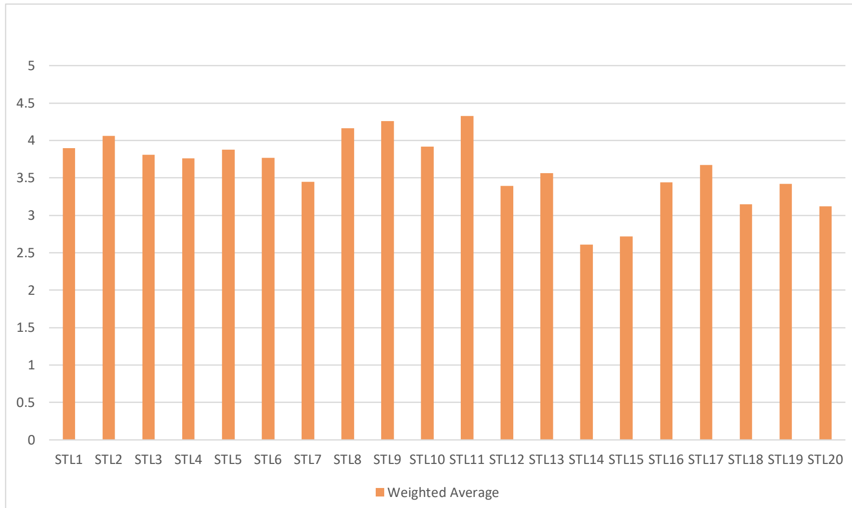


Table 6. All Respondents View of STLs as Content Guides or Curriculum/Objectives

ITEEA's 2000/2002/2007 Standards for Technological Literacy standards and benchmarks were written as content guides to develop technological literacy, not as prescriptive curriculum or lesson objectives. If the STLs are to be revised, what is your view?

Answer Choices	Responses	
Keep the standards and benchmarks as content guides.	51.12%	500
Develop as curriculum or lesson objectives.	40.18%	393
Other (please specify)	8.69%	85
	Answered	**978**

Name Change and Content Guides

All respondents were asked if the name of the standards should remain as is or be updated. The choice to leave the title *Standards for Technological Literacy* (2000/2002/2007/2020) as is was 19.7%. The choice to add the word "Engineering" into a new title garnered 72.7% of the vote, with the preference split almost evenly between *Standards for Technological and Engineering Literacy* (2020) and *Standards for Technology and Engineering Education Literacy* (2020).

The original standards and benchmarks were written as big idea content guides, not as prescriptive curriculum or lesson objectives. This was done intentionally to give states and technology educators the flexibility to meet the standards in a context that was relative to their student population and resources. There have been calls over the years for the STLs to be more prescriptive to direct educators as to what and how to teach the content. Question #17 of the survey addressed this concern by asking all respondents to indicate whether the standards should remain as content guides or change to curriculum or lesson objectives. Table 6 shows over half of respondents wanting the STLs to remain as content guides.

Potential New Content Standards

The original standards totaled 20, with seven content area standards in the Designed World. Those standards included *STL* 14, *Medical Technologies*, *STL* 15, *Agricultural and Related Biotechnologies*, *STL* 16, *Energy and Power Technologies*, *STL* 17, *Information and Communication Technologies*, *STL* 18, *Transportation Technologies*, *STL* 19, *Manufacturing Technologies*, and *STL* 20, *Construction Technologies*. With changes in the field over the past 20 years including a new focus on integrated STEM, engineering, computational literacy, robotics, and other areas, ITEEA and CTETE wanted to determine what content areas ITEEA members and stakeholders felt should be (a) considered as new stand-alone content standards, (b) embedded within the content of the original standards or (c) considered as content inappropriate for the field.

Table 7. Results of Inclusion of Computer Science or Computational Literacy in New STLs

Choice from Survey	All	Classroom Teachers	Supervisors	Professors
Should be new stand-alone standard with benchmarks	61.86% 600	64% 412	63.3% 50	54.6% 70
This content is not appropriate in Technology and Engineering Education	10.52% 102	10.3% 66	12.6% 10	11% 14
Embed the language in other standards	27.63% 268	25.7% 165	24% 19	34.4% 44
Total Percent Total Responses	100% 970	100% 643	100% 79	100% 128

Table 8. Results of Inclusion of Engineering in New STLs

Choice from Survey	All	Classroom Teachers	Supervisors	Professors
Should be new stand-alone standard with benchmarks	61.88% 591	63% 399	63.3% 50	52.3% 67
This content is not appropriate in Technology and Engineering Education	3.46% 33	3% 19	2.5% 2	5.4% 7
Embed the language in other standards	34.66% 331	34% 215	34.2% 27	42.2% 54
Total Percent Total Responses	100% 955	100% 633	100% 79	100% 128

Computer Science and Computational Literacy

Computer science, computational literacy, and computational thinking have been appearing more frequently in literature (Buckler, Koperski & Loveland, 2018; Estapa, Hutchison & Nadolny, 2018; Genota, 2019; Hacker, 2018; Moyer, Klopfer & Ernst, 2018; Sung, 2018). ITEEA's Engineering byDesign™ (EbD™) course *Advanced Technological Applications* includes a Cybersecurity unit with digital literacy as a topic. Traditionally, technology educators viewed computers as a tool, like a band saw or 3D printer, rather than as content in the field. The traditional association of computers with business education, educational technology, and skills like coding for job preparation likely led the original *STL* authors to not include a standard on computer science. With changes over the last 20 years, the *STL* revision survey asked respondents if computer science or computational literacy should be a new standard, embedded in current standards (for example Standard 17, *Information and Communication Technology*), or not be included in the STLs at all. Table 7 documents the results. Six hundred of the 970 responses (61.9%) selected the need to create a new standard for Computational Literacy in the STLs, although only 54.6% of university professors selected this option. For the 268 respondents who chose "embed the language in other standards," the two identified standards with the highest percentages were *STL* 3, *Relationships among Technologies and the Connections Between Technology and Other Fields of Study* (61%) and *STL* 17, *Information and Communication Technologies* (58.7%). Smaller percentages selected the option that the content was not appropriate in technology and engineering education.

Engineering

ITEA added engineering to its organization name in 2010 based on member survey results and long discussions. Some associated councils (CTETE, TEECA) followed suit by adding engineering to their names as well. While the word engineering shows up in the original *STL* 160 times, there have been calls to add engineering as a content standard or change the focus of the field to engineering (Grubbs, Strimel & Huffman, 2018; Hacker, Crismond, Hecht and Lomask, 2017; Moye, J., Dugger, W. and Starkweather, K., 2018; Strimel, Grubbs and Wells, 2017). A research study by Asunda and Quintana (2018) indicated that the *STL* domains of *Design*, *The Nature of Technology*, and *The Designed World*, "provide students with a vehicle to comprehend how technology integrates with engineering practices in the curricular" (p. 24). These domains in the STLs are beneficial to both educators and researchers using evidence-driven strategies to promote effective STEM learning. In a shift from standard science content, *Next Generation Science Standards* (NGSS Lead States, 2013) included engineering design standards and practices at the middle and high school levels.

The results of the survey in Table 8 indicate support for including engineering as a new content standard (62%) and support for embedding the language elsewhere (35%). Support for having engineering as a stand-alone standard was 63% for both classroom teachers and supervisors. University professors selected this option at 52%. The current standards selected for embedding engineering as language were *STL* 9, *Developing understanding of engineering design* (88%) and *STL* 11, *Develop abilities to apply design process* (76.5%).

Science, Technology, Engineering, and Mathematics

Science, Technology, Engineering, and Mathematics, or STEM, is a vehicle or model for integrating four separate content fields in project-based work performed by elementary and secondary students. The idea is that these subjects are integrated in the world beyond the classroom walls, so it makes sense to integrate the subjects in schools rather than teaching content in isolated silos. Literature on STEM and iSTEM proliferated in the 2000s, and recent articles in *TET* focus on the application of teaching STEM concepts (Asunda and Weitlauf, 2018; Reed, 2018). Survey results (Table 9) indicate that most respondents prefer STEM as language to be embedded in current standards (53.3%), not as a new content standard (40.9%). It should be pointed out that two thirds of supervisors selected the choice to embed language in other standards. All 20 current standards were selected above the 50% level to embed STEM language within. The highest percent was for *STL* 3, *Relationships among technologies and the connections between technology and other fields of study* (77.3%).

Table 9. Respondent Views of Including STEM in the STLs

Choice from Survey	All	Classroom Teachers	Supervisors	Professors
Should be new stand-alone standard with benchmarks	40.91% 385	43.5% 271	29.4% 23	35.7% 45
This content is not appropriate in Technology and Engineering Education	5.74% 54	4.6% 29	4% 3	10.2% 13
Embed the language in other standards	53.35% 502	51.8% 323	66.6% 52	54% 68
Total Percent Total Responses	100% 941	100% 623	100% 78	100% 126

Table 10. Respondent Views of Robotics Automation in the STLs

Choice from Survey	All	Classroom Teachers	Supervisors	Professors
Should be new stand-alone standard with benchmarks	61.65% 569	67.65% 416	44.7% 34	49.2% 61
This content is not appropriate in Technology and Engineering Education	5.09% 47	4.2% 26	6.6% 5	8.9% 11
Embed the language in other standards	33.26% 307	27.9% 171	48.7% 37	42% 52
Total Percent Total Responses	100% 923	100% 613	100% 76	100% 124

Table 11. Respondent Views on Gaming/Scientific Visualization in the STLs

Choice from Survey	All	Classroom Teachers	Supervisors	Professors
Should be new stand-alone standard with benchmarks	47.98% 439	53.5% 325	34.7% 26	34.7% 43
This content is not appropriate in Technology and Engineering Education	19.78% 181	18.2% 111	18.7% 14	26.6% 33
Embed the language in other standards	32.24% 295	28.3% 172	46.7% 35	38.7% 48
Total Percent Total Responses	100% 915	100% 608	100% 75	100% 124

Robotics and Automation

Robotics and automation have been taught in technology education since the early 1990s, with the development of tabletop educational robotic arms, text- and graphics-based coding and control applications, and simulated production assemblies. The ITEEA EbD™ course *Advanced Technological Applications* has a Robotics unit. With the acceptance of robotics in engineering courses, multiple student organization competitive events (TSA, TEECA, SkillsUSA, PLTW, US First), and the popularity of television shows with killer robots, robotics content has excited students and led some authors to promote the teaching of robotics and automation (Balaji, 2017; Jackson, Mentzer and Kramer-Bottiglio, 2018; Prier, 2018). The survey results (Table 10) indicated support for it as a new stand-alone standard at 61.6% and embedding in other standards at 33.3%. Classroom teachers showed a stronger interest in including it as a new standard (67.6%) than supervisors (44.7%) or university professors (49.2%). For respondents who selected to embed it in current standards, by far the highest percent selection was in *STL* 19, *Manufacturing Technologies*, at 70.3%.

Gaming and Scientific Visualization

Scientific visualization (SciVis) was first proposed at North Carolina State University and subsequently adopted by the North Carolina Department of Education as an approved technology education course sequence (Ernst & Clark, 2007). Engineering byDesign™ curriculum developed by ITEEA for Grade 9-10, *Game Art Design*, was developed from the scientific and technical visualization model in North Carolina. Survey-takers were asked about adding Gaming/Scientific Visualization to the STLs (Table 11), and 48% stated it should be a new content standard, while 32% requested that it be embedded in other current standards. Interestingly, the percent of individuals who stated gaming and scientific visualization was inappropriate for STLs was higher than the other proposed new content standards at 19.78%. The most selected choice for embedding this language into a current standard was *STL* 17, *Information and Communication Technologies* (62%).

Table 12. Comparison of Classroom Teacher Teaching Level and use of STLs

Content	Number of Teachers by Level	Link to Lesson Plans	Reference to Curriculum	Reference to Assessment	Never Used	No Longer Using
Pre-school Elementary	97	46.4% 45	37.1% 36	20.6% 20	23.7% 23	10.3% 10
Middle School	218	41.3% 90	52.3% 114	31.2% 68	18.8% 41	11.9% 26
High School	383	35.5% 136	48% 184	27.4% 105	21.1% 81	13.8% 53
Other	27	33.3% 9	44.4% 12	33.3% 9	25.9% 7	11% 3

Table 13. Comparison of Classroom Teacher Content Area and use of STLs

Content	Number of Content Teachers	Link to Lesson Plans	Reference to Curriculum	Reference to Assessment	Never Used	No Longer Using
Engineering byDesign™	52	53.8% 28	53.8% 28	40.4% 21	7.6% 4	13.5% 7
Technology Education	240	43.75% 105	55.8% 134	30% 72	12.1% 29	16.7% 40
Technology & Engineering	213	42.3% 90	59.6% 127	36.2% 77	10.8% 23	12.7% 27
Engineering	87	34.5% 30	46% 40	30% 26	20.7% 18	20.7% 18
Project Lead the Way	89	49.4% 44	44.9% 40	31.5% 28	20.2% 18	13.5% 12
STEM	178	38.2% 68	50.5% 90	27.5% 49	25.8% 46	10.1% 18
Other	156	30.1% 47	32.5% 50	17.3% 27	35.2% 55	10.2% 16

Research Question Findings

A graduate student in the Career and Technology Education M.Ed. program at the University of Maryland Eastern Shore proposed a capstone research study to analyze the *STL* revision survey data to provide findings that would inform the decisions being made by ITEEA and CTETE. Krumholtz (2018) posed nine research questions. Based on the survey results, the initial findings for the nine questions follow.

1. Is there a difference in the use of the STL standards dependent on what level and content a teacher is teaching?

Preschool elementary teachers use the STLs as lesson plan links at 46.4%, which is a higher rate than middle and high school teachers (Table 12). Middle school teachers use the STLs at higher rates for reference to curriculum (52.3%) and as a reference for assessment (31.2%) than other teaching levels. The percent of all levels that do not currently use the STLs is in a close range from 30.7% for middle school level to 35% for the elementary teacher level.

By program content designation, there was variation in the results (Table 13). Engineering byDesign™, an ITEEA–developed curriculum based on *Standards for Technological Literacy*, not surprisingly showed the highest percentages of use as links to lesson plans (53.8%) and reference to assessment (40.4%), and the lowest percent of never using (7.6%). The highest percent of reference to curriculum was in technology and engineering at 59.6%. Project Lead the Way was aligned to *STL*, with 49.4% of PLTW teachers reporting that the STLs are linked to lesson plans in their program, and 44.9% using the STLs as a reference for curriculum development. STEM teachers reported high use (50.5%) of the STLs for curriculum development as well. The other data of note is that engineering teachers never used the STLs or no longer use them at a total percent of 41.4%, higher than any other content with the exception of other content teachers (45.4%).

2. Are there differences by teachers in the level of use of the 20 specific standards in their programs?

Technology educators usually teach specific content courses in their programs. It would not be unusual for a department of four to teach a wide selection of technology courses. For this reason, the results of the teaching in alignment with standards will necessarily be varied, particularly in the *Designed World* (Standards

14-20). The survey results indicate a range of teaching from the standards from 2.09/5.0 (*STL* 14) to 4.11 (*STL* 11). Design is an element that crosses most technology courses, and so the top choices are predominantly from the Design Standards *STL* 8, *Attributes of Design*, *STL* 9, *Understanding Engineering Design*, and *STL* 10, *Role of Troubleshooting*, research and development, invention and innovation, and experimentation. Standard #11, *Develop the abilities to apply the design process*, was the most chosen standard by classroom teachers. The least chosen were *STL* 14, *Medical Technologies* (2.09/5.0), and *STL* 15, *Agriculture and Biotechnologies* (2.22/5.0), which is likely linked to the lack of courses in these areas taught by technology and engineering classroom teachers and the lack of preparation that technology educators receive to teach science (Love and Wells, 2017). In the *Designed World* standards, *STL* 19, *Manufacturing Technologies*, was the top choice at 3.36/5.0, with *STL* 17, *Information and Communication Technologies*, coming in second at 3.23/5.0.

Table 14. Comparison of Postsecondary Level/Content Area and Use of STLs

Program Content	Number of Professors	Link to Lesson Plans	Reference to Curriculum	Reference to Assessment	Never Used	No Longer Using
Undergraduate Technology Education	33	42.4% 14	78.8% 26	45.5% 15	0	0
Graduate/ Post-Graduate Technology Education	33	48.5% 16	75.8% 25	54.5% 18	6% 2	9% 3
Undergraduate Technology and Engineering Education	42	57.1% 24	73.8% 31	47.6% 20	7.1% 3	7.1% 3
Graduate/ Post Graduate Technology and Engineering Education	29	48.3% 14	62.1% 18	48.3% 14	10.3% 3	13.8% 4
Undergraduate Engineering Education	16	56.3% 9	50% 8	50% 8	12.5% 2	12.5% 2
Graduate Engineering Education	6	0	50% 3	33% 2	16.7% 1	33% 2
Other	23	30.4% 7	69.6% 16	26.1% 6	17.4% 4	8.7% 2

Table 15. Comparison by Region and use of STLs

Content	All Respondents	Link to Lesson Plans	Reference to Curriculum	Reference to Assessment	Never Used	No Longer Using
Region I East	334	41% 137	51.8% 173	27.5% 92	27.5% 57	13.8% 46
Region II East Midwest	71	40.8% 29	36.6% 26	36.6% 26	15.5% 11	16.9% 12
Region III West Midwest	130	37.7% 49	45.4% 59	26.9% 35	25.4% 33	7.7% 10
Region IV West	108	27% 29	36.1% 39	19.4% 21	36.1% 39	13.9% 15
International	24	37.5% 9	45.8% 11	25% 6	25% 6	4.1% 1

3. How are the STL standards being used by state and district supervisors?

Supervisors are using the current STLs in their states at a level of 68.4% currently, with 14.5% stating that they used them in the past and 10.5% stating that they never used them (Figure 3). They are being utilized by supervisors as a reference for curriculum development (55.3%), linking to lesson plans (22.4%) and as a reference for assessment at 22.4% (Table 3).

4. Are university professor views on the STL standards dependent on the university level being taught and the professor's program name?

There were differences in use of the STLs in post-secondary institutions depending on whether the program was undergraduate or graduate and on the name of the program content (Table 14). The two highest uses of the STLs as links to lesson plans is in undergraduate technology and engineering education (57.1%) and undergraduate engineering education (56.3%). It is lower in undergraduate technology education programs at 42.4%, but this content and level indicated the highest percent of using the STLs as a reference for curriculum development (78.8%). Other content programs with high use of the STLs for curriculum were graduate/postgraduate technology education (75.8%) and undergraduate technology and engineering education (73.8%). The use of the standards as a reference for assessment was highest in graduate/postgraduate technology education (54.5%) and undergraduate engineering education (50%). A notable data finding was that some graduate engineering programs never used the STLs (16.7%) or no longer considered them (33%), meaning that almost half (49.7%) of graduate engineering programs are not using the STLs currently.

5. Are beliefs about the STL standards dependent on which ITEEA Region one works in?

There were differences in the use of STLs depending on the respondent ITEEA Region (Table 15). In Region I, which covers the entire east coast USA, links to lesson plans (41%) and references to curriculum (51.8%) were the highest. Despite this high use in Region I, 27.5% of respondents reported that they never used the STLs. Reference to assessment was highest in Region II at 36.6%. Interestingly, international respondents reported notable usage of the STLs for lesson plans (37.5%), curriculum development (45.8%), and assessment (25%). This may be due to the STLs being translated into other languages (Finnish, Mandarin Chinese, Japanese, German) and active international attendance at ITEEA conferences.

6. What are the beliefs of professors, classroom teachers, and supervisors about whether the standards should remain content guides or more prescriptive objectives?

The majority (51.12%) of respondents wanted the STLs to remain big idea content guides, with 40.18% calling for them to be more prescriptive for use as curriculum or lesson objectives (Table 16). University professors had the highest percent view that the STLs should remain as content guides. Classroom teachers selected STLs to be developed as curriculum or lesson objectives the most (42.9%), perhaps a result of being in the classroom and trying to make use of the STLs on a practical level. More classroom teachers (49.7%) selected content guides as their first choice.

UMES graduate students Chris Clancy and Dawn Shuster discussing the impact of survey results on the summer 2019 *STL* Revision taskforce.

Table 16. Comparison of Classroom Teachers, Supervisors, and University Professor Views on STLs as Content Guides or Prescriptive Objectives

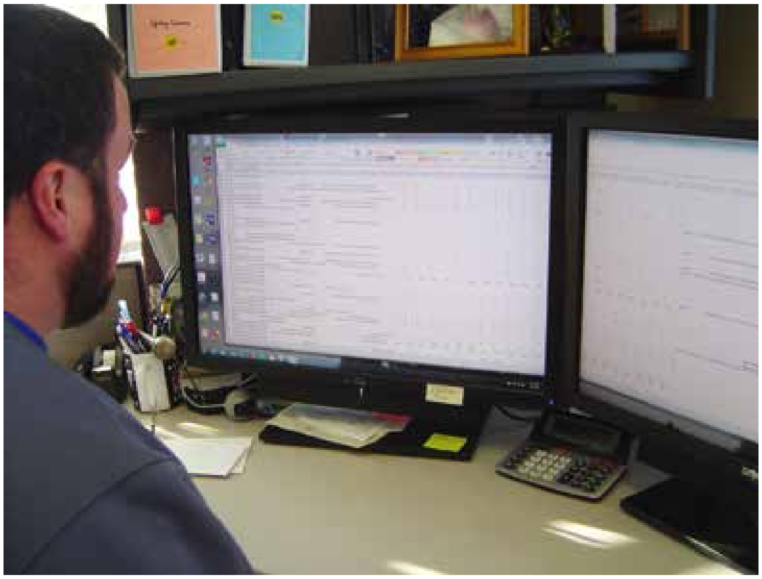
Choice from Survey	All	Classroom Teachers	Supervisors	University Professors
Keep as Content Guides	51.12% 431	49.7% 322	50.6% 40	53.9% 69
Develop as Curriculum or Lesson Objectives	40.18% 342	42.9% 278	34.2% 27	28.9% 37
Other	8.7% 82	7.4% 48	15.2% 12	17.2% 22
Total Percent Total Responses	100% 855	100% 648	100% 79	100% 128

7. What are the beliefs of professors, classroom teachers, and supervisors about inclusion of new standards into STL?

Based on the total responses collected (Table 17), three of five content areas had support as new content standards: *Computer Science/Computational Literacy*, *Engineering*, and *Robotics/Automation*. A substantial percent (27.63%-53.35%) of

Table 17. Summary of Respondent Views on New Content Standards

Choices	Computational Literacy	Engineering	STEM	Robotics Automation	Gaming Sci. Visual
Stand-Alone New	61.865%	61.88%	40.91%	61.65%	47.98%
Not Appropriate	10.52%	3.46%	5.74%	5.09%	19.78%
Embed Language	27.63%	34.66%	53.35%	33.26%	32.24%



UMES graduate student Derrick Krumholtz analyzes a portion of the 25,600 data responses obtained from the recent *STL* Revision survey.

respondents indicated that all five proposed content areas would be better served by being embedded in current standards. One content area (*Gaming/Scientific Visualization* at 19.78%) received double the percentage of the next content area (*Computational Literacy*, 10.52%) for content that was considered inappropriate for the STLs.

8. What are the beliefs of professors, classroom teachers, and supervisors about whether the name of the STL *standards should be changed?*

Overall, the respondents concurred on adding engineering to the name of the revised standards. The two choices for adding engineering were almost tied. S*tandards for Technological and Engineering Literacy* was at 35.07% and *Standards for Technology and Engineering Education Literacy* was favored at 37.63%. Fewer than 20% preferred to keep the same name. Seven and a half percent of respondents suggested other names.

9. How does the teaching of the 20 specific standards at the undergraduate postsecondary level compare to the use of the standards by classroom teachers?

The postsecondary educators tended to teach in alignment with all standards at a higher level than that used by classroom teachers. In addition, the standards were given more equal coverage, while classroom teachers had higher use of specific standards and lower use of others. This may be because teachers teach specific content classes within technology education while professors prepare preservice teachers to teach all content. There was general agreement in the teaching of the standards by classroom teachers and university professors. A positive correlation was obtained between the two groups at .791.

Summary

While decisions on revising the standards will be made by leaders in the field, including classroom teachers, supervisors, professors, and representatives from associated professional associations, the survey results will be presented as information to be considered. Scholarly articles and other survey results will be included, along with specific comments solicited at the 2019 ITEEA conference to assist the teams working on revising the standards. The data collected in the *STL* revision survey is available for other graduate programs and researchers to review and explore other important questions. Please contact ITEEA for access to the survey data.

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