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Science Education in Self-Contained and Non-Self-Contained Elementary Science Classes:

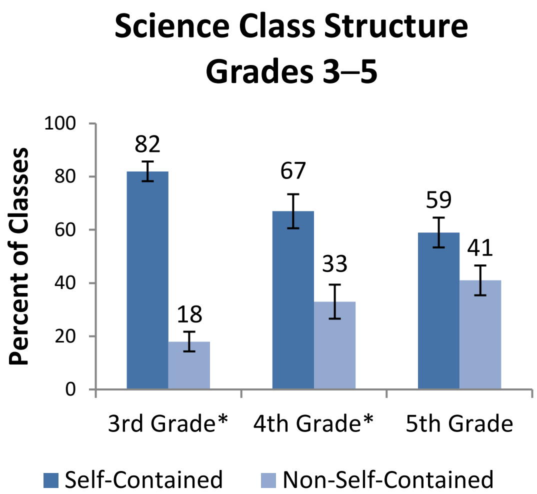
Comparisons of Instruction and Teachers in the Two Settings

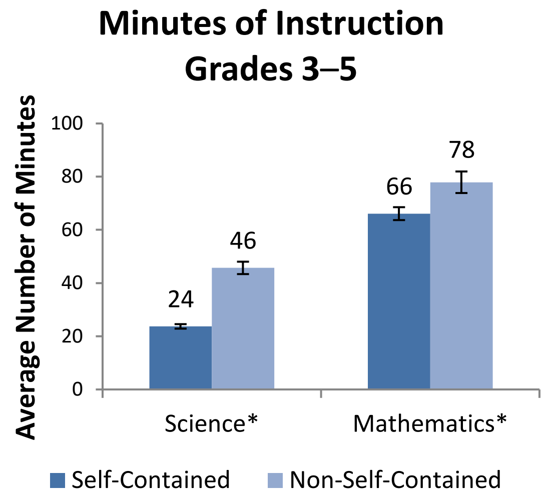
Relative to their middle and high school teacher counterparts, elementary science teachers are both uniquely situated and uniquely challenged for excellent science instruction. More than 90 percent of elementary teachers work in self-contained classrooms, meaning they have opportunities to connect their science instruction with English language arts, mathematics, and social studies. However, teachers in self-contained settings also face formidable obstacles. Accountability pressures in English language arts and mathematics draw instructional time away from science. Further, because teachers in self-contained classrooms are responsible for all core subjects, their preparation tends to be very broad in terms of disciplinary focus.

This brief discusses results from the 2108 NSSME+, a recent major national survey of K–12 schools and teachers in the US. It describes differences in elementary science instruction when it occurs in self-contained vs. non-self-contained classrooms in grades 3–5. It also describes differences in teachers of these classes.

Time for Science Instruction

Grades K–6 self-contained (SC) elementary science classes average a little more than 20 minutes per day of science instruction, considerably less than the time spent on both English language arts (about 90 minutes) and mathematics (about 60 minutes). However, in grades 3–5, roughly a third of elementary science classes are *not* self-contained (NSC), meaning the teacher teaches science to more than one group of students each day. This arrangement, referred to as content specialization, may be fully departmentalized (one teacher for each core subject) or a hybrid in which one teacher on a team of two takes responsibility for two subjects (e.g., mathematics and science) while another teaches the other subjects (e.g., English language arts and social studies). NSC science classes are increasingly common as grade level increases, representing 41 percent of all science classes in grade 5 (see Figure 1). The most obvious, and perhaps most important, difference between grades 3–5 SC and NSC science classes is the amount of science instruction, averaging 24 minutes per day in SC classes and 46 minutes per day in NSC classes. Interestingly, the additional time does not appear to come from mathematics, as NSC mathematics classes average substantially more minutes per day than self-contained classes.





* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

Figure 1

Differences in Instruction

If a straightforward structural change is associated with the amount of science instruction, it is worth exploring other differences that may coincide with this arrangement. NSC science classes are more likely than SC classes to include a heavy emphasis on understanding science concepts (see Table 1). However, they are also considerably more likely to emphasize learning science vocabulary and facts. In terms of actual class activities, NSC science classes are more likely to have the teacher explain science ideas to the whole class at least once a week, as well as to have students engage in whole class discussion and work in small groups. They are much less likely than SC science classes to engage in project-based learning activities and to focus on literacy skills at least once a week (see Table 2).

One series of items asked teachers about the frequency with which students engage in science and engineering practices. NSC classes are considerably more likely than SC classes to engage in many of them (see Table 3). For example, teachers of NSC classes were much more likely than those in SC classes to engage their students in (1) generating scientific questions and (2) using multiple sources of evidence to develop an explanation.

Table 1
Science Classes With Heavy Emphasis on Various Instructional Objectives

	PERCENT OF CLASSES	
	SELF-CONTAINED	NON-SELF-CONTAINED
Understanding science concepts	48 (3.1)	71 (5.2)*
Learning science vocabulary and/or facts	22 (2.7)	44 (5.8)*
Learning how to do science	27 (2.7)	35 (6.4)
Developing students' confidence that they can successfully pursue careers in science/engineering	19 (2.7)	28 (4.7)
Increasing students' interest in science/engineering	24 (2.5)	27 (4.3)
Learning test-taking skills/strategies	24 (3.2)	27 (5.1)
Learning about real-life applications of science/engineering	15 (2.3)	25 (6.3)
Learning about different fields of science/engineering	6 (1.5)	10 (3.1)
Learning how to do engineering	8 (2.0)	6 (2.6)

* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

Table 2
Science Classes in Which Teachers Report Using Various Activities at Least Once a Week

	PERCENT OF CLASSES	
	SELF-CONTAINED	NON-SELF-CONTAINED
Explain science ideas to the whole class	86 (2.2)	97 (1.4)*
Engage the whole class in discussions	91 (1.8)	96 (1.8)*
Have students work in small groups	76 (2.4)	86 (3.7)*
Have students do hands-on/laboratory activities	47 (3.7)	62 (6.1)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	45 (3.5)	50 (6.1)
Focus on literacy skills (e.g., informational reading or writing strategies)	67 (2.9)	45 (5.6)*
Have students read from a textbook, module, or other material in class, either aloud or to themselves	44 (3.3)	43 (6.4)
Have students practice for standardized tests	25 (2.4)	31 (5.7)
Engage the class in project-based learning (PBL) activities	31 (3.3)	19 (3.4)*
Use flipped instruction	8 (1.6)	9 (2.6)

* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

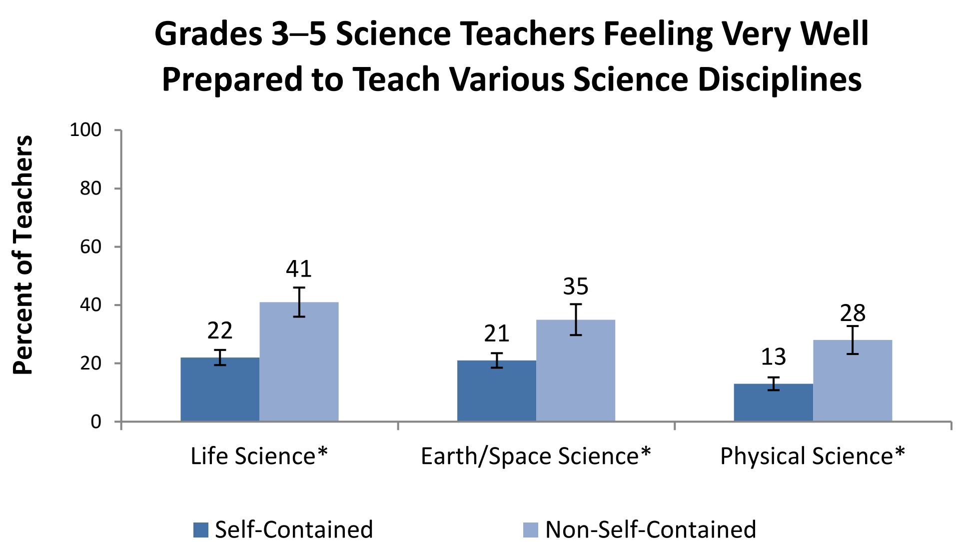
Table 3
Science Classes in Which Teachers Report Students Engaging in Various Aspects of Science Practices† at Least Once a Week

	PERCENT OF CLASSES	
	SELF-CONTAINED	NON-SELF-CONTAINED
Generating scientific questions	31 (3.1)	51 (6.6)*
Making and supporting claims with evidence	30 (2.8)	48 (7.1)*
Organizing and/or representing data using tables, charts, or graphs	30 (2.9)	48 (6.4)*
Using multiple sources of evidence to develop an explanation	27 (3.0)	45 (6.3)*
Developing procedures for a scientific investigation to answer a scientific question	28 (2.8)	41 (5.0)*
Using data and reasoning to define a claim or refute alternative scientific claims about a real world phenomenon	16 (2.0)	32 (6.9)*
Determining what details about an investigation might persuade a targeted audience about a specific claim	11 (2.1)	25 (5.8)*

† The survey included 23 practices. Only those with a statistically significant difference between SC and NSC are shown here.
* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

Teacher Preparation

Despite the differences in instruction, teachers of NSC science classes are no different from their SC counterparts in terms of their formal content preparation. Only a third of grades 3–5 teachers overall have had at least one course in each of the Earth, life, and physical sciences. However, teachers of NSC classes are much more likely to *feel* very well prepared in each of these three science disciplines (see Figure 2). These teachers also have more favorable perceptions of their pedagogical preparedness (see Table 4).



* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

Figure 2

Table 4
Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	PERCENT OF TEACHERS	
	SELF-CONTAINED	NON-SELF-CONTAINED
Encourage participation of all students in science and/or engineering	26 (2.6)	42 (5.4)*
Encourage students' interest in science and/or engineering	22 (2.4)	37 (5.5)*
Use formative assessment to monitor student learning	26 (3.1)	32 (5.7)
Develop students' conceptual understanding of the science ideas you teach	20 (2.6)	32 (5.0)*
Develop students' abilities to do science	16 (2.2)	22 (4.8)
Differentiate science instruction to meet the needs of diverse learners	16 (2.5)	21 (4.1)
Incorporate students' cultural backgrounds into science instruction	9 (1.7)	18 (4.6)
Provide science instruction that is based on students' ideas about the topics you teach	11 (1.9)	17 (3.9)
Develop students' awareness of STEM careers	9 (1.6)	14 (4.4)

* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

An explanation for these differences may be that NSC teachers are much more likely than SC teachers to participate in science-specific professional development (PD). For example, two-thirds of NSC teachers participated in PD in the preceding 12 months, compared to just over one-third of SC teachers (see Figure 3). Further, almost half of SC teachers had no PD in the preceding three years compared to only about one-fifth of NSC teachers.

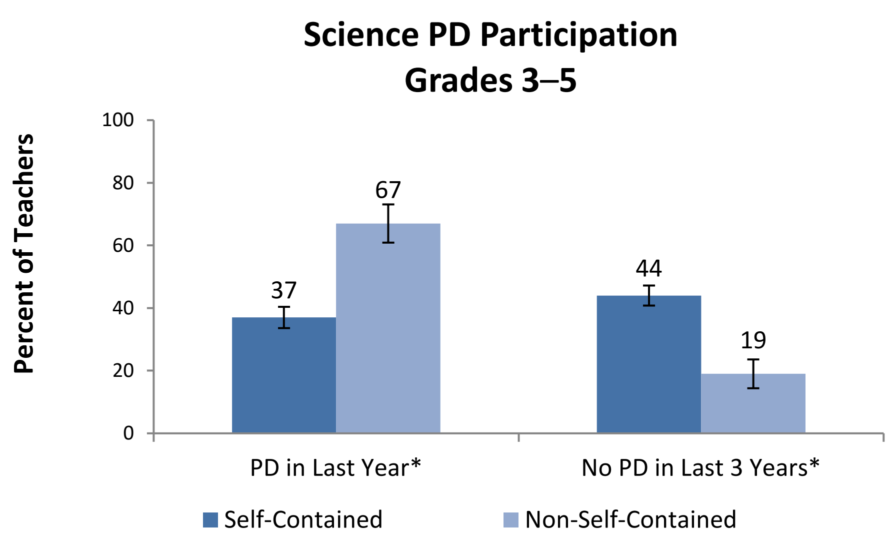


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Figure 3

Differences in School Context

The school context for science instruction also appears to be different for NSC and SC classes. For example, NSC classes are considerably more likely to have lab tables in their classroom (see Table 5), and teachers of NSC classes are more likely to consider their resources for science instruction as adequate. In addition, several factors are more likely to be seen by NSC teachers than SC teachers as promoting science instruction (see Table 6), including:

- Principal support;
- Current state standards; and
- Amount of time to plan, individually and with colleagues.

Table 5
Availability of Laboratory Facilities in Science Classes

	PERCENT OF CLASSES	
	SELF-CONTAINED	NON-SELF-CONTAINED
Electric outlets	92 (2.3)	95 (2.5)
Faucets and sinks	84 (3.3)	72 (8.8)
Lab tables	18 (3.6)	45 (10.4)*

* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

Table 6
Factors Promoting† Instruction in Science Classes

	PERCENT OF CLASSES	
	SELF-CONTAINED	NON-SELF-CONTAINED
Principal support	59 (4.0)	81 (5.7)*
Current state standards	58 (4.0)	79 (6.3)*
Students' motivation, interest, and effort in science	74 (4.0)	75 (7.2)
Amount of time for you to plan, individually and with colleagues	49 (4.3)	67 (8.7)*
Pacing guides	44 (4.5)	60 (8.5)
Amount of instructional time devoted to science	41 (3.9)	52 (9.3)
Amount of time available for your professional development	36 (4.2)	50 (9.0)
Teacher evaluation policies	30 (4.2)	50 (9.7)
Students' prior knowledge and skills	54 (4.1)	49 (9.4)
State/district/diocese testing/accountability policies‡	30 (4.2)	43 (9.8)
Textbook/module selection policies	28 (4.2)	37 (9.5)
Parent/guardian expectations and involvement	31 (3.8)	33 (9.3)

* Indicates a statistically significant difference between SC and NSC (two-tailed independent samples t-test, $p < 0.05$).

† Includes classes in which science teachers indicated 4 or 5 on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

‡ This item was presented only to teachers in public and Catholic schools.

Conclusion

In conclusion, on many measures, it appears students in NSC classes have different science learning opportunities than those in SC classes. Although this change in class setting may seem straightforward, it represents a considerable commitment on the part of teachers and administration. Such a commitment suggests other, less obvious, aspects of the context may be more supportive of science instruction than in schools with exclusively SC science classes. More research is needed to understand how and why the decision to specialize is made and what the intended and unintended consequences are.

About The 2018 NSSME+

The 2018 NSSME+ is based on a national probability sample of schools and computer science, mathematics, and science teachers in grades K–12 in the 50 states and the District of Columbia. The sample was designed to yield national estimates of course offerings and enrollment, teacher background preparation, textbook usage, instructional techniques, and availability and use of facilities and equipment. Every eligible school and teacher in the target population had a known, positive probability of being sampled. A total of 7,600 computer science, mathematics, and science teachers in 1,273 schools across the United States participated in this study, yielding a response rate of 78 percent. After data collection, design weights were computed, adjusted for nonresponse, and applied to the data. The sampling and weighting processes result in nationally representative estimates of schools, teachers, and classes. This Data Brief includes a subset of survey respondents: teachers of 266 self-contained and 117 non-self-contained classes in grades 3–5. Results include standard errors that indicate certainty of estimate. Error bars in charts represent ± one standard error. The significance tests reported did not control for Type I error.

Complete details of the study—sample design, sampling error considerations, instrument development, data collection, and file preparation and analysis—as well as copies of the instruments are included in the Report of the 2018 NSSME+.

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