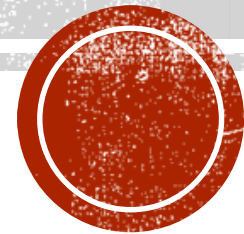


**COMPARING THE 2020 STANDARDS FOR TECHNOLOGICAL AND
ENGINEERING LITERACY TO EXISTING STANDARDS OF NEXT
GENERATION SCIENCE STANDARDS AND COMMON CORE
STATE STANDARDS**

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Standards for Technological Literacy (STL)

- Originally published: 2000
- Revised and Republished 2002 & 2007

Next Generation Science Standards (NGSS)

- Originally published: 2013

Common Core State Standards (CCSS)

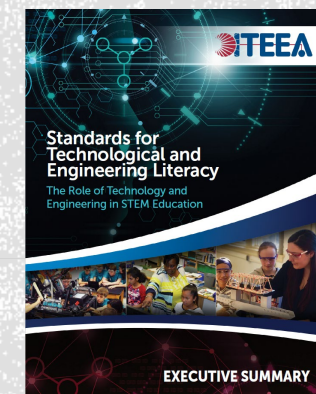
- Originally published: 2010

The 2020 RE(VISION)

- Align benchmarks within standards to link more closely to cross curricular subjects



INTRODUCTION



PURPOSE AND SIGNIFICANCE OF RESEARCH

- **Ultimate purpose – provide resources for the daily classroom teacher**
 - When benchmarks are aligned closer across multiple subjects, different methods and strategies can be used to teach the same material
- **Technology Education and Engineering: Ever-Evolving**
 - Updating standards and benchmarks indicates instructors are as in-tune with the real world (skills & competencies) as possible





- **Current STL Standards**
 - Two decades old & out-of-date
 - 288 benchmarks
- **Newly Proposed Standards**
 - Now 142 benchmarks
- **The *Ultimate Problem***
 - Proposed benchmarks should be linked to appropriate STEM benchmarks in NGSS & CCSS
 - Alignment of benchmarks **improves the linkage of T & E to STEM and increases the potential for academic integration of T & E content.**

To what extent do the existing Next Generation Science Standards align with the revised Standards for Technological and Engineering Literacy?

To what extent do the existing Common Core State Standards for English align with the revised Standards for Technological and Engineering Literacy?

To what extent do the existing Common Core State Standards for Mathematics align with the revised Standards for Technological and Engineering Literacy?

How aligned are the STEL standards based on separate T & E review teams and consultant scores?

RESEARCH QUESTIONS



RESEARCH METHODOLOGY

- **Standards Matrix – The Nucleus of the Study**
 - Encompasses all Standards & Benchmarks of proposed revisions
- Analyzed (linked) by two groups of review teams
 - Teams consist of one Technology and Engineering Education Professor, one Technology and Engineering Education Supervisor, and one Technology and Engineering Education classroom teacher



DEVELOPMENT OF STEL CROSSWALK MATRIX

- STEL Benchmarks edited December 2019, January and February 2020 to current **142**.
- NGSS, CCSS Math and CCSS ELA reviewed for potential benchmarks at identified K-12 levels. **Abridged benchmarks document created to pull matched benchmarks from.**
- Dr. Loveland and Dan Staab identified closely matched benchmarks from three academic standards.
- Submitted to educational experts or graduate students the three academic areas: Baylor University doctoral students reviewed mathematics, Strategic Outreach director from North Carolina State University checked science, and graduate student from University of Idaho reviewed ELA.



	STEL Benchmark	NGSS Benchmark		CCSS Math Benchmark		CCSS ELA Benchmark	
9-12	1P. Analyze the rate of technological development and predict future diffusion.	HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	5	N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	4	<u>ELA-Literacy.RST.9-10.3</u> Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	4

EXAMPLE MATRIX BENCHMARK

Above is an example of a proposed linkage between STEL Benchmark 1P with existing NGSS & CCSS Benchmarks



Level	Descriptor of Level	CCSS Matched Benchmark	Reasoning for score
1	Totally unacceptable match. The proposed benchmark has nothing in common with the STEL benchmark, no language could be construed as being linked, or they are from different areas.	G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.	None of the language pertains to using rates to predict future data. This benchmark is from Geometry – Congruence and implies drawing geometric shapes.
2	Mostly disagree with match. While some aspect of the benchmark might include minimal matched language, the overall benchmark does not link to the STEL benchmark language	S-ID.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points.	While probability might be plausibly linked to STEL 1P, this benchmark is only about data on hand and outliers, not the future.
3	Could be plausible. One could make a stretched argument for linkage between the two benchmarks but overall it is not enough.	S-IC.6 Evaluate reports based on data.	This benchmark is getting closer and could be a go-to math benchmark for many of the 9-12 STEL benchmarks but it is not specific to future predictions.
4	Agree with match. One could reasonably decide that the benchmark could be adapted through its' application to the STEL benchmark.	N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	This is the closest match but still not perfect. It does ask the student to choose and use correctly mathematical data for analyzing a problem. It still does not specify making predictions for future.
5	Strongly agree with match. The language and intent of the benchmark perfectly encapsulates all aspects of the STEL benchmark.	Graph a data set based on the past to make predictions about expected future data	If this was a choice in the CCSS Math benchmarks, it would be an apparent direct match to STEL 1-P

WHAT DO THE SCORES MEAN?

To the left is a description of potential scores of an alignment would indicate.





Today's career fields: competencies and skills are evolving

Knowledge of scientific, mathematical, and engineering theories & principles
Problem Solving Skills



As workforce evolves, instructors' curriculum must also

Instructors must ensure different literacies are being implemented within standards
Literacy should be developed past the point of ability to read and/or write within content

**SCIENCE,
TECHNOLOGY,
ENGINEERING,
AND
MATHEMATICS
(STEM)**

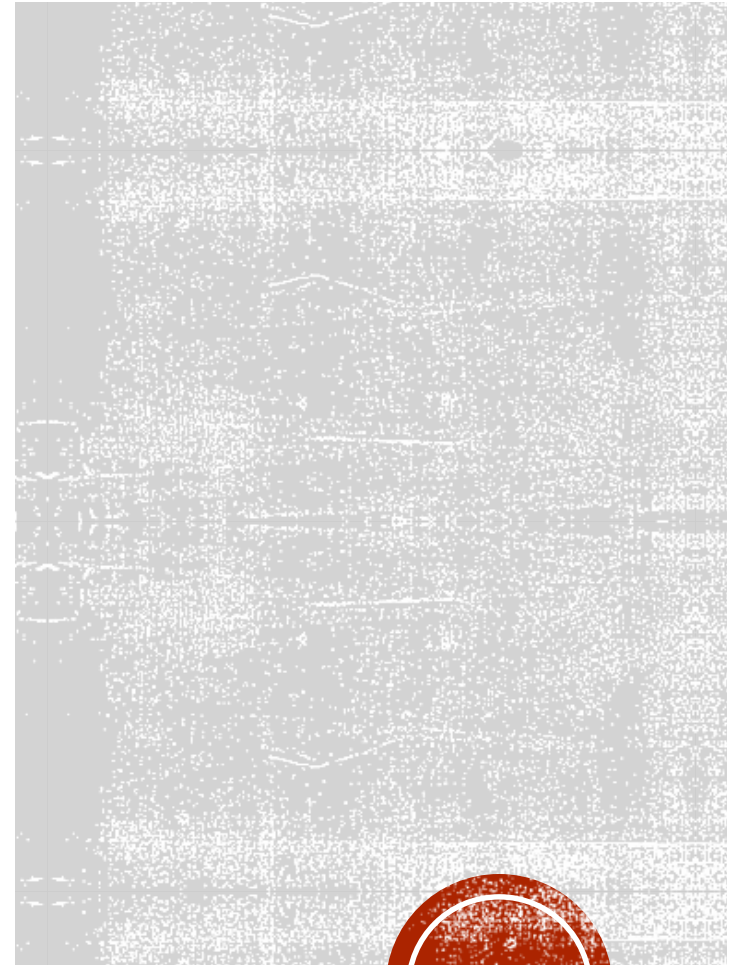


MATCHING THE STANDARDS

- **Essential similarity between the purpose of the sets of standards:**
Provide a measurable reference point for what students should *know* and *do* in today's society
- **Development Teams**
 - Teams of content experts at multiple levels were convened to score the matches between the benchmarks
- **Prominence of Evaluation**
 - Scholarly research on linking standards and benchmarks is *very* limited.
 - This study should fill in some of that gap.



RESULTS & FINDINGS



VALIDATION RESULTS AND LIMITATIONS: CCSS MATH

- Mathematics: Verb changes made since original review and based on Baylor review, 36 math benchmarks were changed before T & E review occurred. Result, only 100 scores of 142 could be reviewed for correlation between two math reviewers and six T & Reviewers.
- **R = .2395**
- Limitation
 - T & E expertise of math reviewers (and) math expertise of T & E reviewers.
 - Changes to language of benchmarks Dec – February on scoring form
 - The T & E reviewers were sent a second batch of 13 benchmarks to re-score based on revised language.
 - If a future replicated study envisioned, there are 21 cells where a different NGSS benchmark could be tested.



**VALIDATION
RESULTS:
CCSS NGSS AND
CCSS ENGLISH
LANGUAGE ARTS**


- Dr. Whitney Richardson White, Program Manager, Strategic Outreach and Special Initiatives and a Science professor for North Carolina State University has strong engineering and science background.
- **R = .447**
- University of Idaho graduate student in English department scored ELA matches.
- **R = .333**



BENCHMARK VALIDATION SUMMARY

	Team A Team B Correlation	Reviewer's Total Mean	Consultant's Mean	Correlation
STEL - NGSS	.51	3.67	3.83	.447
STEL – CCSS Math	.42	3.50	3.47	.24
STEL – CCSS ELA	.82	3.67	4.62	.333





**BENCHMARK
CROSSWALK
RESEARCH
RESULTS**

- Two teams convened, consisting of **one each university professor, state or district supervisor and classroom teacher**, all from field of Technology and Engineering Education.
- Team A and Team B **scored 142 matches** to NGSS, Math and ELA.
- Team means and SD for NGSS, Math and ELA.
- Correlation Team A to B: NGSS **$r=.51$** , Math **$r=.42$** , ELA **$r=.82$**
- Combined mean of six reviewers used for cut score: 3.0 or higher
- Difference of team mean to total mean used as secondary cut: .5 or lower.
- Four potential scenarios but only one leads to valid match.

WHAT DO THE MATRIX SCORES MEAN?

SCENARIO 1: LOW MEAN AND HIGH DIFFERENCE

- Example STEL 3-B: Total $\bar{\chi}$ = 2.5, Difference Team $\bar{\chi}$ to Total $\bar{\chi}$ = .83
- This proposed match between STEL 3-B and NGSS K-2-ETS1-2 is rejected.

SCENARIO 2: HIGH MEAN AND HIGH DIFFERENCE

- Example STEL 1-J: Total $\bar{\chi}$ = 4.0, Difference Team $\bar{\chi}$ to Total $\bar{\chi}$ = .67
- This proposed match between STEL 3-B and NGSS MS-ETS1-4 is rejected.



SCENARIO 3: LOW MEAN AND LOW DIFFERENCE

- Example STEL 4-M: Total $\bar{\chi}$ = 2.17, Difference Team $\bar{\chi}$ to Total $\bar{\chi}$ = .17
- This proposed match between STEL 4-M and Math 6.SP.5 is rejected.

SCENARIO 4: HIGH MEAN AND LOW DIFFERENCE

- Example STEL 2-R: Total $\bar{\chi}$ = 4.67, Difference Team $\bar{\chi}$ to Total $\bar{\chi}$ = .33
- This proposed match between STEL 2R and ELA-Literacy RST.6-8.9 is accepted.





- Based on cut score of 3.0 Mean and less than .51 difference of team mean to total mean, the numbers of accepted benchmark matches are:
- **STEL to NGSS:** 119/141 benchmarks
- **STEL to CCSS Math:** 79/139 benchmarks
- **STEL to CCSS ELA:** 119/140 benchmarks

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