Multistate Standard-Setting Technical Report for the *Praxis*® Technology and Engineering Education (5053) Test

Student and Teacher Assessments: Validity and Test Use

ETS

Princeton, New Jersey

February 2024

Executive Summary

To support the decision-making process of education agencies establishing a passing score (cut score) for the *Praxis*® Technology and Engineering Education (5053) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study (Tannenbaum, 2011, 2012).

Participating States

Panelists from 10 states, were recommended by their respective education agencies. The education agencies recommended panelists with (a) experience as technology and engineering teachers or college faculty who prepare technology and engineering teachers and (b) familiarity with the knowledge and skills required of beginning technology and engineering teachers.

Recommended Passing Score

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the *Praxis* Technology and Engineering Education test, the recommended passing score is 65 out of a possible 100 raw-score points. The scale score associated with a raw score of 65 is 157 on a 100–200 scale.

Introduction

To support the decision-making process for education agencies establishing a passing score (cut score) for the *Praxis*® Technology and Engineering Education (5053) test, research staff from ETS designed and conducted a multistate standard-setting study (Tannenbaum, 2011, 2012) in January 2024. Education agencies [1] recommended panelists with (a) experience as technology and engineering teachers or college faculty who prepare those technology and engineering teachers and (b) familiarity with the knowledge and skills required of beginning technology and engineering teachers. Ten states (Table 1) were represented by 13 panelists. (See Appendix A for the names and affiliations of the panelists.)

Table 1
Participating States and the Number of Panelists

Alabama (1 panelist)	Kansas (2 panelists)
Arkansas (1 panelist)	Maryland (2 panelists)
Connecticut (2 panelists)	Mississippi (1 panelist)
Idaho (1 panelist)	North Dakota (1 panelist)
Indiana (1 panelist)	Pennsylvania (1 panelist)

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each state, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a group of experienced educators. Each state may want to consider the recommended passing score but also other sources of information when setting the final *Praxis* Technology and Engineering Education passing score (see Geisinger & McCormick, 2010). A state may accept the recommended passing score, adjust the score upward to reflect more stringent expectations,

[1] States and jurisdictions that currently use *Praxis* tests were invited to participate in the multistate standard-setting study.

or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the state's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the *Praxis* Technology and Engineering Education test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows states to recognize that any test score on any standardized test—including a *Praxis* Technology and Engineering Education test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows states to gauge the likelihood that the recommended passing score from the current panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each state should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that they should receive a license/certificate, but their actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that they should not receive a license/certificate, but they actually do possess the required knowledge/skills. States needs to consider which decision error is more important to minimize.

Overview of the *Praxis*® Technology and Engineering Education Test

The *Praxis*® Technology and Engineering Education *Study Companion* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level technology and engineering teachers have the knowledge/skills believed necessary for competent professional practice.

The 2-hour assessment contains 120 selected-response items[2] covering five content areas: *Fundamentals of Technology and Engineering* (approximately 30 items), *Design and Application of Products and Systems (*approximately 25 items), *Technology Contexts 1: Energy, Materials, and the Built Environment* (approximately 19 items), *Technology Contexts 2: Information, Computation, and Technological* (approximately 19 items), and *Pedagogy and Professional Responsibilities* (approximately 27 items).[3] The reporting scale for the *Praxis* Technology and Engineering Education test ranges from 100 to 200 scale-score points.

Processes and Methods

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the standard-setting study agenda.

Reviewing the Test

The standard-setting panelists first took the test and then discussed the content measured. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level technology and engineering teachers or areas that address content particularly important for entry-level technology and engineering teachers.

Defining the Just-Qualified Candidate

[2] Twenty of the 120 selected-response items are pretest items and do not contribute to a candidate's score.
[3] The number of items for each content area may vary slightly from form to form of the test.

Following the review of the test, panelists described the just-qualified candidate. The *just-qualified candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panelists created a description of the just-qualified candidate, focusing on the knowledge/skills that differentiate a *just-qualified* from a *not quite-qualified* candidate. To create this description, the panel first split into three breakout groups to consider the just-qualified candidate. in order to create a draft description. Then they reconvened and, through whole-group discussion of the three drafts, reached consensus on the final version to use for the remainder of the study.

The written description of the just-qualified candidate summarized the panel discussion in a list format. The description was not intended to describe all the knowledge and skills of the just-qualified candidate but only highlight those that differentiate a *just-qualified candidate* from a *not-quite-qualified* candidate. A clean, PDF-version of the final description was distributed to panelists to use for the remaining phases of the study (see Appendix C for the just-qualified candidate description).

Panelists' Judgments

The standard-setting process for the *Praxis* Technology and Engineering Education test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). Using this method, each panelist judged each item on the likelihood (probability or chance) that the just-qualified candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the just-qualified candidate would answer the item correctly because the item is difficult for the just-qualified candidate. The higher the value, the more likely it is that the just-qualified candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the just-qualified candidate and the item and determined the probability that the just-qualified candidate would answer the question correctly. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Items in the 0 to .30 range were those the just-qualified candidate would have a *low chance* of answering correctly.

- Items in the .40 to .60 range were those the just-qualified candidate would have a *moderate chance* of answering correctly.
- Items in the .70 to 1 range were those that the just-qualified candidate would have a *high chance* of answering correctly.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that there was a *high chance* that the just-qualified candidate would answer the question correctly, the initial decision would be in the .70 to 1 range. The second decision for the panelist was to judge if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationales. All panelists completed a post-training evaluation to confirm that they had received adequate training in the Modified Angoff method and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. Item-level data were highlighted to show when panelists diverged in their judgments or converged in their judgments (i.e., when at least two-thirds of the panelists' judgments were in the same difficulty range).

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the just-qualified candidate and helped to clarify aspects of items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to each other's judgment, but for them to understand the different, but relevant, perspectives among them.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists' final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

Results

Expert Panels

Table 2 presents a summary of the panelists' demographic information. The panel included 13 educators representing 10 states. (See Appendix A for a listing of panelists.) Five panelists were teachers, 2 were a school administrator or department head, four were college faculty, one was a college administrator or department head, and one was a pathway advisor/pre-engineering curriculum specialist. All four faculty members' job responsibilities included the training of technology and engineering teachers.

Table 2
Panel Member Demographics

Background Survey Question	Number	Percent
What is your current position?	**N**	**%**
Teacher	5	38
School Administrator or Department Head	2	15
College faculty	4	31
College Administrator or Department Head	1	8
Pathway Advisor/Pre-Engineering Curriculum Specialist	1	8
How do you describe yourself (i.e., race/ethnicity)?	**N**	**%**
Asian or Asian American	2	15
Black or African American	1	8
White	9	69
Hispanic or Latino/White	1	8
What is your gender?	**N**	**%**
Female/Woman	4	31
Male/Man	9	69
Are you currently certified as a technology & engineering teacher in your state?	**N**	**%**
Yes	8	62
No	0	0
I am not currently working at the P-12 level	5	38
Are you currently teaching technology & engineering in your state?	**N**	**%**
Yes	7	54
No	1	8
I am not currently working at the P-12 level	5	38

Table continues on the next page.

Table 2 *(continued from the previous page)*
Panel Member Demographics

Are you currently supervising or mentoring other technology & engineering teachers?	**N**	**%**
Yes	3	23
No	5	38
I am not currently working at the P-12 level	5	38
Including this year, how many years of experience do you have teaching technology & engineering?	**N**	**%**
3 years or less	1	8
4–7 years	3	23
8–11 years	1	8
12–15 years	0	0
16 years or more	3	23
I am not currently working at the P-12 level	5	38
Which best describes the location of your K–12 school?	**N**	**%**
Urban	1	8
Suburban	4	31
Rural	2	15
I am not working in a school (e.g., district-level)	1	8
I am not currently working at the P-12 level	5	38
If you are college faculty, are you currently involved in the training/ preparation of candidates in technology & engineering?	**N**	**%**
Yes	4	31
No	0	0
Not college faculty	9	69

Standard-Setting Judgments

Table 3 shows the passing score recommendations of each panelist at each round—the number of raw points needed to "pass" the test. The recommendations are the raw score points needed out of a maximum of 100.

Table 3

Raw Score Recommendation of Each Panelist by Round of Judgments

Panelist	Round 1	Round 2
1	63.80	63.50
2	64.70	63.90
3	51.45	56.05
4	57.30	60.40
5	60.30	64.50
6	79.40	75.55
7	69.00	67.95
8	65.65	66.05
9	60.70	60.15
10	69.75	67.80
11	59.20	59.40
12	66.30	65.00
13	73.60	73.35

Table 4 summarizes the standard-setting judgments of the panel at each round of judgment. The mean represents the panel's passing score recommendation at each round. Table 4 also includes the standard deviation and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel's standard-setting judgments. It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test. (Appendix D provides the technical notes, which further describe the SEJ.)

Table 4

Summary Statistics by Round of Judgments

Statistic	Round 1	Round 2
Mean	64.70	64.89
Minimum	51.45	56.05
Maximum	79.40	75.55
SD	7.30	5.46
SEJ	2.02	1.52

Round 1 judgments are made without discussion among the panelists. Therefore, there is typically more variability in judgments present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease—indicating convergence among the panelists' judgments—was observed (see Table 4).

The Round 2 mean score is the panel's final recommended passing score. The panel's passing score recommendation for the *Praxis* Technology and Engineering Education test is 64.89 (out of a possible 100 raw-score points). The value was rounded to the next highest whole number, 65, to determine the functional recommended passing score. The scale score associated with 65 raw points is 157.

The conditional standard error of measurement (CSEM) around the recommended passing score is 4.79 raw points. A standard error represents the uncertainty associated with a test score (See Appendix D for further information about the CSEM.) Table 5 shows the raw scores and the scale scores associated with one and two CSEM below and above the recommended passing score.

Table 5

Scores 1 and 2 CSEM Around the Recommended Passing Score (RPS)

Scores	Raw Score Points out of 100	Praxis Scale Score Equivalent
RPS - 2 CSEM	56	144
RPS - 1 CSEM	61	151
RPS	**65**	**157**
RPS +1 CSEM	70	164
RPS +2 CSEM	75	171

Notes. CSEM = conditional standard error(s) of measurement. The CSEM of the recommended passing score is 4.79 raw points. The unrounded CSEM value is added to, or subtracted from, the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and then converted to scale scores.

Final Evaluations

The panelists completed an evaluation at the conclusion of the standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were shown the panel's recommended passing score after Round 2 and asked, in the evaluation, (a) how comfortable they are with the recommended passing score and (b) if they think the score was *too high*, *too low*, or *about right*. A summary of the final evaluation results is presented in Appendix E.

All panelists strongly agreed or agreed that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists strongly agreed or agreed that

they were prepared to make their standard-setting judgments. All panelists strongly agreed or agreed that the standard-setting process was easy to follow.

All panelists reported that the description of the just-qualified candidate was at least somewhat influential in guiding their standard-setting judgments. All of the panelists reported that between-round discussions were at least somewhat influential in guiding their judgments. Six of the 13 panelists indicated that their own professional experience was very influential in guiding their judgments.

Seven of the 13 panelists indicated they were very comfortable with the passing score they recommended; five panelists indicated that they were somewhat comfortable and one panelist was somewhat uncomfortable with the recommended passing score. Twelve of the 13 panelists indicated the recommended passing score was about right; one panelist indicated that the recommended passing score was too low.

Summary

To support the decision-making process for education agencies establishing a passing score (cut score) for the *Praxis* Technology and Engineering Education test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the *Praxis* Technology and Engineering Education test, the recommended passing score is 65 out of a possible 100 raw-score points. The scale score associated with a raw score of 65 is 157 on a 100–200 scale.

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Appendix A: Panelists' Names & Affiliations

Participating Panelists With Affiliation and State

Panelist Name	**Panelists' Affiliation and State Abbreviation**
Allison Carter	Arkansas Department of Education - Division of Career and Technical Education (AR)
Jason Dockter	Valley City State University (ND)
Kyle Elward	CTE Digital Media Technology Instructor (MS)
Patrick Foster	Central Connecticut State University (CT)
Mylinda Fowler	Shippensburg Area Senior High (PA)
Bramdatt Goolsarran	Montgomery County Public Schools (MD)
Gary Graves	Washburn University (KS)
Wendy Ku	Simsbury Public School (CT)
Trevor Maiseroulle	Pittsburg State University (KS)
Vincent Martinez	Clearwater Valley High School (ID)
Nathan Mentzer	Purdue University (IN)
Thomas Siegrist	Montgomery County Public Schools (MD)
Tiffany Sudbury	Jefferson County Schools (AL)

Appendix B: Agenda

Praxis® Technology and Engineering Education (5053)

Standard-Setting Study

DAY 1 AGENDA

10:00 AM ET/9:00 AM CT/ 8:00 AM MT/ 7:00 AM PT/6:00 AM AK/5:00 AM HI	Welcome, introductions, and goals for the day Standard-setting overview presentation • Q&A about the training • Polling: Checking for understanding Test familiarization for the test • Overview & instructions • Independent test familiarization • Self-scoring instructions • Independent self-scoring **Break** Discussion of the content measured **Lunch break** Just-Qualified Candidate • Overview • Polling: Evaluation of JQC training • Small group drafts **Break** Just-Qualified Candidate (continued) • Whole group consensus
7:00 PM ET/ 6:00 PM CT/ 5:00 PM MT/ 4:00 PM PT/3:00 PM AK/2:00 PM HI	End of Day 1

Praxis® Technology and Engineering Education (5053)

Standard-Setting Study

DAY 2 AGENDA

10:00 AM ET/9:00 AM CT/ 8:00 AM MT/ 7:00 AM PT/6:00 AM AK/5:00 AM HI	Overview of the Day
	
	Honoraria Payment Process Presentation
	
	Standard Setting Training for Selected-Response Items
	• Instructions and materials
	• Independent practice round judgments
	
	Break
	
	Practice Round Data Discussion
	• Instructions, materials, and screen setup
	• Discussion of the practice round data
	• Polling: Evaluation of the judgment training
	
	Round 1 Standard Setting Judgments
	
	Lunch break
	
	Round 1 feedback: Summary data
	• Polling: Evaluation of data presentation
	Round 1 feedback: Item-level data and
	Round 2 judgments (break as needed)
	• Check out when finished
	BREAK
	
	Round 2 feedback: Recommended Passing Scores
	
	Complete final evaluation
	
	Wrap Up/ Final Steps
	• Review Nondisclosure of Secure Materials
	  ○ Destruction of Files
	  ○ What you can/cannot discuss
	• Final Questions and Thank You

7:00 PM ET/ 6:00 PM CT/ 5:00 PM MT/ 4:00 PM PT/3:00 PM AK/2:00 PM HI	End of Day 2

Appendix C: Just-Qualified Candidate Description

Description of the Just-Qualified Candidate[4]

A just-qualified candidate…

1. Is familiar with the relationships between technology and other curricular areas (e.g., STEAM, humanities, CTE)
2. Knows and uses appropriate tools, and terminology related to instructional technologies
3. Understands safety rules, procedures, and processes
4. Understands the engineering design process
5. Knows the critical features of each step of the engineering design process (e.g., design statement, constraints, criteria)
6. Is familiar with national standards (e.g., STEL and ISTE)
7. Knows the basic technology contexts in technology and engineering education
8. Understands and recognizes the universal systems model (inputs, processes, outputs, feedback)
9. Is familiar with professional organizations and career and technical student organizations
10. Knows the purpose of and where to find professional development opportunities
11. Knows the interrelationships between technology and society
12. Is familiar with instructional strategies and assessments that support student learning in technology and engineering education
13. Is familiar with modifying instructional practices as well as accommodating students with special needs (e.g., students with IEPs, 504s, and Title I status)

[4] Description of the just-qualified candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

Appendix D: Technical Notes

Standard Error of Judgment (SEJ)

The standard error of judgment (SEJ) is one way of estimating the reliability or consistency of a panel's standard-setting judgments. It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same threshold score on the same form of the assessment. The SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of threshold scores (Tannenbaum & Katz, 2013).

The SEJ is calculated by dividing the standard deviation of the panelists' judgments (*SD*) by the square root of the number of panelists (*n*). The result serves as an estimate of the standard error of the mean (Brennan, 2002).

$$SEJ = \mathrm{SD} / \sqrt{n}$$

Conditional Standard Error of Measurement (CSEM)

The conditional standard error of measurement (*CSEM*) for a test is computed from the study value (*SV*) of the recommended passing score and the number of selected-response items (*n*) on the test (see Lord, 1984):

$$CSEM = \sqrt{(SV)(n - SV)/(n - 1)}$$

Appendix E: Final Evaluation Results

Table E1

Final Evaluation Process Questions

Likert Statement	Strongly agree *N*	Strongly agree %	Agree *N*	Agree %	Disagree *N*	Disagree %	Strongly disagree *N*	Strongly disagree %
I understood the purpose of this study.	11	85	2	15	0	0	0	0
The instructions and explanations provided by the facilitators were clear.	5	38	8	62	0	0	0	0
The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	9	69	4	31	0	0	0	0
The explanation of how the recommended passing score is computed was clear.	8	62	5	38	0	0	0	0
The opportunity for feedback and discussion for round 2 judgments was helpful.	12	92	1	8	0	0	0	0
The process of making the standard-setting judgments was easy to follow.	7	54	6	46	0	0	0	0

Table E2

Final Evaluation: Standard-Setting Process

	Too much time *N*	Too much time %	About the right amount of time *N*	About the right amount of time %	Too little time *N*	Too little time %
Small group JQC drafts	3	23	9	69	1	8
Whole group JQC consensus	1	8	12	92	0	0
Training and practice for making standard-setting judgments	1	8	12	92	0	0
Round 1 judgments (independent)	4	31	7	54	2	15
Round 2 judgments (with discussion)	0	0	12	92	1	8

Table E3

Final Evaluation: Influences in Standard-Setting Judgments

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential *N*	Very influential %	Somewhat influential *N*	Somewhat influential %	Not influential *N*	Not influential %
The description of the just-qualified candidate	12	92	1	8	0	0
The between-round discussions	7	54	6	46	0	0
The knowledge/skills required to answer each test item	11	85	2	15	0	0
The passing scores of other panel members	3	23	8	62	2	15
My own professional experience	6	46	7	54	0	0

Table E4

Final Evaluation: Comfort with the Panel's Recommendation

Question	Very comfort-able *N*	Very comfort-able %	Somewhat comfort-able *N*	Somewhat comfort-able %	Somewhat uncom-fortable *N*	Somewhat uncom-fortable %	Very uncom-fortable *N*	Very uncom-fortable %
Overall, how comfortable are you with the panel's recommended passing score?	7	54	5	38	1	8	0	0

Table E5

Final Evaluation: Opinion of the Final Recommendation

Statement	Too low *N*	Too low %	About right *N*	About right %	Too high *N*	Too high %
Overall, the recommended passing score is:	1	8	12	92	0	0