

CHAPTER SIX

Influences on Lessons

Introduction

The previous chapters focused on describing the designs of mathematics and science lessons and the strengths and weaknesses of their implementation. This chapter examines some of the reasons the lessons were designed as they were.

In planning mathematics and science lessons, teachers are influenced by a multitude of factors that work together to impact what content is taught, how it is taught, and the materials selected to engage students with the content. These factors may include curriculum standards/frameworks; accountability systems; teachers' familiarity with specific content and pedagogy; their perceptions of the needs of the students; and views of the principal, parents, and other key stakeholders. Following the *Inside the Classroom* observations, extended interviews were conducted with the teachers to determine what led them to select the content in the lesson, and why they chose the pedagogy and the materials used in the lesson. The ultimate goal of the interviews was to determine which factors have the greatest influence on the design of the lessons students experience each day in mathematics and science instruction in the United States.

Interview data were analyzed to determine which factors were most likely to influence teachers' selection of content, pedagogy, and instructional materials. As noted earlier, data were weighted in order to yield unbiased estimates for all mathematics and science lessons in the United States.

Influences on Selection of Mathematics/Science Content

The extensive interviews conducted with teachers observed in this study included a number of questions focused on the content of the lesson observed. Specifically, teachers were asked to describe what led them to teach the topics, concepts, and skills in the lesson. Researchers probed to determine whether the content of the lesson was included in the state or district curriculum or course of study; a state or district mathematics/science assessment; and/or the textbook/program designated for the class. In addition, teachers were asked about the degree to which each of these factors influenced their selection of the topics, concepts, and skills included in the lesson. Researchers also noted other factors mentioned by teachers as influencing their selection of content that were not directly asked about in the interview.

It is important to note that it is difficult to disentangle some of the influences on content. The data presented in this section are based on the teachers' descriptions of what was most salient in their selection of content for the lessons. However, teachers may not always be aware of the influences operating behind the scenes. For example, teachers were much more likely to cite state/district curriculum standards than state/district tests as influencing content, although there is

substantial effort at the policy level to align the two. Similarly, teachers often cited state/district curriculum standards as an influence, but rarely mentioned national standards. At the same time, many state and district standards documents indicate that they are modeled on national standards.

As can be seen in Figure 23, state/district curriculum standards are the most frequently cited influence on lesson content, followed by the textbook/program designated for the class, and state/district accountability systems. The nature of the influence of these and other commonly-cited factors is described in the following sections.

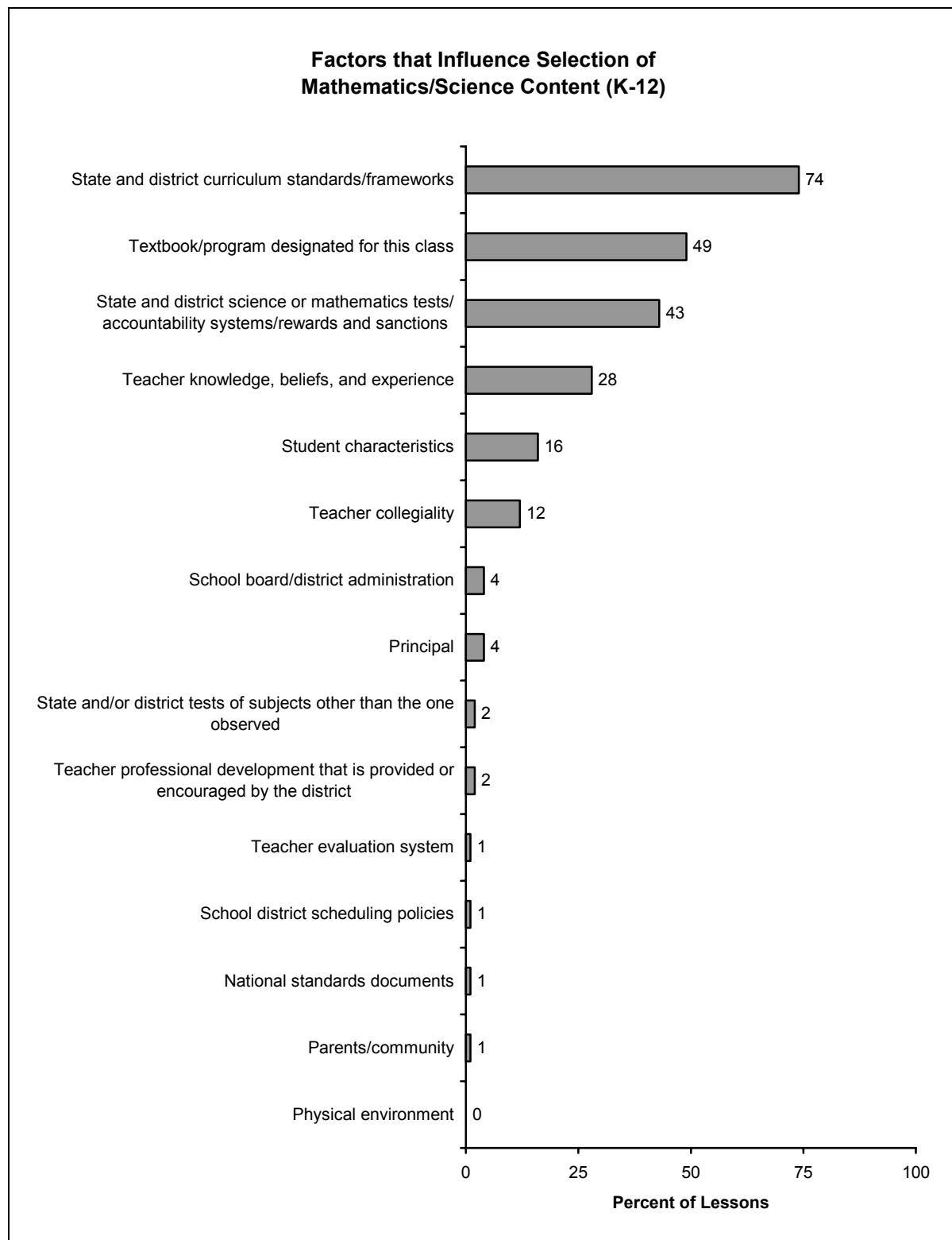


Figure 23

Influence of Curriculum Standards on Content Taught

Mathematics/science content is at the core of the instructional experience for students. The topics focused on lessons determine the potential knowledge students come away with at the end of each course. Based on the data collected for the *Inside the Classroom* study, for most mathematics and science lessons, the decision of what to teach is made by someone other than the teacher. According to teachers, state and district level policies communicated through curriculum standards have a substantial influence on the selection of content, providing a road map for what to teach in roughly 3 out of 4 mathematics/science lessons nationally.

Teachers frequently commented that they not only follow the guidelines in selecting the content they teach to their students, they are required to do so. For example:

[The state's course of study is] very important because we align everything and, therefore, you're always conscious of the state requirements, and once you align everything, you know that you're going in the right direction and the children are getting everything that they pretty much need during the course of the year. (3rd grade mathematics teacher)



Generally speaking, the standards dictate where I should be going. They say teach the human body systems, so I teach the human body systems. (7th grade science teacher)



As far as the state, we are teaching to the curriculum. If it says we have to teach it in the 7th grade, you teach it. There's a set of goals; there's a set of objectives, and you teach it... We are driven by the state objectives... You teach to the objectives. (7th grade mathematics teacher)



In other words, the state standards will determine what chapters that we teach and don't teach. (High School Honors Chemistry teacher)



I don't get to choose. I have to do what the curriculum says. (High School Honors Trigonometry teacher)



Oh, I don't have a choice. If the district and state say this is what you teach, this is what you teach. End of story. (High School Consumer Mathematics teacher)

Some teachers are given frameworks of what children are expected to know and have flexibility of when they teach particular content areas. Other teachers are provided with pacing guides

which dictate the order in which topics should be taught, and in some cases how much instructional time should be devoted to a particular content area. Teachers describe this level of guidance as follows:

We try to follow the state benchmarks, and we have a curriculum guideline that is set up, K–12, and it should be when it's introduced, when it's gone over, and when it's mastered. (7th grade mathematics teacher)



That's a big part of our curriculum guide...We have a curriculum map. And ours is only broken down into nine weeks. We must cover a certain amount of information in nine weeks. So, the curriculum map is what keeps us on track. (7th grade mathematics teacher)



[Prior to the new scope and sequence] I could make it work the way I felt it was best and now we don't have that option. It's spelled out in a particular order and they give us nine week exams from the board...they are tracking to make sure you are doing what you are supposed to be doing. (10th grade Biology teacher)



[The state] has a state curriculum framework. And then our school took that and did a curriculum mapping...and then they did pacing guides. And the pacing guide tells us what we're to teach in each chapter and how many days to spend on a chapter, it's a guideline. And so, one reason I did today's lesson is it's on our pacing guide that we do that. (High School Algebra II teacher)

Given the emphasis on national standards in the last ten years, it is surprising that mathematics and science teachers rarely mention national standards as having an influence on their selection of content. When national standards were mentioned by teachers, it was most often in the context of describing their state or district standards and the alignment of these documents to national standards.

Influence of Textbook/Curriculum Programs on Content Taught

After state and district standards, the next most common influence on content appears to be textbook/curriculum programs, typically selected at the district level, with 1 in 2 teachers nationally reporting that the textbook has an influence on the content they select for their lessons. In some cases, teachers report following closely the sequence of topics laid out in the text. Said these teachers in describing their use of the designated curriculum program:

That's exactly where we were...as far as chapter-wise...because I pretty much go in order, or in the sequence of the book, because it's pretty much a good order for the kids to learn the concepts. (Kindergarten mathematics teacher)



[The fact the topic was in the designated text] was an important factor. Sometimes I may pull a resource to enhance, to add to it, but I really do try to go with the topics in the book. (8th grade science teacher)



The book perhaps was the most influential. I trust the book. I can get everything from the book and teach the kids what I think they need to know. (8th grade Algebra I teacher)



When I get a little more experience I may deviate a lot more, but right now I pretty much follow the textbook. (High School Physical Science teacher)



I looked through the book, and I think the progression of the book is sound. So, quite frankly, I'm just following the progression of the book to an ultimate final exam. (High School Geometry teacher)

Influence of Accountability Systems on Content Taught

Based on the teacher interviews, the content selection for nearly 1 in 2 lessons nationally is influenced by some sort of accountability system related to student achievement. For many teachers, pressure for their students to do well on high stakes testing drives their selection of topics. Surprisingly, even though mathematics testing is more common, science teachers were just as likely to report tests as an influence on their selection of topics. Said these teachers:

It's really important for kids to be familiar with the information so when they get ready to take the assessment at the end of the year, they'll know what they're doing. (4th grade mathematics teacher)



We are teaching right to that [state assessment] and that's not how I prefer to do it, but it's the way we are geared right now. (4th grade science teacher)



I definitely wouldn't be doing that unit if it weren't for the benchmark test coming up. (8th grade Pre-Algebra teacher)



I don't like to be driven by a test, but it was important. I feel compelled to teach it if they're going to be tested on it, because I don't want them to get on the test and say "I

don't know this; what in the world is this?" I think that would be the worst disservice I could do them. (8th grade science teacher)



I do five ACT problems every day with all of my classes. I find that they really need the review and they need to work on the problem types that appear on that test. (High School Algebra III teacher)



Content has changed because the curriculum guide and the [state assessment] keeps changing, so when they shift, you shift. And what that test says you need to teach, that's what you teach. So that has changed from the first three years of my teaching. Some of this material I may not have covered but now that I know for a fact that this is something my students will be tested on, and I have my standards and benchmarks, I know what I've got to hit. (10th grade, Biology teacher)

It is interesting to note that the influence of testing on the topics selected for lessons is not limited to teachers whose students are being tested that school year. On occasion, teachers report that they select the content that is taught during the lesson because it will be on tests in future years. As described by two mathematics teachers:

They're tested in third and fifth, which is why you saw the worksheet that has nothing to do with what was taught. It's a review...we revisit so that we don't lose what we've gained...We do graphing in math, but we will continue to graph throughout the year because of the [state] test that they have to take. So we continue to reinforce things that we know they're going to see on this test. (4th grade mathematics teacher)



I know on the [state test]—it [the concept fraction as part of a set] is definitely on there—from talking with a 5th grade teacher, I know it's on there. That's why I really wanted to cover and focus on fractions and decimals, because she told me that, it's part of her experience that it's part of the [state test] ...But to prepare them—I want them prepared for 5th. (4th grade mathematics teacher)

Some teachers clearly feel pressure from testing, and select topics to prepare students for the tests, especially if they are uncertain about the extent of alignment between the standards and the test. Others who encounter high stakes testing describe a different perspective. These teachers trust that the tests will be aligned to the standards which outline what students should know. Instead of focusing on test preparation, they follow the curriculum standards in selecting the topics for their lessons.

The Teacher's Role in the Selection of Content

Teacher characteristics, knowledge, beliefs, and experiences emerge as having some influence on the selection of content in roughly a fourth of mathematics and science lessons in the nation. Included in this category are teacher background, preparation, and interest in the content area; teacher beliefs about content, and what students should know about the content; and teacher beliefs about student learning. Said these teachers:

I like to relate stuff that is interesting to me to what the state requires, even if it's not exactly [the same]. There are questions about plate tectonics in the guide. But, it may not be an exact match. (8th grade Integrated Science teacher)



I make sure that I enjoy the topic that I'm teaching. I generally find something in the topic that I will enjoy, and I'll emphasize it. Things that I'm big on, I like classification and I like vocabulary. I think all these kids taking botany should be taking Latin instead. Whatever I can find along those lines to emphasize, I'll do that. (High School Botany teacher)

Both mathematics and science teachers describe aspects of the content they believe to be important to students' understanding of the discipline; teachers indicate that they would teach these particular concepts regardless of whether they are included in the curriculum frameworks. As described by these teachers:

[The content of this lesson] is an essential thing that they need to have....There's a lot of other things you can do in the classroom....Once they know their numbers to 10 because you use numbers in a lot of different ways, not just during math time, so that kind of thing helps them. (Kindergarten mathematics teacher)



Studying matter and the nature of matter is not part of the fourth grade curriculum, but I have a hard time thinking about beginning to discuss anything in science without some idea of what matter is and its forms. (4th grade science teacher)



Certain things I think are important. One thing leads to another. So you have to understand the atmosphere to understand weather. And to understand weather you have to understand the water cycle. And to understand the water in the atmosphere—one concept simply leads into another concept...I like it. I think it's relevant. (8th grade science teacher)



I teach what I believe general chemistry ought to cover...I think the gas laws are an important thing for people to learn. I think that understanding [the gas laws] is pretty

fundamental. People can, if they know the gas laws, they can understand things like convection currents and maybe they can understand meteorology a little better, and lots of connections...I am kind of big on gas laws because they fit right in (to problem solving). (11th grade Chemistry teacher)

Influence of Student Characteristics on Selection of Content

Only about a fifth of mathematics and science teachers select content based on some characteristic of the students they are teaching. Most often in these situations, teachers pick content geared to address the ability levels of their students. For example, teachers with classes including low ability students often mention selecting content that is at a level the students could understand and that allows them to focus on the basics. Teachers with mixed ability classes report selecting content to address the “middle of the road” student, while teachers with high ability students report including challenging content in their lessons. For example, these teachers described the influence of student ability on their content decisions:

I have one student who [is at a] pre-primer reading level who happens to be straight from Africa...I have students who are at first and second grade up to seventh grade reading level in that class. So I try to keep things as basic as possible. (6th grade science teacher)



Because of the different reading levels I try to get it right in the middle...But that's why I had a back up activity [for the more advanced students]. (6th grade science teacher)



You have to stress some things to kids...But as you get down, even in the pre-algebra and especially in the math, you have to put it down on a level where they can understand it...A lot of times you can't go with the language that's presented in the book. You have to put it in a simpler form. (8th grade Pre-Algebra teacher)



They come to us woefully unprepared out of grade school; I consistently have kids who can't multiply one-digit numbers. And I'm supposed to teach a high school math curriculum. As a consequence a lot of what I do is cycling back, trying to find out where the kids are, to move them up. You never get to where they really need to be. I hate the thought of dumbing-down the curriculum, so my tension is to try to find ways to teach high-level mathematics using the kinds of problems that the kids can approach with their rudimentary skills. (9th grade Integrated Mathematics teacher)



This class ranges from, I hate to [say] “slow learner” but, slow learner...And I have three students in there that could well fit into the regular biology curriculum that we

have. But, because of the type of students I have you have to water it down a little bit.
(10th grade Biology teacher)



Since this is an honors class I try to make them do some harder things....I try to pull some things out of the pre-calculus book. (11th grade Honors Trigonometry teacher)

In some lessons, teachers select review content to include in the lessons because students have not yet mastered the concept. This lack of mastery is sometimes due to absenteeism in the class. For example:

I have a core group of maybe five in this class that have very high absenteeism...And I have several that were absent, so I determined to review that [worksheet]. (7th grade mathematics teacher)

Teacher Collaboration as an Influence on Content Selection

A small proportion of teachers (an estimated 12 percent nationally) indicate that their collaboration with other teachers influences their selection of content. This collaboration may be in the form of two or more teachers within a grade level working together to determine what students need to know and what should be taught, collaborating to provide a consistent program for students. Sometimes they assist each other in the design of lessons in areas where some of the teachers lack confidence; for example, a single teacher may decide what science content will be taught by all of the teachers in the grade. As described by these teachers:

I know the second grade classes, we try to do the same thing, you know, teach the same subject so that if you move from one class to the next, we would all be learning the same thing. Different styles, but the content is the same. (2nd grade science teacher)



We work as a group. Everybody decides what our themes are going to be. Everybody gets together and donates whatever, and there are six of our teachers. This [lesson] is all an accumulation of all six of us getting together. All six are doing this math today. We get together and plan. (3rd grade mathematics teacher)



The three of us that regroup our kids, we meet together because we want to stay on the same topics together in case we do have kids that need to move....And so we got together and decided that this week and next week would be our area and perimeter weeks because we have a list of all the different topics we need to teach for the state standards. (4th–5th grade mathematics teacher)



Two years ago when I got the book, the other teacher and I went through it and we talked about what lessons to do, certain things to work on, and how much time we'd spend on each. (6th grade mathematics teacher)



There are three math teachers and we kind of collaborated. We try and stick to what the book has set up for us...We try to stick with the same schedule and be in the same place at the same time, or in the same lesson. (7th grade mathematics teacher)



I plan together with two other 9th grade science teachers. Neither of them has taught physical science at this level before. (9th grade Physical Science teacher)

Collaborations sometime go across grade-levels, with teachers from higher grades designating content students need to know prior to their class. Said this teacher:

I'll talk to the Calculus teacher and she will share things with me. She'll tell me, your kids were weak in this or that, and that will help me focus the following year. It's really up to us to decide what is going well and what is not. (High School Pre-Calculus teacher)

Influence of Other Factors on Selection of Content

Other potential influences investigated in the teacher interview are rarely cited as important in the selection of content. Although quite a few of the teachers mention their school board, district administration, and principal endorsing the inclusion of certain content in their lessons, very few teachers report that these individuals/groups have direct influence on their selection of content. Similarly, teachers rarely report that parents or the community, professional development sessions or graduate courses, or teacher evaluation systems influence their selection of content.

Influences on Selection of Instructional Strategies

Interviews with teachers in this study also included questions focused on the factors which influenced them to select the pedagogy and instructional materials for their lessons. As is the case with influences on content, it is difficult to disentangle influences on instruction. From the teacher's perspective, it may be the textbook or professional development that is influencing instruction, but these may in turn have been influenced by other factors such as state/district assessments, national standards, etc.

While teachers report that the content of most lessons is guided by external factors such as state and/or district curriculum standards or frameworks, these policy instruments appear to have much less of an influence on the selection of instructional strategies in lessons. Instead, teachers indicate that they have a great deal of latitude in selecting the strategies they employ to teach a particular content area.⁷ A number of teachers commented on the contrast between detailed regulations guiding what they teach and freedom over how they teach the concepts. For example:

The state tells us specifically what is to be taught, but I can teach it any which way. (8th grade Advanced Science teacher)



[The principal] wants to match things up with the upcoming [state goals and test], but he trusts us to do that...We have the freedom to select however means we want to get a concept across. (10th grade Biology teacher)

Influence of Teacher Knowledge, Beliefs, and Experience on Instruction

This sense of autonomy in choosing how to implement lessons is reflected in teachers' identification of factors that have the greatest influence on their selection of pedagogy. While many of the factors examined in this study appear to have some influence on instructional strategies, the teachers' background, knowledge, and experience; and their beliefs—about the subject, about effective pedagogy, and about their students—most frequently influence their selection of particular instructional strategies. (See Figure 24.) The nature of these and other influences is described in the following sections.

⁷ These interview data are consistent with data from the 2000 National Survey of Science and Mathematics, where teachers reported that they are far less likely to have control over the curriculum than they are over the methods to teach the curriculum.

Factors that Influence Selection of Instructional Strategies (K-12)

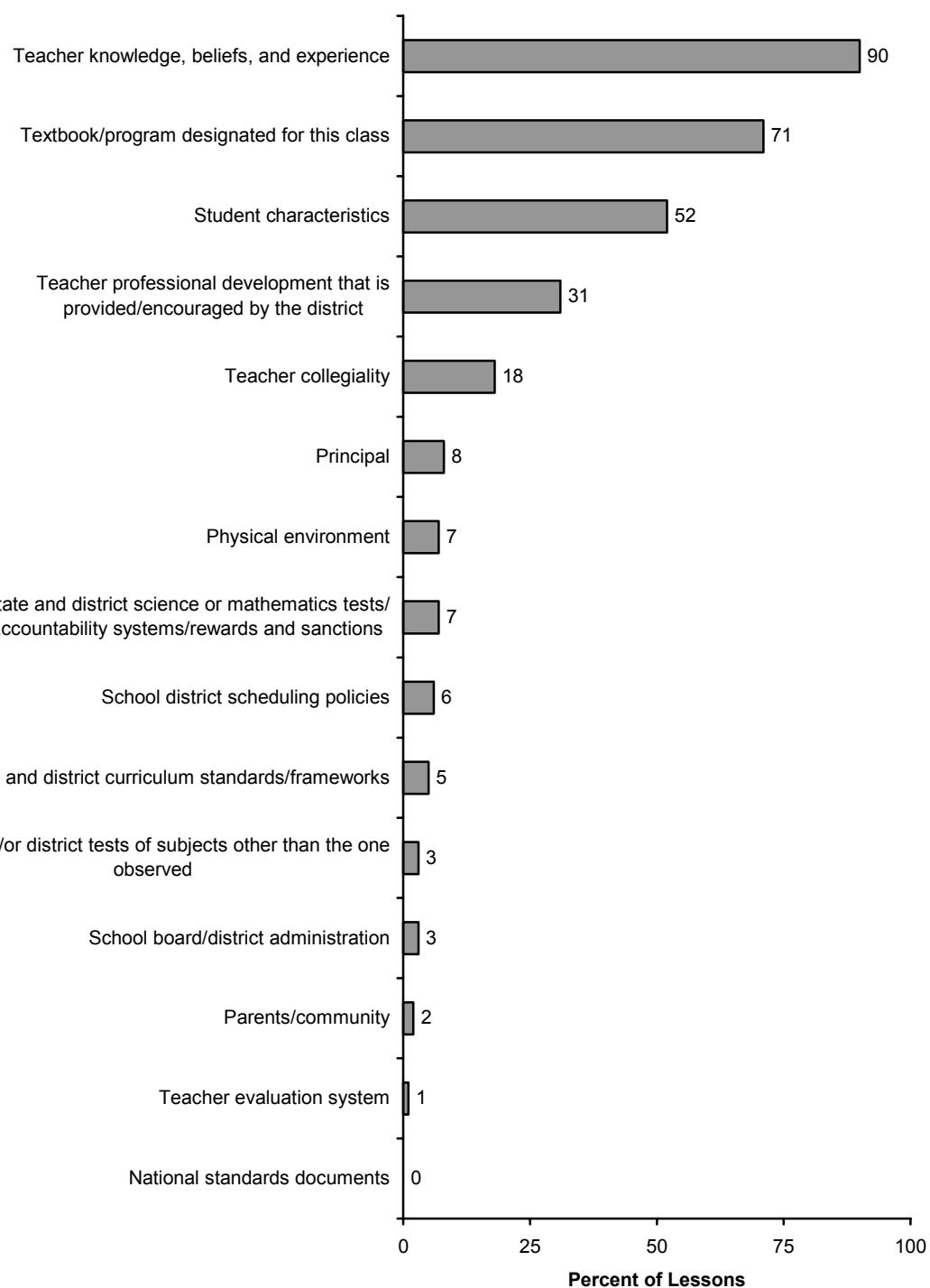


Figure 24

Teacher Beliefs About Effective Instruction

In many cases, teachers' decisions appear to be primarily influenced by their beliefs about instruction and how students learn best. Teachers report incorporating real-world examples to foster the engagement of students with concepts that otherwise might not interest them or would be too abstract for students to understand. They use examples both to provide a hook to engage students and to provide a bridge between what students already know and the more abstract concepts. Said teachers of the advantages of providing a real world context:

I have found that when you make yourself and what you're teaching real and human, the kids respond better...If there's something that I have or I know, or someone in my family, I always try to share that because they'll remember it...I use my husband a lot and the things from his job I share...So I pass on things that he has taught me or told me, and I try to make it like I said common to this area, things that kids can hold on to, because a lot is so abstract for them. (3rd grade science teacher)



Well, they have a better understanding of fractions and hopefully they had seen the connection of the lesson with their lives because I think often times our problem in teaching is how to connect what we are teaching them in theory and concepts into their lives because if there is no connection, there is no interest. (6th grade mathematics teacher)



They need to apply it to something that they are doing rather than just saying, "I can work this problem," and multiply it out. It is important that they know how to solve a problem in their life. (8th grade mathematics teacher)



[I include examples that are relevant to their experience because] it's like you hit this place where they go "we don't know what you're talking about so we're just going to you know, zone out"; to where they realize that this does actually relate to something in their life. And it's always good when you get to that point. But I don't always get there. Some days they just sit there and zone out the whole time, and I don't think they ever connect at all with what I say...Today's examples come more from my multitude of experience fixing my cars. I only seem to have had clunkers. (High School Physical Science teacher)

Hands-on, interactive pedagogies are often identified by teachers as effective strategies because they actively involve students in the lesson. Said these teachers:

I really believe that children must be actively responsible for their learning. If I just tell them, then I'm not helping them take what they already know and go to the next level. A lot of times the children know it, but you have to take the time to question them, take what they know and then move up. You can get them thinking and actively involved, then they'll remember next time. I want to get them thinking and expressing out loud...I'm not

a big paper/pencil person...I do what I have to do to make sure they can do it independently and can explain their answer. (2nd grade mathematics teacher)



I love it [hands-on]. They learn better than just reading from a book. (2nd grade science teacher)



I believe that hands-on is most beneficial for students, but it is difficult to find good activities...and time-consuming, getting all the materials, nothing they can hurt themselves on...The longer I teach, the more I realize it's worth the time. (7th grade Earth Science teacher)



It gets [the students] more interested, keeps them busy, they learn more when they are involved with hands-on activities. (10th grade Biology teacher)

Other teachers express a belief in the effectiveness of using multiple instructional strategies in order to address the varied learning styles of their students. For example:

They have different styles of learning. Some are audio, visual, tactile. I just try to present things in a variety of ways. (7th grade Life Science teacher)



At the 7th grade level, with the mixed group that we have, I have a lot that are not identified with special needs. I still do integrate a lot of things in my lesson that would meet all of the needs—a lot of peer tutoring...I use a lot of hands-on and try to hit all the different learning styles with them. (7th grade mathematics teacher)



The [materials I used] allow me to get to the students with all these different types of learning styles. The auditory learner, the visual learner. I'm trying to get a little bit of everybody. I'm touching everybody. (10th grade Biology teacher)

Some teachers note their belief that effective instruction requires the use of “traditional” as well as “reform-oriented” strategies. Said these teachers:

I'm not a person who strictly believes totally in discovery learning. I think...the hands-on kinds of things with the tangrams—I think that has its place. But, I also think kids...have to have the facts stated...I think they need a reference tool to use in their learning. And I think this textbook can provide that. (6th grade mathematics teacher)



I talk very little. But I use a lot of strategies. Hands-on, but not extensive. Lecturing. Videos. Presentations through the computer. Now I have in the past used cooperative learning. Sometimes I let them work in pairs. (7th grade Life Science teacher)



And I don't necessarily believe that is the only way we should teach. I think it's a mix. You've got to be able to do the hands-on work, but there is a time for lecture and example. To find that balance is hard. (8th grade Pre-Algebra teacher)



This is my 29th year and so a lot of things I try to use...but I find that old time lecture is good. It is good. So I'm not as up-to-date perhaps as some of the younger teachers with all the technology. But I try to draw on a variety of methods. (8th grade science teacher)



Actually, just trial and error over the years. Trying to get a feel for what works and what does not work. Like I try to tell my students, you can't always be in the lab, you can't always look at the weather, you can't always be outside. I can do what I can in the room, but you have to have lecture. There is some degree of lecture. (10th grade Biology teacher)

A number of mathematics teachers cite a belief in the link between repetition and learning as reasons for the selection of instructional strategies that allow for reiteration of concepts. These teachers describe the need for setting up an environment for students where there is frequent review of concepts. For example:

It's got to be that way [the re-teaching]. The kids who don't get it can see it the second time through...I remember taking a workshop once from Madeline Hunter, and her big thing is ITIP—instructional theory into practice—and she stated that things have to be repeated or taught 150 times before it becomes permanent memory, so you can't just teach things once and expect them to get it. (2nd-3rd grade mathematics teacher)



And I believe with math you need total rote repetition to grasp concepts. (7th grade mathematics teacher)



We don't make our kids memorize enough. I'm not unreasonable; I don't make them memorize everything. They need to know some basic math facts. Their understanding is going to be better. Some things just have to be memorized or they're handicapped when

they go on. On every test I give them an extra problem that has something to do with $y = mx + b$. Just to keep it fresh in their mind. (11th grade Pre-Calculus teacher)

In discussing their lesson designs, some teachers talk about what they believe to be their role in the learning process, and how this belief influences their selection of instructional strategies. These teachers describe themselves as facilitators, helping to guide student learning and develop the students' abilities to be self-reliant learners. For example:

And I don't consider myself a teacher. To me, I'd like to consider myself as an educational facilitator. I'm here to help you learn, I'm not going to cause you to learn. But if I can help you, I'll try to provide the environment where you can learn. I will also not solve your problems for you, but I will show you how to solve them because I'm not taking on your responsibilities and accountability. (8th-9th grade Algebra teacher)

Teachers' Background and Experience

In some cases, teachers' backgrounds influence their selection of strategies for lessons. For example, pre-service preparation may contribute to teachers' comfort with various pedagogical practices. Similarly, the extent of teachers' experience, or lack of experience, may lead them toward the use of particular strategies. Finally, the teachers' own experience as a mathematics/science learner sometimes proves an influential factor in instructional decisions.

A number of teachers noted that their pre-service preparation has led to their perceptions of how students learn best and their comfort with the pedagogical strategies they use. Teachers described a number of different pedagogies that were addressed in their pre-service experiences, indicating that they use these both in the observed lessons and more generally: hands-on approaches, lecture, questioning to guide learning, and the use of multiple strategies. For example:

I went to the university and they had a constructivist model ... We were given lessons and information on discovery and inquiry. So I'm real comfortable with it. It makes a lot of sense to me. (7th grade mathematics teacher)



When I did my student teaching at [school name], the teacher there was very much, what do I want to say, straight-laced traditional-type person. And, I think he instilled within me that there's probably few substitutes for the type of teaching that I do that work any better... Now, I'm not saying that if I had a psychology class I might not put 'em all in a circle and have them pass around a football, or something. [But in my mathematics class], I feel the best thing is to do the lecture type, question type. (8th-9th grade Algebra teacher)



Actually a lot of strategies that I've used come from just my educational courses, like my methods in teaching classes. They are really good at just introducing techniques that I do use, not just the lecture or what we used today, but there are a lot of different

strategies that I do use that I must credit to [name of college] (10th grade Biology teacher)

While some teachers report that their teaching experiences contribute to their use of various instructional strategies, other teachers report that their lack of experience influences how they choose to teach a lesson. Specifically, teachers note that lacking the skills to implement other approaches, they choose more structured pedagogical strategies, and follow the textbook more closely. Said these teachers:

Sometimes when I got straight notes, they get a little boring. I understand that...I'm going to school, and so one of these days I will have more demos and activities than just straight notes. I'm working in that direction, haven't gotten there yet, but I'm getting there. (11th grade Chemistry teacher)



I tend to be more teacher-directed. I would like to be less teacher directed. I would like for my classes to do more exploration. I like to get the kids involved as much as possible. But that is not always easy to do. So I would say that I am not real happy with this style of teaching and [it] is an area I am looking to improve. (High School Pre-Calculus teacher)

Teachers' personal experience with learning mathematics and science also has some influence on instruction. Some teachers described how they themselves learned mathematics or science, indicating that they select instructional approaches that they hope will help their students learn as well. Said these teachers:

I always had to have something in front of me and that's why a lot of times I'll use things for the children, even though some of them may already know, I like to see them feel and touch and that sort of thing. And, like some of the children, even though they can add sometimes they might mis-add and so just to have it there in front of them reaffirms so...I was a visual learner, so I guess I just needed manipulatives as well. (3rd grade mathematics teacher)



What I tell my students is the way that I'm teaching them is the way that someone taught me. The strategies that I use I picked up from teachers that [taught me]. I didn't get them from my college instructors. I didn't get them from observing or anything like that. The way that I teach is because it's the way a teacher that I had one time or another taught me that way. The way that they taught me; I learned that way. I'll teach them[that way] because I think they will learn it. I'm the type of person that I have to do something to learn it. You tell me something, you explain something to me, I'll ask you to explain it to me again several times. So I have to do it. I have to actually do it to learn it. (4th grade science teacher)



I remember my math teacher when I was in school...I still remember the way she taught certain topics...I emulate what she did. (9th grade Pre-Algebra teacher)



I realized that by experiencing it was how I learned, and I wanted to teach the same way. (High School Physics teacher)

Influence of Designated Textbook/Curriculum Program on Instruction

Textbooks are second only to teachers' knowledge, experiences, and beliefs in the frequency of influence on instruction. The majority of teachers (71 percent nationally) rely to some extent on the textbook/curriculum program in their school or district in making decisions on how to teach. However, the extent to which instructional materials impact instruction varies widely. Many teachers describe these materials as the basis of their lessons, using them exactly as they are laid out. Others report that they design the structure of their lessons, picking and choosing activities from the designated materials and supplementing them with materials from other sources, or making some modifications to the design of the materials provided. Still others describe using the designated materials only as a resource in their development of what students experience in their lessons.

Following the Textbook Plan

Teachers who report closely following the textbook/curriculum material describe various reasons for doing so. Many of these teachers believe that the materials include all of the experiences students need to learn the content effectively. Others "trust" the textbook developers, and/or believe that the people who selected these materials did so because they are aligned to curriculum standards and district tests, so no modifications are needed. Said these teachers:

Everything is laid out and explained, step by step. I conducted the lesson just as it's laid out in the manual. (3rd grade mathematics teacher)



I used the book exactly as it is laid out, because it had everything I needed for this topic. (3rd grade science teacher)



I like just about everything about it [the mathematics program]. I follow the format of the book. (6th grade mathematics teacher))



I'm trusting that some research went into development of these materials, that I can trust the solidity of them in terms of sound mathematics. (9th grade Integrated Mathematics teacher)



I must admit I think that the class is very textbook-oriented. I trust the judgment of textbook writers and textbook selectors to pick out a curriculum within that textbook that's going to be okay...That book has been used for 5–6 years. I'm pretty happy with it. (High School Pre-Calculus teacher)

Modifying the Textbook Plan

Other teachers indicate that they do not use their textbook/materials as designed. Instead these teachers modify the materials, picking and choosing lessons and portions of the lessons, and supplementing them with resources from other sources. Teachers describe a variety of reasons for these decisions, including the need to make the material more interesting and accessible to students.

Materials-wise, sometimes I use it, sometimes I don't...So, you know, it's pick and choose. (Kindergarten mathematics teacher)



It's [the math program] okay. It has some good ideas, it's fine. It's something you can build on, it's a base. It could be more creative, more hands on, I love hands-on. Although it does have hands-on, just more ideas. Because sometimes we have to go through books and find ideas to add to it to make it more interesting. (2nd grade mathematics teacher)



They [the textbook authors] have a sequential way to teach the concepts. Personally the fourth grade teachers know [the textbook] is not the answer to everything. That's why we integrate. We have our other math lesson in the afternoon...I just don't think any grade level can rely on a single textbook to meet the needs of all the students for that particular year or of the district. (4th grade mathematics teacher)



I don't like the book very well because it doesn't give enough practice in each area. It will give one page of something, and then go on to something else. So I'm not real thrilled with the book. (5th grade mathematics teacher)



The other book was troublesome for parents because they couldn't follow it, so we've gone to this book, but we don't follow it religiously. We pick and choose the parts that we think the kids need. (6th grade mathematics teacher)



*This unit is in our textbook, and I have also pulled other resources to use in teaching it.
[Its influence is] fifty percent. (8th grade science teacher)*

Using the Textbook as a Resource

Although many teachers report some use of the textbook materials in their lessons, a handful of teachers report using the designated text only as a resource, rarely using it directly in lessons. Regarding why they rely only minimally on the text or curriculum program for their instructional decision-making, these teachers said:

We have a textbook, but it's really outdated. But I use it as a reference. (2nd grade science teacher)



It's okay for me to use as a reference, like I said I try not to do too much with it because a lot of the wording is kind of difficult for them. (7th grade Life Science teacher)



There are a lot of mistakes in our textbook, and I want a new one, so I didn't use it much, just for the review part. (8th grade Earth Science teacher)



I utilize the textbook very rarely. I've found that kids don't like the textbook anyway. Other than the assigned reading, I don't use the text at all...a lot of the ideas they have or the "labs" they have or the experiments they have for hands-on activities are not at all beneficial...This is the first year that [our school] has ever had an earth science class...and in a lot of respects...the exercises and the labs we're doing...are things that I have come up with or designed myself. I feel very comfortable using that because most of them are straight from my own head. (9th grade Earth Science teacher)



I used the standard text that we used to give me the idea and the general concept that I wanted to cover, but I got most of the information out of the other ones, since it covered the subject better and almost all of my examples were from basically out of my head, stuff that I remembered from other things. (12th grade, Advanced Placement Science teacher)

It should be noted that instruction in about 30 percent of lessons nationally is not at all influenced by the textbook/program materials designated for the class. In these instances, it appears that teachers are utilizing other resources they have at their disposal to design lessons.

How Characteristics of Students in their Classes Influence Instruction

Earlier in this section, teachers' beliefs about how students typically learn were described as having a large influence on instruction. About half of teachers nationally are influenced in their selection of instructional strategies/materials by the characteristics of the particular students in their classes, not just their beliefs about how children learn in general. The ability levels of the students, and their behavior, are the characteristics most often considered in determining the strategies that would be most effective. In addition, proficiency with the English language and student absenteeism influence teachers' selection of instructional strategies.

Gearing Instruction to Low Ability Students

Teachers frequently mention using specific instructional strategies and materials to address the needs of students they perceive as low ability. Strategies employed to provide access for these students include repetition, use of visual aids, and slowing the pace. Said these teachers:

My 5th graders are reading on a 3rd or 4th grade level. That's why we read everything aloud, I mean everything. Otherwise, the book would be way too difficult for them. (5th grade science teacher)



The explanation at the top of the paragraph, it just wasn't broad enough. My kids need you to break it down piece by piece. (6th grade science teacher)



I probably went a little slower today...But this group needs a lot of reinforcement on their skills. (7th grade mathematics teacher)



So I've got this project right now and some other projects that I try to keep going to keep them hands-on and more data-oriented. We'd played Yahtzee in the past, just for half-days, just to do some recording and make some choices and adding stuff up....I really found that with this low math group, it's really important to work a straight "how things go" and not just expect them to be in math class as in "here's the concept...go to work." (7th grade mathematics teacher)



With that particular class, because a lot of them in there are either slow readers, or non-readers or remedial readers, they don't get anything out of reading stuff out of the textbook. So they actually have to be doing. That's why I kind of did the activity with them where they were looking through the newspaper. They have to do, so they like to do a lot of hands-on stuff. (7th grade Life Science teacher)



This group is a lot slower than others. They need to see everything. I have some kids in the other class who can write down what I say. Here, I make sure I have my overheads ready. [Instruction is] stretched out a little bit more and includes a lot more repetition. They need to see everything. (9th grade Physical Science teacher)

Gearing Instruction to High Ability Students

Instructional decision-making is similarly influenced by the presence of high ability students, in many cases allowing classes to move more quickly. Some teachers mention the need to incorporate the use of real-world applications to gain these students' interest; others talk about the use of discovery methods because they believe these students can handle the freedom associated with this pedagogy. Still other teachers believe that more traditional lecture-type strategies are more fitting to the learning styles of high ability students. Said these teachers:

These kids really get it. When I think I might have to explain something twice, they often surprise me by being ready to move onto something else. (High School Pre-Calculus teacher)



Most of them are very self-motivated and we just kind of cut to the chase. We present the material. And if they have a particular problem, we may try to change the approach just a little bit to better the understanding, but it is going to be mostly lecture and examples and question and answer-type stuff. (12th grade AP Calculus teacher)

Addressing the Needs of Heterogeneous Groups

Classes comprised of students with a wide range of ability levels present particular challenges for mathematics and science teachers. Some teachers report that they work individually with students, and use enrichment worksheets for those students completing work earlier than others. More often teachers indicate that they have students work in pairs/small groups of mixed abilities so they can help one another. For example:

From what I know about the students, some of them move quickly and then some rely on the others—and that's why I like the small group because I knew that such-and-such is going to rely on this person to help their understanding more than I could. (4th grade mathematics teacher)



In that class I have about four [students] I'd rate as high ability, and I have about five who are kind of in the middle, and the rest of them were kind of below the average working ability. So it's kind of a mixture. That's one of the reasons I was trying to pair them in a particular manner—so I would get the ones that have the greater ability to work with the ones that are a little bit slower or a little farther behind. (8th–9th grade Algebra teacher)

Teachers also talk about designing lessons to assist students who may be having difficulty understanding due to language and/or cultural barriers. In addition to using cooperative groups

as part of their lesson, teachers report more emphasis on vocabulary and drawing pictures to ensure that these students understand what is being discussed.

Adjusting Instruction Based on Student Behavior

To some extent, the behavior of students has an impact on teachers' selection of instructional strategies for their lessons. Teachers who perceive their students as well-behaved and willing to follow classroom routines design their lessons accordingly. These lessons include strategies that allow for more individual freedom such as hands-on activities, time for individual work, and cooperative groups. The teachers trust that the students can handle the independence inherent in these strategies and will do well as a result. Said these teachers:

This group is real good at following directions. They take care of themselves a lot. They're an independent group of kids. They can do a lot on their own which is why I chose to do the experiment this way because I knew most of them would be able to handle it. (1st grade science teacher)



I think because I really like this class that I do more hands-on...My other classes weren't allowed out of their seats. (7th grade science teacher)

In contrast, in classes where the teacher identifies students as having behavior problems, they report using instructional strategies such as lecture and whole group instruction to allow them to better control the students. Said these teachers:

You noticed we didn't use a lot of hands-on manipulatives today. I try to do that every once in a while, but when you throw that into the mix with [names of two students] today, it was tough to get them even listening to me anyway, but if they had something in their hands, and the rest of them had something in their hands, I could have forgotten it. We do use manipulatives, but not today. (1st grade mathematics teacher)



Behavior is not a strong point for most of the groups across the [City] School system at this time. So I try to find lessons that will keep them calm. Usually nothing that will harm anyone. So I try to come up with safe lesson. (5th grade science teacher)



These are the talkiest group of students I've ever seen. And if you really don't stay on top of them, they'll be talking about the weekend, they'll be talking about everything else, so [lecture/note-taking] is the best way I found this year to get information to them. (7th grade science teacher)

Other teachers report making instructional decisions based on "out of class" behavior such as student absenteeism and tardiness. When students are not present for every lesson, teachers

report that they have to allot more time for review of concepts and catching individual students up. Said these teachers:

It's always a balance, trying not to ignore kids who are out, because I have an obligation to help all kids to meet the standards. Saying clues like: "We did this yesterday"; "This is a review"; "One more time here it is"; I don't want to bore the kids who've been coming, but I try to keep doing this to give the absentee kids a chance to at least get caught up. Frankly, I'm not satisfied with it. The kids who miss a lot of days are not going to pass, at least not this year. They get so far behind and so confused that even sitting down with me and going over things doesn't help when all the other kids have given answers, have participated, and have insights into things that are really helpful. (9th grade Integrated Mathematics teacher)



Absenteeism, there has been a pretty good bit of. It's frequently the same students. I just try to make them responsible, but then of course it takes me extra time to keep track of them and everything else. And really by policy they are responsible for their makeup work, so it's their duty to come find me and make sure that they get arrangements made. But I do try to keep after them to see that they do. (High School Physical Science teacher)

Influence of Professional Development on Instruction

Professional development for mathematics and science teachers often focuses on the development of pedagogical skills, and an estimated 31 percent of the teachers nationally attribute their selection of instructional strategies, at least in part, to their professional development activities. Teachers report that courses they have taken or professional development sessions they have attended introduced them to a particular pedagogy, or reinforced strategies that they were already using in their lessons, including the use of manipulative/hands-on activities, cooperative learning, small group work, cognitive coaching and other strategies aligned with brain theory research. As these teachers said in describing their choice of instructional strategies for the observed lessons:

[Publisher workshops] bring a lot of the manipulatives and show you many different ways that you can use manipulative things. So, it was very helpful. (Kindergarten mathematics teacher)



We have lots of staff development opportunities in cooperative learning groups and hands-on activities. We are required to get at least 12 staff development hours in the area of our choice. In this particular year I have over 50 staff development hours, and several have been in cooperative learning and hands-on activities. (They have been) very helpful. (4th grade science teacher)



[The professional development] is where I saw the usefulness of manipulatives and visual materials for students to learn math better. (6th grade mathematics teacher)



Probably some of the workshops and then some courses that I'm taking. Presently now I'm taking Introduction to Exceptional Children...so I try to make the lesson plans, you know, expand a little bit. And then, um, within my Educational Psychology try to understand what are some of the students thinking, why are they doing some of the things they are doing. So with those two types of things, with the courses and workshops, you know, I consider that to be very useful. (9th grade Integrated Science teacher)



They try to provide you with different things that you can try and they always tell you: don't be teacher-oriented, be more student-oriented. So professional development provided me with some of the strategies that I use. (12th grade Consumer Mathematics teacher)

Influence of Teacher Collegiality on Instruction

Eighteen percent of teachers nationally are directly influenced in the instructional strategies and materials they select by their work with colleagues at their school. Teachers explain that they routinely plan with one or more teachers at their school, usually teachers at the same grade level. Some teachers describe the meetings as formal planning sessions; others characterize them as informal idea exchanges. In either case, these collaborations result in the sharing of strategies and materials used in lessons. Said teachers of these collaborations:

I work with the other first grade teacher. We decided this year to put the children in groups of three instead of working on their own like we have done in previous years. We thought the students could help each other with the measuring and cutting, plus learn some cooperation skills. (1st grade science teacher)



We talk about how we present things; what works and what doesn't. When they were talking about the money unit, I know what didn't work for them, what trouble they had. It gave me ideas of what to avoid or what to hit hard with my kids. (2nd grade mathematics teacher)



The other ladies I work with in 3rd grade, we get together and we plan together so all the 3rd graders do the same thing, so I am influenced by them. (3rd grade science teacher)

Other Factors Influencing Instruction

Other potential influences included in the interview protocol are less frequently cited as important in the design of instruction. For example, only about 10 percent of teachers nationally indicate that their principals influence their instruction; in most of these cases principals are cited as endorsing particular instructional strategies or materials. Teacher evaluation systems appear to have even less impact on instruction, with only 1 percent of teachers nationally citing teacher evaluation as influencing their lesson designs.

Surprisingly, given the age of many schools in the United States, and the current budget problems in many school systems, very few teachers indicate that their selection of pedagogy is influenced by constraints in the physical environment (7 percent nationally). When the physical environment is mentioned, it is usually by science teachers who are unable to use laboratory/hands-on activities due to space and equipment deficiencies.

Similarly, very few teachers mention that scheduling policies, such as class length, have any impact on their selection of instructional strategies. Most teachers citing some influence of scheduling on their instructional decisions talk about how block scheduling allows them to slow the pace of their lessons and to implement a variety of instructional strategies during the extended class period.

Although state and district mathematics and science tests impact teachers' selection of content in almost half of lessons nationally, these tests appear to have relatively little influence on the selection of pedagogy or materials (7 percent). Where testing is a factor, teachers report using various strategies to prepare students for these assessments, including drill and practice and presenting content in a manner similar to the way it will appear on the test. In a number of mathematics lessons observed, teachers had selected or designed review worksheets or test preparation materials to use with students. In addition, due to the pressure of high stakes tests in reading and mathematics, a few science teachers reported that they altered the design of their lessons to include reinforcement of skills students will encounter on those tests.

A similar trend is found when examining the influence of state and district curriculum frameworks on instruction. While most teachers are guided by these frameworks in their selection of content, few teachers (5 percent nationally) report any direction from curriculum frameworks when selecting pedagogy or instructional materials for lessons. Finally, areas cited as influencing instruction by fewer than 5 percent of teachers, include school board and district administrators, national standards, and parents/community.

