

Subject-Matter Knowledge and the Standards of the National Board

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Abstract

Over the years there has been general agreement that teachers must know the subject matter they teach, but efforts to define precisely what knowing subject matter means have met with difficulty. With the advent of the National Board for Professional Teaching Standards and the resources that this organization has committed to the question, turning to the National Board's standards for answers seemed reasonable. We posed two questions: (1) What emphasis did the National Board assign to subject-matter knowledge as an element of teaching in its standards? and (2) What attributes of subject-matter knowledge are reflected in the standards advanced by the National Board? We used standard content-analysis procedures in addressing these questions. We found that overall, about 20% of the standards were addressed to subject-matter knowledge and 80% to other important elements of teaching. We also found that the views of the National Board about subject-matter knowledge seem to emphasize specific facts, laws, and generalizations. There was little concern in the standards for knowing the history of the disciplines or the structure (ways of knowing) associated with the disciplines. Implications of the findings are discussed. (185 words)

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There is much to-do these days about teacher competence, particularly in subject matter. This is not a new phenomenon; opinions about the knowledge that a teacher should have in a discipline have cycled in and out of prominence since the beginnings of teacher education (Edelfelt & Raths, 1999; Grossman, Wilson, & Shulman, 1989). The expectations for accomplished teaching advanced by the National Board for Professional Teaching Standards (n.d.1) are an example of a recent contribution to this literature.

At one level of discourse, almost everyone takes the position that teachers should know their subject, but what is meant by “know their subject” is not clear. Some argue, as an experienced secondary school principal did with us, that it means teachers can answer any question put to them by their students. Others contend that it means teachers do not make egregious errors of fact, grammar, or spelling that embarrass them, the school, and the profession (Weaver, 1979).

A position with perhaps greater expectations holds that teachers who know their subject understand what is not known in their field and what cannot be known (Wilson, Shulman, & Richert, 1990). Further, they can trace the history of knowledge in their subject and explain what was taken for knowledge in the past that has subsequently been discredited (Morowitz, 1990; Raths, 1999).

Finally, curriculum theorists claim that knowledge of subject matter involves exploring the characteristics, the structure, and the epistemology of a discipline; investigating why and how subjects are categorized into fields of study; and discovering how disciplines are related (Parker & Rubin, 1966).

Which of these conceptions or combinations thereof represent what is meant by the claim, “This teacher knows the subject matter”?

Another complication is that little consensus exists on what teachers at the different levels of schooling require (Ben-Peretz, 1984). Is it reasonable to expect secondary

school teachers to have a broader and deeper understanding of the subject matter they teach than elementary school teachers who teach most subjects? What is a reasonable expectation for special education teachers? Obviously an easy generalization that all teachers should know their subject matters is more complicated than it seems at first.

A third complicating element is whether knowledge is fixed and absolute, or changing. If knowledge is changing, then teachers' knowledge of subject matter also must be mutable and evolving. Of course, some knowledge in any content area is fairly fixed, durable, or stable, but a standard characteristic of disciplines is the changing nature of knowledge. Physics is now more Einsteinian than Newtonian; mathematics seems to be shifting from a focus on calculus to an emphasis on finite mathematics; earth scientists now speak of the "big bang" theory, which was not found in the textbooks a mere 25 years ago. Similar changes in concepts and orientations have occurred in other disciplines as well. Although much knowledge is fairly stable, changes in knowledge are continuous. To be in command of subject matter, a teacher must be a persistent learner.

Context of the Study

As the foregoing discussion demonstrates, the concept "teacher subject-matter knowledge" is complicated. To contribute to its clarification, a study of standards for teacher competence in subject matter is important today. The standards of the National Board provide an opportunity to examine the thinking of experts on the issue. In the last 15 years, the National Board has devoted much time, effort, and money to committees developing standards for the advanced certification of teachers. The committees have included schoolteachers, experts in child development, teacher educators, and professors in relevant disciplines. The resulting standards indicate that subject-matter knowledge is one of several areas of competence required of accomplished teachers. Although the National Board's work has received its share of

criticism (Thirunarayanan, 2004), in general it has been well received by educators and has been applied in assessing teachers for advanced professional certification.

According to the National Board's (n.d.2) website, more than 40,000 teachers have earned national professional certification.

An examination of the National Board's subject-matter standards for highly qualified teachers also is particularly relevant at this time in view of the criteria for highly qualified teachers put forth in 2001 by the No Child Left Behind Act (a reauthorization of the Elementary and Secondary Education Act) (U.S. Department of Education, n.d.). In fact, the results of such an examination might bring more detail to No Child Left Behind's general criteria.

Also relevant is consideration of other factors that National Board standards include as essential in defining highly qualified teachers.

Research Questions

We reviewed most of the National Board's standards for accomplished teachers and found that they included about the same areas of focus. Therefore we selected five subject-matter standards for our study (those for the core subjects and for world languages other than English) as representative of all National Board standards. Most students take the four core subjects.

These standards prompted the following research questions:

1. What emphasis did the National Board assign to subject-matter knowledge as an element of teaching in its standards for middle and secondary school teachers of English, mathematics, science, social studies–history, and world language?
2. What attributes of subject-matter knowledge are reflected in the standards advanced by the National Board for middle and secondary school teachers of English, mathematics, science, social studies–history, and world languages?

Significance of the Research Questions

Examining current views of subject-matter knowledge and discerning the conceptions embedded in those views is essential, particularly because the literature shows little agreement on what constitutes subject-matter knowledge. This study is especially timely. The No Child Left Behind legislation requires states to define “high-quality teachers,” with a strong emphasis on the language of the law on subject-matter knowledge. Teams representing practitioners, teacher educators, professionals in relevant disciplines, and experts in child development worked with the National Board to develop standards for accomplished teachers. Our analysis may provide the field with a more comprehensive concept of highly qualified teachers.

Procedures

To conduct our study, we used the basic procedures of content analysis (Berelson, 1952). These procedures included counting and coding the sentences found in the standards under review; estimating the reliability of the coding judgments; acknowledging our assumptions; and explaining the delimitations of our approach.

Our procedures included three steps. First, we counted the sentences under each of the relevant standards in all the disciplines that we selected for study. Second, we classified the sentences that were directed at expectations of subject-matter knowledge. Third, to get a grasp of the National Board’s position on the important construct of expectations of subject-matter knowledge, we coded the sentences that were directly related to it.

Counting and Coding of Sentences

For Research Question 1, we took the most recent National Board standards for adolescents and young adults in the five disciplines under examination (National Board, 1998, 1998/2001, 2001a, 2001b, 2001c) and numbered all the sentences under each standard. We counted the number of sentences assigned to each substandard that

included knowledge of subject matter and to each standard associated with assessment, knowledge of students, professional community, outreach, reflection, and similar areas related to a broad conception of teaching. The counts provided a view of the amount of attention given to subject-matter knowledge in the broad range of desiderata expressed by the National Board in its sets of standards.

For Research Question 2, we coded all the sentences having to do with subject-matter knowledge into five categories: specific subject-matter knowledge, general subject-matter knowledge, subject-matter knowledge related to teaching students, generalizations about teaching, and none of the above. This effort portrayed the general thrust of the narratives found in the National Board work related to subject-matter knowledge. The criteria that we used for coding the subject-matter knowledge sentences are described in Appendix A.

To refine our data related to Research Question 2, we introduced a new set of codings. In this effort we classified the sentences that were coded as representing specific subject-matter standards (above) according to seven categories: what accomplished teachers can do; what accomplished teachers know; what accomplished teachers understand; what accomplished teachers are familiar with; what accomplished teachers know about the history of their discipline; and what accomplished teachers know about the structure of their discipline; and other. (The coding system is explicated in the coding sheet in Appendix B.) This coding task was designed to uncover the structure of the National Board's conception of specific subject-matter knowledge.

Estimation of the Reliability of the Coding Results

For both sets of codings, we worked independently, classifying the sentences according to our coding schemes. After coding each of the standards within each discipline, we conferred, comparing results, negotiating some disagreements, and agreeing to disagree on others. After each of these exchanges, we amended the coding guides to clarify our

definitions further. The levels of agreement reported here reflect the postconference findings.

For the first coding task, classifying the sentences related to subject-matter knowledge into five categories, the levels of agreement ranged from 87% for social studies–history to 79% for mathematics and world languages. For the second coding task, classifying the specific subject-matter sentences from task 1 into seven categories, the levels of agreement ranged from 93% for English and mathematics to 79% for science.

Assumptions

Our procedures were based on the following assumptions, most of them standard ones associated with content-analysis approaches:

1. That the number of sentences written to each standard within each discipline is an indicator of the importance of the standard.
2. That the results of our coding are trustworthy.
3. That the standards themselves are not just window dressing – that how candidates for National Board certification are ultimately and actually assessed is a direct reflection of the standards.

Delimitations

We narrowed our project in the following ways:

1. We examined only the standards for adolescents and young adults in the areas of English, mathematics, science, social studies– history, and world languages at the middle and secondary school level. We made this decision because (a) we understood that these five areas represented the subjects most students take; (b) we thought that these five areas represented well all the areas included in middle and secondary schools; and (c) after a review of most other National Board subject

and grade-level standards, we concluded that these five areas were similar in content and emphasis to the others.

2. We took the titles of the standards at face value and did not examine all the other standards for statements of what accomplished teachers need to know.

Findings

We report our findings relating to the two research questions and some related issues.

Findings for Research Question 1

Research Question 1 asked, “What emphasis did the National Board assign to subject-matter knowledge as an element of teaching in its standards for middle and secondary school teachers of English, mathematics, science, social studies–history, and world language?” Our scheme addressing this question involved counting the number of sentences assigned to each standard in each of the five disciplines (see Table 1). The names of the standards varied a bit from discipline to discipline, and we combined those that seemed to be of the same sort. For example, “Knowledge of Students” found in the English, mathematics, social studies–history, and world language standards was merged with “Understanding Students” in the science standards. The findings show that overall, 21% of the sentences are allotted to standards associated with subject-matter knowledge.

[Insert Table 1 about here.]

The discipline with the heaviest emphasis on subject-matter knowledge is social studies–history, with 33%. The discipline with the least number of sentences in this area is English, with 12%.

Findings for Research Question 2

Research Question 2 asked, “What attributes of subject-matter knowledge are reflected in the standards advanced by the National Board for middle and secondary school

teachers of English, mathematics, science, social studies–history, and world languages?” Our scheme addressing this question involved classifying all the sentences in the subject-matter knowledge standard for each discipline according to five categories (see Table 2). We were especially interested in how specific the standards were in defining what accomplished teachers need to know. Of the 462 sentences that described subject-matter knowledge in the five standards, 251 (54%) were specific. The remaining 46% of the sentences were general, were directed to instruction, or applied to any discipline. (See Appendix A for the coding scheme.)

[Insert Table 2 about here.]

As a follow-up, we classified the sentences in Table 2 that related to subject-matter-specific standards into seven categories in an effort to describe graphically what expectations were held in this area for accomplished teachers (see Table 3). The results of this analysis showed that 75% of the sentences dealt with what teachers should know how to do, know, understand, or be familiar with. Approximately 12% addressed the history or the structure of the discipline. The remaining 13% could not be classified under our system of coding.

[Insert Table 3 about here.]

Related Findings

Although the National Board spent much time and money having each disciplinary team develop standards for such areas as assessment, for relating with parents, and for contributing to a community of learners, the sentences for those standards authored by social studies–history teachers, mathematics teachers, English teachers, and so on are remarkably alike. There is great consistency, if not a consensus, about how those standards operate in the context of accomplished teaching in any subject on the middle and secondary school level.

On the other hand, the National Board appeared to be committed to the idea that distinguished science teachers know what science teachers need to know, distinguished social studies–history teachers know what social studies–history teachers need to know, and so on. Oddly, this commitment to the disciplines did not carry over to writing standards for such areas as assessment, reflection, and families. It would have been appropriate and more consistent with the National Board’s value of the specific knowledge of specialists for it to have, for example, assessment professionals contribute expertise to the standards on assessment, sociologists to the standards on family outreach, and cognitive psychologists to the standards on reflection. As we read the standards in these important areas, we were not able to see a disciplinary nuance in the assessment standards, for instance, or in the family outreach standards. Specialists too could contribute to those standards and assist in finding some uniformity and consistency across disciplines to aid in communicating what is expected of accomplished teachers in these areas.

Conclusions and Discussion

Conclusions

First, we asked, “What emphasis did the National Board assign to subject-matter knowledge as an element of teaching in its standards for middle and secondary school teachers of English, mathematics, science, social studies–history, and world languages?” Our analysis supports the following conclusion: Subject-matter knowledge was only 1 of approximately 11 important components of accomplished teaching. Even so, it received more emphasis than any other single component, with 21% of the sentences used to describe accomplished teaching assigned to subject-matter knowledge.

Surely this conclusion speaks to the importance of elaborating on the definition of “highly qualified teacher” now deeply rooted in efforts to implement No Child Left Behind. Given the broad dimensions of accomplished teaching reflected in these

standards, efforts to identify highly qualified teachers must not be given short shrift by looking only or even primarily at grade-point averages, transcripts, or test scores. The public and our nation's youth deserve much more.

Second, we posed the question, "What attributes of subject-matter knowledge are reflected in the standards advanced by the National Board for middle and secondary school teachers of English, mathematics, science, social studies–history, and world languages?" The results of our study support the following conclusion: In the various standards we studied, subject-matter knowledge was treated mainly as "knowing the facts." The standards gave little attention to important overarching ideas, ways of knowing, structures of the disciplines, or the transient nature of knowledge.

Discussion

Shortcomings in language. Discussions of what teachers need to know about their subject matters are fraught with difficulties because of the insufficiency of our language and our strategies of discourse. Colleagues seem to feel comfortable asserting that social studies–history teachers need to know the causes of the Civil War or that science teachers need to know the steps of the scientific method. The advocates for these claims apparently assume that all who accept them as credible agree on what the causes of the Civil War were or what the steps of the scientific method are. If the authors of standards spelled out what they thought the causes of the Civil War were, and then expected social studies–history teachers to know those specifics, a consensus would be difficult to achieve among social studies–history teachers, who are likely to dispute the facts.

Similarly in science, if the standard asked that science teachers know the steps of the scientific method, most would accept the standard. But if the standard read, "Know these six steps of the scientific method," there probably would be less agreement because scientists and science teachers are unlikely to agree on what particular steps make up the scientific method.

So discussions of subject-matter knowledge are apt to use general language rather than specific language to communicate bits of knowledge that teachers need to know – categories of knowledge, rather than specifics. This level of abstraction in enunciating expectations gives little help to evaluators who must construct assessment tasks that align with the standards approved by the National Board. Further, the imprecision makes it difficult for candidates for National Board status to know what is expected.

Roles of knowledge in teaching, then and now. An old-fashioned and discredited view of teaching involves a teacher knowing subject matter, and through lectures, demonstrations, or exhortations, passing on the knowledge to the student. This model especially requires that the teacher know his or her subject matter.

Another view of teaching places the student in greater control of his or her learning. The student listens, observes, cogitates, conceptualizes, reflects, integrates new learning with existing knowledge and awareness, creates understandings of what has transpired, and then digests everything. The teacher tries to learn what the student has “done” with the subject matter. Although knowledge of subject matter is important, such functions as accommodating prior knowledge, presenting information in various modalities, assessing students’ skills and beliefs, and the like come to the fore.

Further, under this view of teaching, understanding the curriculum is more important than merely recounting it. Teachers must understand their language, mathematics, science, and social studies–history content. With such understanding, they can better interpret the views of their students, their sources, their links, and their imports. The National Board’s expectations for accomplished teachers in terms of “understanding” represent only about 23% of all the sentences describing specific subject-matter knowledge.

Variations across standards. These generalizations notwithstanding, the treatment of subject-matter knowledge was quite different from discipline to discipline, as reflected in Tables 2 and 3. That is, apparently there was no “National Board” view of subject-

matter knowledge giving direction to the crafting of the various standards. Rather, there were idiosyncratic views that reflected differences either among disciplines or among the various committees charged with writing about subject-matter knowledge.

For example, the science committee described the specific content that teachers need to know in 17 sentences, with 9 of them (53%) directed to the structure of science as a discipline. The mathematics committee required 59 sentences to set the specific knowledge needed by mathematics teachers, with only 5 of them (8%) addressing the structure of the discipline. The social studies–history committee wrote 136 sentences addressing the specifics of what social studies–history teachers need to know, with just 8 (6%) speaking to the structure of social studies–history as a discipline. English and world languages committees spoke to specific subject-matter knowledge requirements with 14 sentences and 25 sentences respectively. Is the character or the essence of each discipline so different that it has its own view of subject matter?

Further, few sentences in the standards spoke either to the structure of the discipline or to the history of the discipline. In this respect the science committee devoted more than half of its sentences to teachers' knowing the structure of the scientific process. Apparently the social studies–history committee members were less interested in having distinguished teachers of social studies–history understand the ways in which social studies–history is conducted as a discipline.

This raises the question of how the work of the various committees was reviewed. When the National Board received the committees' work, did it apply standards or rubrics in deciding that the effort was worthy of publishing as official positions of the National Board?

In the postmodern world, scholars have been accepting the notion of multiple realities. Thus, it is not surprising that the views of one group about what teachers need to know did not match, emulate, or overlap with the views of another group.

However, this ontological idea is not clearly reflected in the National Board's narratives. On the contrary, those narratives suggest that professional, accomplished teachers know what teachers need to know. The idea that the views of what subject matter is needed by accomplished teachers are transitory, subjective, and reflective of the whims of various committees runs counter to the notion that teaching is a profession with a broad consensus on what is needed. Postmodernists probably feel comfortable when one group of people see Earth's moon as a geological specimen of rocks and minerals while others see it as made of green cheese. Such views surely reflect multiple realities, but as professionals, we know that some views of reality are more useful and more credible than others.

Our bottom line is that, given the variety of expressions of subject-matter knowledge approved by the National Board, we do not know what position the National Board takes on the question, "What do accomplished teachers need to know about their subject matter?" Certainly the standards make clear the need for more specificity in what is meant by subject matter and for balance between subject-matter competence and several other factors essential for high teacher competence.

So the National Board's efforts are a good start, but there is work to be done.

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Appendix A

Coding Standards for Classifying Sentences in Subject-Matter Knowledge Standards

In analyzing National Board standards, we coded every sentence in each standard for subject-matter knowledge in five disciplines – English, mathematics, science, social studies–history, and world languages – to determine whether it depicted something that was subject matter – specific (SMS), subject matter – general (SMG), generic to any teaching field (G), a discussion of pedagogical content knowledge (PCK), or indeterminate (O).

A sentence considered separately from a sequence of sentences can easily be misinterpreted when taken out of context. We tried to avoid such misinterpretation in coding by considering the context of a sentence.

We used the following coding rules to guide our work:

1. SMS: A statement about facts, understandings, principles, concepts, or categories that includes the specifics that accomplished teachers in the discipline should know.

To be classified as SMS, a sentence must meet the following criteria:

- a. The sentence mentions a specific subject matter such as science, mathematics, or English. Phrases such as “distinguished teachers of mathematics,” “accomplished science teachers,” or the pronoun “they” referring to the previous phrases do *not* count as mentions of subject matter.
- b. The sentence cites elements of knowledge, or categories that include specific elements of knowledge, relevant to the discipline. (See the underlined elements in the examples.)
- c. The sentence gives emphasis to the teacher’s knowing something about the content.

Examples

1. Accomplished teachers recognize algebra's role for modeling problem situations and for reasoning and drawing inferences about functions. (Mathematics)
2. Using their knowledge of the properties of Euclidian space, teachers solve problems in a variety of fields – art, engineering, etc. (Mathematics)
3. Accomplished teachers should also be familiar with other areas of mathematics opened up by technology, such as self-similarity in fractal geometry. (Mathematics)
4. They understand and can explain how to use limits, derivatives, integrals, as tools to measure and analyze rates of change. (Mathematics)

2. SMG: A statement about what teachers should know about their subject matter but written generally, without specifics.

To be classified as SMG, a sentence must meet the following criteria:

- a. The sentence must mention a specific subject matter or discipline such as science, mathematics, or English. Phrases such as “distinguished teachers of mathematics,” “accomplished science teachers,” or the pronoun “they” referring to the previous phrases do *not* count as mentions of subject matter.
- b. The sentence must give emphasis to the teacher's knowing something about content. (See the underlined words and phrases in the examples.)
- c. A statement calling on teachers to know the principles of science (without citing them) or to understand the structure of grammar (without specifying the structure) or to grasp the major ideas of social studies–history (without delineating the ideas) falls into the SMG category.

Examples

1. They know their students, and they know the ideas and procedures of mathematics. (Mathematics)

2. New concepts, principles, and methods become a part of the discipline [mathematics] each year. (Mathematics)
3. Accomplished mathematics teachers' knowledge of mathematics is constantly growing in a way that encourages the integration of new facts, concepts, procedures, technologies, and applications into their teaching repertoire. (Mathematics)
4. For accomplished science teachers, a starting point for establishing such a productive learning climate is a deeply structured knowledge of the nature of science and the inquiry process. (Science)
5. It is axiomatic that science teachers at all levels should know the fundamental facts and concepts they have been charged with inculcating by the time their students graduate from high school. (Science)

3. G: A generalization about teaching that applies to any subject or any level.

To be classified as G, a sentence must meet the following criteria:

- a. There is no mention of a subject matter or discipline in the sentence. That is, words such as "science" or "mathematics" are not found in the sentence. Phrases such as "distinguished teachers of mathematics," "accomplished science teachers," or the pronoun "they" referring to the previous phrases do *not* count as mentions of subject matter.
- b. The description applies to the practice of teaching at any level or for any subject. The description might include understandings, skills, practices, goals, actions, or steps associated with teaching or teachers.

Examples

1. They [teachers] respect all their students and help them meet new challenges. (Mathematics)

2. They recognize that the long range goal of a teacher is to help students become self-directed and capable of learning on their own. (Mathematics)
3. Teachers operate with a sense of purpose in the classroom. (Science).

4. PCK: A description of a pedagogical move, act, or motive associated with a specific subject matter.

To be classified as PCK, a sentence must meet the following criteria:

- a. The sentence must mention a specific subject matter such as science, mathematics, or English. Phrases such as “Distinguished teachers of mathematics,” “accomplished science teachers” or the pronoun “they” referring to the previous phrases do *not* count as mentions of subject matter.
- b. The sentence must describe a teaching motive, action, objective, goal, practice, or steps associated with instruction in the classroom.

Examples

1. Recognizing that each student can gain increased mathematical understanding, they expect their students to prosper in the study of mathematics, and they communicate that expectation to them. (Mathematics)
2. Teachers help students acquire confidence in learning, doing, and understanding mathematics. (Mathematics)
3. Accomplished teachers seek to keep all their students involved in learning mathematics. (Math I)

Note: The focus of 1, 2, and 3 is not about the teacher “knowing” something about mathematics. Instead, in a mathematics context, the sentence calls on the teacher to understand classroom processes or to take certain actions in the classroom. We are reserving our classification of SMG and SMS for sentences that are concerned with teacher knowledge of subject matter.

4. And only teachers who understand the inquiry process will be able to involve their students in doing their own consistent, strategic, and legitimately scientific investigations. (Science)

5. O: A statement that is an observation about schools, teaching, or human nature and not about teaching, the act of teaching, or what teachers know about their subject matter.

To be classified as O, a sentence must meet the following criteria:

- a. The sentence may or may not mention a particular subject matter; the key issue here is that the sentence does not describe teaching actions or knowledge that teachers ought to know. Instead, the sentence comments on the current contexts of teaching or the attributes of students (or circumstances that surround teaching or schooling).
- b. The sentence is a fragment leading to a bulleted list, or a rhetorical device to move from one topic to another.

Examples

1. In most cases, instructional goals will already have been defined broadly at the district, state, and national levels. (Science)
2. But what, exactly, is the knowledge base that an accomplished science teacher must command, given the extraordinary vastness of the domain of science? (Science)
3. Each of these aspects of the accomplished science teacher's command of the subject area requires further explication. (Science)
4. The breadth of their knowledge base, organized by discipline, includes a firm understanding of the following aspects of science: (Science)

Appendix B

Classifications of SMS Sentences

We wanted to give special attention to sentences that addressed specific subject-matter knowledge. To that end we further classified sentences classified under the coding scheme found in Appendix A as “subject matter – specific,” into one of the following six categories. If a sentence did not fit, we classified it as Other (O).

- A: What accomplished teachers can do: These sentences describe what teachers can do and can demonstrate in the classroom associated with their subject-matter knowledge. They can speak, write, do proofs, link the past to the present.
- B: What accomplished teachers know: These sentences include specific facts, generalizations, and topics that teachers should know.
- C: What accomplished teachers understand: These sentences tell what teachers understand about subject matter.
- D: What accomplished teachers are familiar with: These sentences include facts teachers recognize, are aware of, or have a personal relationship with in regard to subject matter.
- E: What accomplished teachers know about the history of their discipline: These sentences speak to knowing the history of the discipline.
- F: What accomplished teachers know about the structure of their discipline: These sentences speak about the structure and the characteristics of the discipline, how facts are ephemeral, how the structure links to other disciplines, and so forth.

Table 1**Number of Sentences Written to Various NBPTS Standards Across Disciplines**

Standard	English	Mathe- matics	Science	Social Studies- History	World Lang.	Total
Knowledge of Students	26	63	45	42	46	222
Knowledge of Subj. Mtr.	45	112	58	205	42	462
Fairness	17	38	31	30	35	151
Learning Environment	30	16	41	59	37	183
Instructional Resources	40	0	32	27	21	120
Integrated Instruction	149	101	129	74	76	529
Assessment	21	23	26	29	24	123
Self-Reflection	21	20	29	41	29	140
Professional Community	20	14	21	20	15	90
Family Outreach	20	25	14	32	24	115
Promotion of Social Understanding	0	0	0	61	55	116
Total	389	412	426	620	404	2,251
Percent Subj. Mtr.	12%	27%	14%	33%	10%	21%

Table 2

**Classification of Sentences Found in Subject-Matter Standards for English, Mathematics, Science,
Social Studies-History, and World Languages**

Discipline	Reliability Estimate	Specific Subject Matters	General Subject Matters	Subject Matter Linked to Teaching	General	Other	Total
English	80%	14	3	8	17	3	45
Mathematics	79%	59	10	8	8	27	112
Science	85%	17	10	7	12	12	58
Social Studies-History	87%	136	10	23	21	15	205
World Languages	79%	25	4	7	1	5	42
Total		251	37	53	59	62	462

Table 3

Classifications of Sentences Describing Subject-Matter Specifics, by Discipline

Categories	English	Mathematics	Science	Social Studies- History	World Languages	Total
Reliability Estimate	93%	93%	79%	90%	92%	
Can do	1	23	2	30	15	71
Know	4	3	1	34	4	46
Understand	2	12	3	36	4	57
Familiar	5	3	1	6	0	15
History	2	3	1	0	0	6
Structure	0	5	9	8	2	24
Other	0	10	0	22	0	32
Total	14	59	17	136	25	251

Table 1
Count of Sentences Written to Various NBPTS Standards
Across Disciplines

Standard	Mathematics	English	History	Science	World Lang.	Total
Knowledge of Students	63	26	42	45	46	222
Knowledge of Subj. Mtr.	112	45	205	58	42	462
Fairness	38	17	30	31	35	151
Learning Environment	16	30	59	41	37	183
Instructional Resources	0	40	27	32	21	120
Integrated Instruction	101	149	74	90	56	470
Assessment	23	21	29	26	24	123
Self-reflection	20	21	41	29	29	140
Professional Community	14	20	20	21	15	90
Family Outreach	25	20	32	14	24	115
Promoting Social Understanding	0	0	61	0	55	116
Total	412	389	620	387	384	2192
Percent Subj. Mtr.	27%	12%	33%	15%	11%	21%

Problems with this table:

We need to make sure that the subject matter totals found here agree with those we classified in Table 2. They do – but do we need another row to enter the N's for Knowledge of Language Acquisition and Science Inquiry. Could the last two be added in with the Integrated Instruction? See below.

For some reason, we did not code the Science standard, Science Inquiry as subject matter knowledge, but then we fault them for not dealing with structures and the like. How can we fix that up?

Also, we didn't count Knowledge of Language acquisition in Subject Matter Knowledge. I think the reason was that the standard was about pedagogy and not about subject matter knowledge. Could that be true as well for the Science Inquiry standard?

Table 2

Classification of Sentences Found in Subject Matter Standards for
English, history, mathematics, science, and world languages

Discipline	Reliability Estimate	Specific Subject Matters	General Subject Matters	Subject Matter Linked to Teaching	General	Other	Total
English	80%	14	3	8	17	3	45
History	87%	136	10	23	21	15	205
Mathematics	79%	59	10	8	8	27	112
Science	85%	17	10	7	12	12	58
World Languages	79%	25	4	7	1	5	42
Total		251	37	53	59	62	462

Table 3
 Classifications of Sentences Describing Subject Matter Specifics
 By Discipline

Categories	English	History	Mathematics	Science	World Languages	Totals
Reliability Estimate	93%	90%	93%	79%	92%	
Can Do	1	30	23	2	15	71
Know	4	34	3	1	4	46
Understand	2	36	12	3	4	57
Familiar	5	6	3	1	0	15
History	2	0	3	1	0	6
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