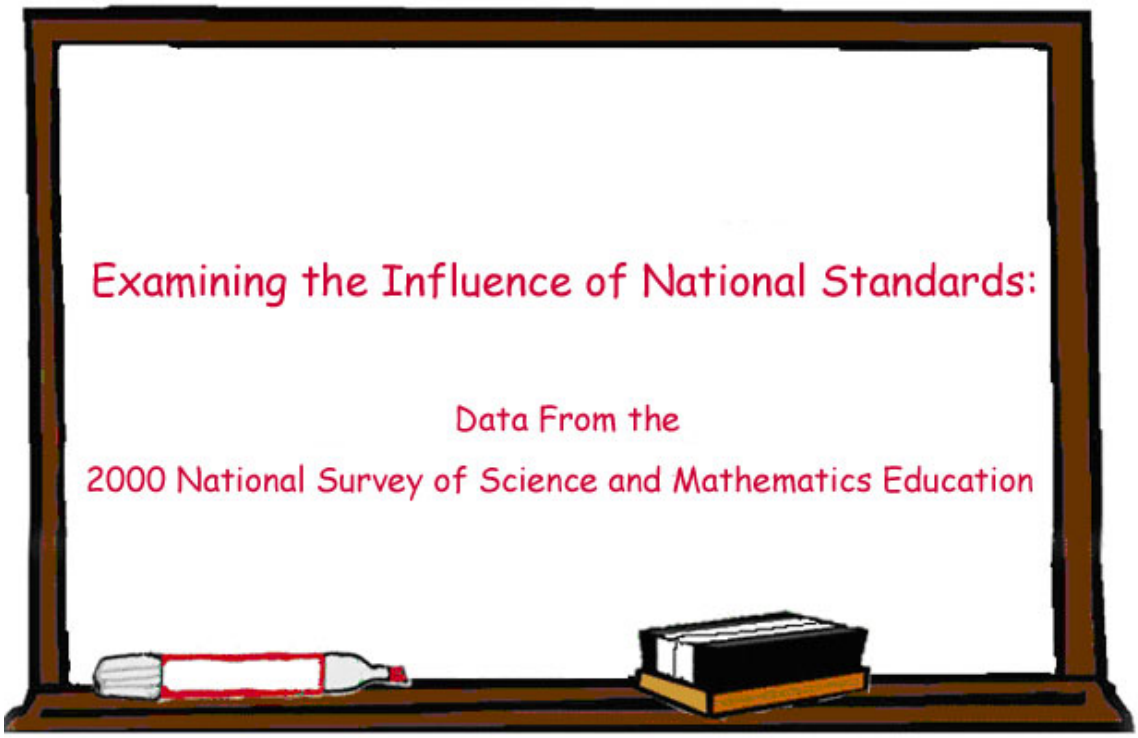

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Introduction

The *Report of the 2000 National Survey of Science and Mathematics Education* (Weiss et al, 2001) described teachers' familiarity and agreement with national standards as well as the extent to which teachers report implementing the recommendations in the *National Science Education Standards* (National Research Council, 1996). The purpose of this paper is to investigate the relationships between teachers' self-reports of familiarity with and implementation of the *Standards* and (1) preparedness to use standards-based teaching practices, (2) emphasis on instructional objectives, and (3) classroom practices.

Data from the 2000 National Survey show that about 60 percent of grade 5–12 science teachers are at least somewhat familiar with the S*tandards* compared to only 33 percent of grade K–4 teachers (Table 1).[1] Weiss et al (2001) also reported the extent to which teachers agree with the *Standards*, and the extent to which they have implemented them in their teaching. As can be seen in Table 1, roughly 70 percent of science teachers indicated that they agree with the vision of the *Standards* and indicate that they are implementing the recommendations in the *Standards* at least to a moderate extent.

Table 1
Science Teachers' Familiarity with, Agreement with, and Implementation of the NRC *Standards*, by Grade Range

	Percent of Teachers					
	Grades K–4		Grades 5–8		Grades 9–12	
Familiarity with NRC *Standards*						
Not at all familiar	67	(2.2)	42	(3.7)	37	(2.0)
Somewhat familiar	22	(1.8)	31	(3.0)	34	(2.2)
Fairly familiar	9	(1.3)	19	(2.4)	18	(1.4)
Very familiar	2	(0.5)	8	(1.6)	10	(1.1)
Extent of agreement with NRC *Standards*†						
Strongly disagree	0	(0.4)	0	—§	0	(0.2)
Disagree	4	(2.0)	5	(2.3)	7	(1.6)
No Opinion	26	(3.7)	27	(4.1)	22	(2.3)
Agree	61	(4.1)	62	(4.4)	65	(2.9)
Strongly Agree	8	(2.4)	6	(2.0)	5	(0.9)
Extent to which recommendations have been implemented†						
Not at all	5	(1.9)	4	(2.1)	4	(1.1)
To a minimal extent	26	(3.9)	22	(5.1)	28	(2.3)
To a moderate extent	57	(4.1)	51	(5.3)	56	(2.5)
To a great extent	12	(2.5)	23	(4.5)	12	(1.6)

§ No teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.
† These analyses included only those teachers indicating they were at least somewhat familiar with the *Standards.*

Additional analyses of these data show that there are no statistically significant differences in extent of familiarity, agreement, or implementation by school urbanicity, region, or SES.

[1] The standard errors for the estimates presented in this report are included in parentheses in the tables.

Using factor analysis, Weiss et al (2001) created a number of composite variables from the 2000 National Survey of Science and Mathematics Education. The composite scores were calculated by summing teacher responses to a series of related items and dividing by the total possible points. Analyses for this report focused on the relationships between teachers' responses about standards and three sets of composites.

Teacher Preparedness

- Preparedness to use standards-based teaching practices;
- Preparedness to teach students from diverse backgrounds; and
- Preparedness in the content area taught.

Instructional Objectives

- Emphasis on standards-based instructional objectives; and
- Emphasis on science content objectives.

Classroom Practices

- Use of projects/extended investigations;
- Use of strategies to develop students' ability to communicate ideas;
- Use of journals/portfolios;
- Use of informal assessment;
- Use of laboratory activities; and
- Use of traditional teaching practices.

Regression analysis was used to examine the relationships between the above composites and (1) teacher familiarity with the *Standards* and, (2) for those who were familiar with them, the extent of implementation of the *Standards*.[2] The regression analyses also controlled for a number of teacher characteristics (e.g., gender, race, content preparedness, years taught) and school factors (e.g., urbanicity and school attention to S*tandards*). Because science teaching in self-contained classes is often very different than in departmentalized classes, the interaction between being a self-contained teacher and familiarity with/implementation of the *Standards* was tested in each model.

The amount of variance explained by the models presented in this paper ranges from 7 to 38 percent. However, with the data available, it is not possible to determine whether the unexplained variance is due to some other factor(s) or to random variation in these measures among the population.

It should be noted that all of the analyses conducted for this report are correlational, not causal. It is not possible to tell from these data the direction of the relationship. The purpose of these analyses is to explore potential relationships among the variables, and to suggest directions for future research.

[2] All analyses were conducted using WesVar 4.1.

Teacher Preparedness

Since content preparedness is often considered a necessary, although not sufficient, pre-requisite for implementing standards-based instruction, it was decided to explore the relationship between familiarity with and implementation of the *Standards* and teacher content preparedness prior to conducting the other analyses. Table 2 shows that, when controlling for demographics, there is not a significant relationship between teacher content preparedness and teachers' reports of familiarity with or implementation of the *Standards*. It is interesting to note that teacher participation in 35 or more hours of professional development in the previous three years is correlated with higher levels of perceived content preparedness.

Table 2
Regression Results for Familiarity With and Implementation of the *Standards* and Teacher Content Preparedness

	Familiarity With	Implementation Of
Intercept	55.23	58.54
	(4.76)	(6.75)
Teacher Demographics		
White	-2.31	-0.21
	(2.51)	(3.47)
Female	-7.44*	-4.25
	(2.99)	(2.39)
Years Taught	0.10	0.21
	(0.12)	(0.13)
Grade Level (Grades 5–8 omitted)		
Grades K–4	-2.16	-4.29
	(2.41)	(3.33)
Grades 9–12	17.59***	15.06***
	(2.23)	(3.12)
More than 35 hours of Professional Development in last three years	10.94***	6.84*
	(2.91)	(2.70)
Self-Contained	-1.81	-3.01
	(3.07)	(5.73)
School Characteristics		
Metro Status (Suburban omitted)		
Urban	2.14	2.34
	(2.07)	(2.95)
Rural	6.05	7.38
	(3.29)	(4.32)
School Attention to *Standards* Composite	0.05	-0.04
	(0.05)	(0.07)
***Familiar with* Standards**	4.25	—
	(2.98)	
Familiar with* Standards *X Self-Contained	4.63	—
	(3.66)	
***Implementing the* Standards**	—	3.56
		(3.35)
Implementing the* Standards *X Self-Contained	—	6.48
		(5.53)
N	1984	1097
R^2	0.163	0.165
F	31.36***	11.98***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As can be seen in Table 3, teachers indicating they are familiar with the *Standards* report being better prepared to use standards-based teaching practices and to teach students from diverse backgrounds, scoring about 6 and 9 points higher, respectively, on these composites than teachers not familiar with the *Standards*. Not surprisingly, teacher content preparation is also a significant predictor of pedagogical preparedness.

Table 3
Regression Results for Familiarity with the *Standards* and Teacher Preparedness to Use Standards-Based Teaching Practices and to Teach Students Form Diverse Backgrounds

	Use Standards-Based Teaching Practices	Teach Students from Diverse Backgrounds
Intercept	45.91 (3.73)	52.74 (3.88)
Teacher Demographics		
White	1.34 (2.26)	-5.44** (2.03)
Female	5.34* (2.25)	7.60** (2.82)
Years Taught	0.04 (0.09)	0.00 (0.08)
Grade Level (Grades 5–8 omitted)		
Grades K–4	-4.28* (1.74)	-1.36 (1.91)
Grades 9–12	-3.54* (1.71)	-3.52 (2.04)
More than 35 hours of Professional Development in last three years	2.18 (1.63)	1.84 (1.69)
Science Content Preparedness Composite	0.30*** (0.03)	0.27*** (0.03)
Self-Contained	0.34 (3.07)	5.67 (2.91)
School Characteristics		
Metro Status (Suburban omitted)		
Urban	0.68 (1.66)	4.08 (1.79)
Rural	-0.56 (1.90)	-2.89 (1.96)
School Attention to *Standards* Composite	0.03 (0.03)	0.00 (0.04)
***Familiar with* Standards**	6.20** (2.23)	8.94*** (2.37)
Familiar with* Standards *X Self-Contained	-3.67 (2.62)	-9.20** (3.04)
N	1936	1953
R^2	0.241	0.170
F	21.63***	11.95***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

However, as shown by the significant interaction term, the relationship between being familiar with the *Standards* and preparedness to teach students from diverse backgrounds differs for self-contained and non-self-contained classroom teachers. To illustrate this interaction, Figure 1 shows the predicted values on this composite for one set of teachers (white, female, suburban, middle-school teacher with less than 35 hours of professional development over the previous three years, and average teaching experience, content preparedness, and school-wide attention to S*tandards*) by familiarity with the *Standards* and self-contained status. For non-self-contained teachers, familiarity with the *Standards* is clearly related to higher perceptions of preparedness to teach students from diverse backgrounds; no such relationship exists for self-contained teachers.

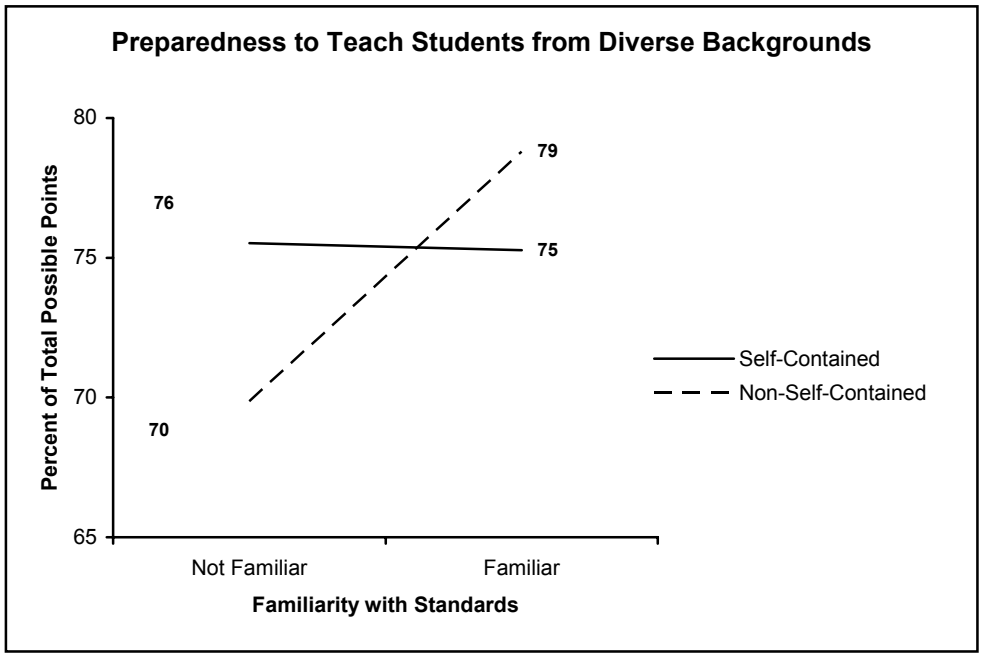

Figure 1

Table 4 shows that teachers who report implementing the *Standards* indicate that they are better prepared to use standards-based teaching practices and to teach students from diverse backgrounds. Again, science content preparedness is a significant predictor for these two composites.

Table 4
Regression Results for Implementation of the *Standards* and Teacher Preparedness to Use Standards-Based Teaching Practices and to Teach Students From Diverse Backgrounds

	Use Standards-Based Teaching Practices	Teach Students from Diverse Backgrounds
Intercept	48.85 (6.39)	55.37 (6.70)
Teacher Demographics		
White	-1.97 (2.71)	-4.24 (3.01)
Female	6.14 (3.34)	5.55 (3.01)
Years Taught	0.08 (0.10)	-0.06 (0.09)
Grade Level (Grades 5–8 omitted)		
Grades K–4	-1.26 (2.76)	1.72 (2.25)
Grades 9–12	-4.20* (1.95)	-7.62*** (2.15)
More than 35 hours of Professional Development in last three years	3.25* (1.61)	3.26* (1.63)
Science Content Preparedness	0.31*** (0.04)	0.28*** (0.04)
Self-Contained	-7.04* (2.98)	-4.67 (3.91)
School Characteristics		
Metro Status (Suburban omitted)		
Urban	-1.21 (2.30)	5.43* (2.55)
Rural	-4.05 (2.47)	-3.91 (2.46)
School Attention to *Standards*	0.06 (0.04)	0.06 (0.04)
***Implementing the* Standards**	5.17* (1.99)	6.09* (2.59)
Implementing the* Standards *X Self-Contained	2.17 (2.89)	-2.22 (3.77)
N	1082	1090
R^2	0.327	0.241
F	12.46***	8.60***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Instructional Objectives

The 2000 National Survey of Science and Mathematics Education also asked teachers to what extent each of a number of instructional objectives was emphasized in a randomly selected class. Factor analysis of these items indicated that two distinct factors existed: emphasis on nature of science objectives (e.g., learning to evaluate arguments based on scientific evidence) and emphasis on science content objectives (e.g., learning basic science concepts).

As can be seen in Table 5, teachers familiar with the *Standards* are more likely to report focusing on nature of science objectives in their classroom teaching, but are no more or less likely to focus on science content objectives. Interestingly, self-contained teachers are much less likely to report focusing on either type of objective than are non-self-contained teachers, perhaps reflecting the relatively minor emphasis placed on science instruction in the lower grades.

The regression model containing implementation of the *Standards* tells a similar story: a greater emphasis on nature of science objectives and no difference on science content objectives. (See Table 6.) The absence of difference on the science content objective outcome is somewhat reassuring. One concern sometimes expressed about the *Standards* is that they may de-emphasize the need to learn basic content and process skills. However, in this study, neither familiarity with nor implementation of the *Standards* is associated with a reduced emphasis on basic science content objectives.

Table 5
Regression Results for Familiarity with the *Standards* and Instructional Objectives

	Nature of Science	Science Content
Intercept	46.37	59.33
	(5.73)	(7.16)
Teacher Demographics		
White	8.44***	3.29*
	(2.31)	(1.58)
Female	1.52	0.96
	(1.23)	(0.96)
Years Taught	0.17**	0.05
	(0.06)	(0.05)
Grade Level (Grades 5–8 omitted)		
Grades K–4	-6.72**	-1.41
	(2.40)	(1.93)
Grades 9–12	-1.22	-0.90
	(1.57)	(1.10)
More than 35 hours of Professional Development in last three years	1.86	0.81
	(1.21)	(0.94)
Science Content Preparedness	0.09**	0.09**
	(0.03)	(0.03)
Self-Contained	-12.45***	-5.25*
	(2.83)	(2.13)
Pedagogy Control	0.03	0.16**
	(0.06)	(0.06)
School Characteristics		
Metro Status (Suburban omitted)		
Urban	2.09	1.23
	(1.60)	(1.30)
Rural	1.65	0.20
	(2.04)	(1.20)
School Attention to *Standards*	0.08*	0.05
	(0.03)	(0.03)
***Familiar with* Standards**	3.59*	0.04
	(1.52)	(1.40)
Familiar with* Standards *X Self-Contained	4.49	2.76
	(2.70)	(2.34)
N	1923	1928
R^2	0.265	0.152
F	31.86***	7.27***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6
Regression Results for Implementation of the *Standards* and Instructional Objectives

	Nature of Science	Science Content
Intercept	52.52	62.16
	(7.90)	(6.20)
Teacher Demographics		
White	6.43*	3.87
	(2.97)	(1.98)
Female	2.52	2.57*
	(1.43)	(1.21)
Years Taught	0.03	-0.03
	(0.10)	(0.07)
Grade Level (Grades 5–8 omitted)		
Grades K–4	-8.08***	1.15
	(2.10)	(2.75)
Grades 9–12	-0.31	0.47
	(1.89)	(1.33)
More than 35 hours of Professional Development in last three years	1.74	2.10
	(1.57)	(1.27)
Science Content Preparedness	0.11*	0.07
	(0.05)	(0.04)
Self-Contained	-6.51	-6.89
	(3.79)	(3.73)
Pedagogy Control	-0.03	0.12*
	(0.08)	(0.05)
School Characteristics		
Metro Status (Suburban omitted)		
Urban	0.05	1.39
	(2.37)	(1.32)
Rural	-1.30	-2.40
	(2.23)	(1.80)
School Attention to *Standards*	0.06	0.06
	(0.04)	(0.03)
***Implementing the* Standards**	5.38**	1.44
	(1.72)	(1.40)
Implementing the* Standards *X Self-Contained	-0.76	3.54
	(4.56)	(3.34)
N	1078	1077
R^2	0.192	0.126
F	8.13***	4.53***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Classroom Practices

The 2000 National Survey of Science and Mathematics Education also collected data on a variety of reform and traditional classroom practices. If the *Standards* are having an impact on teachers, one would expect to see differences in instructional practices depending on whether teachers are familiar with and implementing the *Standards*.

Table 7 shows the relationships between each of the teaching practice composites and familiarity with the *Standards*. For each of the five teaching practice composites "aligned" with the *Standards*, familiarity is a significant positive predictor. In all but one (use of journals/portfolios), science content preparedness is also a significant predictor. Interestingly, self-contained teachers were no more or less likely to report using these teaching practices than non-self-contained teachers. Further, while high school teachers were no less likely to use laboratory activities or informal assessment than grade 5–8 teachers, they were less likely to use projects/extended investigations, journals or portfolios, and strategies that are intended to develop students' ability to communicate ideas.

Although teachers familiar with the *Standards* report greater use of standards-based teaching practices, they are no less likely to make use of traditional teaching practices, possibly indicating that teachers familiar with the *Standards* are using a more diverse set of instructional strategies.

Somewhat surprisingly, teacher report of implementation of the *Standards* is related only to the composite measuring use of laboratory activities, perhaps because this is what most teachers associate with the *Standards* (Table 8). Participation in more than 35 hours of professional development in the previous three years also predicts the composite score for use of laboratory activities, but not the other composites, possibly reflecting the make-and-take nature of many professional development efforts.

Table 7
Regression Results for Familiarity with the *Standards* and Teaching Practices

	Use of laboratory activities	Use of projects/ extended investigations	Use of informal assessment	Use of journals/ portfolios	Use of strategies to develop students' ability to communicate ideas	Use of traditional teaching practices
Intercept	51.85	29.98	46.72	33.92	46.50	54.07
	(7.45)	(4.57)	(7.00)	(7.47)	(6.01)	(4.97)
Teacher Demographics						
White	2.75	5.80**	8.47***	11.88***	4.00*	4.78*
	(1.92)	(1.66)	(1.51)	(2.43)	(1.88)	(1.84)
Female	2.05	0.83	3.99**	3.27	3.03*	-0.94
	(1.26)	(1.32)	(1.25)	(1.94)	(1.26)	(0.84)
Years Taught	0.04	0.05	-0.09	0.02	0.11*	0.09
	(0.06)	(0.05)	(0.06)	(0.08)	(0.05)	(0.05)
Grade Level (Grades 5–8 omitted)						
Grades K–4	-3.98	-9.79***	0.78	-3.28	0.23	-11.73***
	(2.55)	(1.88)	(2.19)	(2.99)	(1.95)	(1.39)
Grades 9–12	-2.12	-5.46***	-1.73	-9.89***	-5.05***	0.89
	(1.50)	(1.38)	(1.30)	(2.31)	(1.26)	(1.03)
More than 35 hours of PD in last three years	3.76**	1.73	1.13	1.72	0.94	0.61
	(1.13)	(1.13)	(1.43)	(2.08)	(1.03)	(0.80)
Science Content Preparedness	0.07**	0.06*	0.09**	0.01	0.10***	0.03
	(0.03)	(0.02)	(0.03)	(0.04)	(0.03)	(0.03)
Self-Contained	-1.39	-2.41	-4.02	0.77	-1.85	-7.49***
	(3.36)	(2.40)	(2.40)	(3.35)	(2.34)	(1.72)
Pedagogy Control	0.07	-0.02	0.20**	-0.07	0.13*	0.10*
	(0.07)	(0.04)	(0.07)	(0.07)	(0.06)	(0.05)
School Characteristics						
Metro Status (Suburban omitted)						
Urban	-1.40	0.27	-1.36	2.45	-1.92	-0.84
	(1.78)	(1.26)	(1.39)	(1.93)	(1.13)	(1.18)
Rural	-2.41	0.67	-1.62	-0.32	-1.52	-0.60
	(1.89)	(1.99)	(1.75)	(2.73)	(1.57)	(1.45)
School Attention to *Standards*	0.00	0.03	0.03	0.10*	0.04	0.06**
	(0.05)	(0.03)	(0.03)	(0.05)	(0.03)	(0.02)
***Familiar with* Standards**	7.15***	4.92**	1.15*	6.11***	3.38**	0.36
	(1.43)	(1.44)	(1.31)	(1.68)	(1.22)	(0.97)
Familiar with* Standard *X Self-Contained	-2.25	1.91	2.55	3.37	2.78	2.74
	(2.28)	(1.99)	(2.31)	(3.42)	(2.03)	(1.51)
N	1919	1833	1914	1900	1902	1870
R^2	0.137	0.205	0.127	0.098	0.109	0.380
F	9.95***	19.76***	7.63***	10.47***	5.89***	47.99***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8
Regression Results for Implementation of the *Standards* and Teaching Practices

	Use of laboratory activities	Use of projects/ extended investigations	Use of informal assessment	Use of journals/ portfolios	Use of strategies to develop students' ability to communicate ideas	Use of traditional teaching practices
Intercept	63.24	41.77	60.63	39.13	61.36	64.71
	(5.74)	(5.78)	(6.09)	(7.70)	(5.37)	(4.13)
Teacher Demographics						
White	0.28	4.09	10.32***	11.71**	3.01	1.70
	(2.89)	(2.77)	(2.16)	(3.46)	(2.33)	(1.99)
Female	2.23	-0.58	2.29	2.17	2.22	-1.26
	(1.48)	(1.41)	(1.39)	(2.08)	(1.61)	(0.96)
Years Taught	-0.07	-0.14*	-0.19**	-0.17	0.03	-0.10
	(0.07)	(0.07)	(0.06)	(0.09)	(0.06)	(0.04)
Grade Level (Grades 5–8 omitted)						
Grades K–4	2.17	-5.89	2.50	2.61	4.02	-10.69***
	(3.17)	(3.43)	(2.24)	(3.09)	(2.09)	(2.14)
Grades 9–12	-2.18	-4.06*	-1.11	-9.46***	-5.20***	1.41
	(1.53)	(1.60)	(1.53)	(2.57)	(1.42)	(1.09)
More than 35 hours of PD in last three years	3.62**	2.05	1.58	1.80	0.63	0.92
	(1.23)	(1.33)	(1.37)	(2.10)	(1.10)	(0.97)
Science Content Preparedness	0.08**	0.09**	0.09*	0.06	0.10**	0.04
	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.02)
Self-Contained	-10.92*	-1.33	-3.08	4.34	-3.62	-5.62
	(4.40)	(4.81)	(3.63)	(4.93)	(3.41)	(2.90)
Pedagogy Control	0.00	-0.13*	0.09	-0.15*	0.02	0.01
	(0.05)	(0.06)	(0.06)	(0.07)	(0.05)	(0.04)
School Characteristics						
Metro Status (Suburban omitted)						
Urban	-1.31	-0.13	-3.79*	0.15	-1.22	-1.97
	(1.50)	(1.66)	(1.71)	(2.26)	(1.29)	(1.26)
Rural	-1.44	2.51	-4.50*	0.12	-0.66	-1.66
	(1.96)	(2.66)	(1.90)	(3.42)	(2.00)	(1.47)
School Attention to *Standards*	-0.01	0.04	0.02	0.18***	0.02	0.06*
	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)
***Implementing the* Standards**	3.87*	3.41	1.28	5.52	1.42	0.38
	(1.83)	(1.88)	(1.62)	(2.84)	(1.48)	(1.28)
Implementing the* Standards *X Self-Contained	4.04	-1.41	0.32	-5.31	1.83	-0.05
	(3.70)	(3.80)	(3.44)	(5.55)	(3.29)	(2.88)
N	1075	1025	1067	1062	1066	1042
R^2	0.128	0.112	0.102	0.138	0.070	0.376
F	4.23***	3.01***	4.12***	8.12***	2.64***	20.73***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusions and Recommendations for Further Research

Although familiarity with the *Standards* was related to teacher report of standards-based teaching practices, further investigation shows that this relationship is primarily due to the greater use of laboratory activities. Teachers who indicated they were implementing the *Standards* were no more likely to be using such standards-based practices as extended investigations, informal assessment, or journals/portfolios than teachers indicating they were not implementing the *Standards*. These findings raise a number of interesting questions about both the interpretation and the implementation of *Standards*, including:

- Does implementing the *Standards* mean following all of the recommendations they contain? If not, is there a minimum set required?

- Given the number of content standards included in the *Standards* and the time it takes to implement inquiry in the classroom, is it reasonable to expect to find large increases in the use of standards-based teaching practices?

In order to investigate these questions, future research would need to more deeply probe teachers' understanding of what it means to implement the *Standards* and the factors that facilitate and inhibit implementation of the *Standards*.

References

National Research Council. *National Science Education Standards.* Washington, DC: National Research Council, 1996.

Weiss, I.R., Banilower, E.R., McMahon, K.C., and Smith, P.S. *Report of the 2000 National Survey of Science and Mathematics.* Chapel Hill, NC: Horizon Research, Inc., December 2001.