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ABSTRACT

Cognitive interviews were conducted with 12 teachers and 66 of their students to learn how to improve National Assessment of Educational Progress (NAEP) questionnaire items asking about instructional practices and teacher development experiences. Items were purposively selected from those used in the 1996 and 1998 NAEP student and teacher background questionnaires in fourth grade reading, mathematics, and science, and eighth grade mathematics and science. NAEP items that were administered in analogous forms to teachers and their students were chosen, to facilitate validation, and items known or thought to be problematic were selected. Several general types of item problems were found: (1) behavioral frequency items; (2) time frame problems; (3) problems with response options; (4) comprehension problems; (5) problems with list format items (loss of content); (6) problems with "check all that apply" items; and (7) other problems and issues. The cognitive interviews, with validation components, enabled detection of many survey design problems and an understanding of the reasons for their occurrence so that these problems can be avoided in the development of future NAEP and other background survey items. (Contains 9 tables and 16 references.) (SLD)

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The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items

Working Paper No. 2002–06 August 2002

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The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items

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August 2002

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Executive Summary

Cognitive interviews were conducted with teachers and their students to learn how to improve National Assessment of Education Progress (NAEP) questionnaire items asking about instructional practices and teacher professional development experiences. Items were purposively selected from those used in the 1996 and 1998 NAEP student and teacher background questionnaires in fourth grade reading, mathematics, and science, and eighth grade mathematics and science. NAEP items that were administered in analogous forms to teachers and their students were chosen, to facilitate validation. Additionally, items known or felt to be problematic were selected.

Cognitive interviewing protocols were developed and administered to teachers in their classrooms. After the interviews were completed, their responses to instructional practice items were validated. Additional items were administered, to enable subsequent validation of their students' responses. Then, cognitive interviewing protocols were administered to these teachers' students. Students' responses were compared to those provided by their teachers. When student and teacher responses were discrepant, further probing could be triggered. This ensured an understanding of the etiology of response discrepancies.

Several general types of item problems were found. These are discussed below.

Behavioral frequency items. Many NAEP questionnaire items were behavioral frequency items. These items ask how frequently a student engages in specific activities or a teacher employs specific instructional practices. Analyses of NAEP student behavioral frequency response data have not been especially informative.

When teachers' responses to the behavioral frequency items studied were compared to responses of their students, very high rates of discrepancy were observed. The average level of agreement between fourth grade students and their teachers on items that used a four-point rating scale was 38 percent; for eighth grade students and their teachers, the level of agreement was 51 percent. The level of agreement that would be expected by random guessing is 25 percent.

There were several different reasons for these high rates of discrepancy. These include issues of item comprehension, scale problems, and other technical survey design issues. We feel the major source of these discrepancies is inherent in the task the students were being asked to perform. To answer these items, an individual can either count the number of times a behavior was performed or employ estimation strategies. When behaviors occur frequently and are of low salience, estimation strategies are typically employed. These estimates then have to be averaged over a time period (which is not always explicitly and unambiguously specified). The result of these calculations then must be compared with a series of response options and one of these options must be selected. Few eighth graders and fewer fourth graders are able to employ efficient and accurate estimation strategies and then average these estimates over a time period. In other words, the high rate of failure for these items is largely due to the fact that fourth and eighth grade students lack the cognitive skills and abilities required to synthesize an accurate response.

Time frame problems. The period of relevance for a survey item (e.g., the period over which behavioral frequencies are to be estimated) is called the item's time frame. Our investigations enabled detection of the existence of implicit time frames that were inconsistent or in conflict with the item's intended time frame. Items asking "When you study mathematics in school, ..." were almost always interpreted by teachers as asking about the current school year. Students would often think of a shorter, more recent period or a period of high salience.

Items that asked, "Have you ever done hands-on activities or projects in school with the following?" were interpreted by some, but not all students, as implicitly referring to the same time frame (current school year) asked about in the other items. Other students, particularly fourth graders, would interpret "ever" literally. They would include activities in other grades.

Thus, vaguely defined explicit time frames and inconsistencies between an item's explicit and implicit time frame contributed to response discrepancies.

Problems with response options. Another time frame problem was associated with the response options for some of the frequency items inquiring about instructional practice. In our discussions with fourth grade teachers, we found that science lessons are not provided on a daily basis. Rather, they are episodic. However, the behavioral frequency scale for student science items was explicitly linked to the periods when science was being taught ("When you study science in school"). Accordingly, the response option, "Almost every day," was explicitly interpreted as "Almost every day that science is taught." Unfortunately, the next two response options ("Once or twice a week" and "Once or twice a month") are implicitly linked to the calendar year. There is a conflict between the options' implicit and explicit time frame. If science is usually taught twice a week and the focal behavior occurs nearly every time science is taught, the response alternatives "Almost every day" (explicitly interpreted) and "Once or twice a week" (implicitly interpreted) become indistinguishable.

Comprehension problems. Certain words and phrases were not always interpreted as intended by the item writers, and, like linguistically complex items, were associated with comprehension problems. That is, these items were interpreted differently by different respondents. One commonly used phrase, "students in your class," was discovered to be especially problematic for teachers. When teachers were asked "How often do the students in your class do ...?" they would either respond about the <u>typical</u> student or about how frequently <u>any</u> student in their class engaged in the focal behavior. Accordingly, a response of "almost every day" could mean that on most days at least one student used a computer or it could mean that the typical student used a computer nearly every day.

Survey items often included parenthetical examples to clarify the meaning of a technical term or construct. In many cases, students were unable to generalize from the examples to the intended construct. In these cases, the examples become the focus of the question. For example, when fourth graders were asked about whether they had ever done any hands-on activities with "Chemicals (for example, mixing or dissolving sugar or salt in water)", many would only focus on the examples. For these students, the item became a question about whether they had ever mixed or dissolved sugar or salt in water.

Numerous comprehension issues, particularly those associated with the understanding of terms relating to specific instructional practices (e.g., "real-world problems," "hands-on activities," "science demonstration") as well as other words and phrases are discussed in greater detail in sections 3and 4.

Problems with list format items: Loss of context. Another problem was associated with the presentation of items in a list format. In list format items, an item stem will ask a question such as "When you do mathematics in school, how often do you do each of the following?" A rating scale will be provided, together with a list of several different behaviors. For example:

When you do mathematics in school, how often do you do each of the following?
Fill in one box on each line.

	Almost every day	Once or twice a week	Once or twice a month	Never or hardly ever
1. Do mathematics problems from textbooks	☐	☐	☐	☐
2. Do mathematics problems on worksheets	☐	☐	☐	☐
3. Solve mathematics problems with a partner or in small groups	☐	☐	☐	☐
.				
.				
9. Discuss solutions to mathematics problems with other students	☐	☐	☐	☐
10. Use a computer	☐	☐	☐	☐

As the respondent went through this list, it was not unusual to forget the conditions specified in the item stem. By the time the respondent got to "use a computer," the respondent would not infrequently lose the item's context and respond about general usage of a computer. The context of using a computer *for doing mathematics in school* had been lost. This loss of context occurred many times, for a variety of items, for both students and teachers.

Problems with "Check all that apply" items. Survey design and layout issues were the source of some problems. "Check all that apply" items provide a respondent with a list of behaviors, attributes, or characteristics and request the respondent to check all that apply. When a student did not understand what an item in the list meant, the student would usually (but not always) leave the box alongside this alternative unchecked. An unchecked box could either reflect the fact that the respondent did not understand the item, refused to answer the item, or that the item did not apply to the respondent.

Other problems and issues. Issues associated with the development of items relevant to each different subject area are discussed in the report. For example, elementary grade science items for students must take into account the episodic nature of science lessons, the integration of science lessons with other lessons, and difficulties inherent in identification of a lesson as a science lesson (e.g., Should a discussion of a recent earthquake be considered "current events" or "science?"). Similarly, the development and analysis of items dealing with reading and mathematics instruction should take into account the fact that instruction in these areas may be integrated with instruction in other subject areas.

Overall summary. Cognitive interviews, with validation components, enabled detection of many survey design problems and an understanding of the reasons for their occurrence. As a result, these problems can be avoided in the development of future NAEP and other background survey items.

1. INTRODUCTION

NAEP Background Questionnaires

The National Assessment of Educational Progress (NAEP) is involved in a major effort to measure the educational achievement of our nation's children. As part of this effort, when students take NAEP achievement tests, they also answer questions about a variety of background factors that are known or believed to be related to performance on these tests. Some of the questions are related to home background factors (e.g., parent education, TV watching, and homework). Other questions ask both students and teachers about instructional practices such as the use of computers in mathematics or the frequency of group activities in reading. Students are asked attitudinal questions about specific subjects; teachers are asked background items about professional development.

There has been concern about the quality of student background data. Data from fourth graders on specific factors (e.g., parent education) have been deemed unreliable due to high omission rates. For similar reasons, data from eighth grade students, in particular from minority students, have also been of questionable reliability. Accordingly, a study was undertaken in 1996-97 to investigate the quality of the fourth and eighth grade home background items. A cognitive interviewing protocol was developed, which included a validation component. Parents of the students were interviewed along with their children, providing information to validate their child's responses. These procedures enabled identification of item problems that would not otherwise have been detected (Levine et al., 2001).

This study is an extension of the previous effort. Cognitive interviewing protocols were again developed; these included validation components. However, this time the questions were primarily concerned with instructional practices. So, students' teachers provided the validating information.

Instructional background items from the 1996 and 1998 NAEP background questionnaires in fourth grade reading, mathematics, and science, and eighth grade mathematics and science were selected for investigation. A total of 66 students and 12 teachers participated in this study.

Cognitive Interviewing and Validation

Cognitive interviewing (also known as verbal reporting [Willis et al., 1991]) of questionnaire respondents is a form of interview used to uncover the mental processes involved when a respondent reads and responds to survey questions (Willis et al., 1999). Cognitive interviews are effective in determining how respondents comprehend survey items and what strategies they use to devise answers. Such interviews are primarily conducted in the course of pretesting surveys, to identify sources of respondent confusion and misunderstanding (Krosnick, 1999; Fowler and Cannell, 1996; Schaeffer and Maynard, 1996). They may lead to the verification of an expected question problem or the discovery of a problem that was unanticipated (Willis et al., 1999; DeMaio and Rothgeb, 1996). Cognitive interviewing can facilitate not only finding a problem but also fixing that problem (Willis et al., 1999).

In most cognitive interviews, two basic techniques are utilized: "think-alouds" and verbal probing (Willis et al., 1999). In the think-aloud technique, the interviewer asks the subject to report what he or she is thinking as he or she is answering an item. Often a simple question such as "Can you tell me what you're thinking?" is used. The interviewer records the process the respondent describes as he or she arrives at an answer. In addition, specific probes related to each item (e.g., requests to paraphrase the question or requests to define words and phrases) are developed and then administered after the participant has produced a response to the survey question.

The use of validating information can be of tremendous benefit to the cognitive interviewer (Huberman and Levine, 1999). Although think-alouds and normal probing enable the identification of many item problems, there are occasions when an individual's think-aloud and responses to probes will fail to reveal the existence of an incorrect response. But, if the interviewer knows the response is problematic (as a result of validating information), further probing can be employed until reasons for the otherwise undetectable item problem are determined. Validation data also lend themselves to simple, tabular presentations of the effectiveness of an item.

Validation information can be quite difficult to obtain. Not infrequently, the item being validated is a self-report item where only the respondent knows "truth." Effective procedures for validating self-report data employing focused retrieval, extensive retrieval, varied retrieval, and attempts to evoke multiple representations of the construct of interest through the reconstruction of a calendar/diary for a time period of interest have been used to validate self-reports of hours worked (Edwards, Levine, and Cohany, 1989). In a similar fashion, to improve the quality of eyewitness reports of a crime, these procedures have been employed in a technique called (coincidentally) "cognitive interviewing." The principles underlying this type of cognitive interviewing are (Fisher and Quigley, 1992):

1) *Context reinstatement.* The same psychological environment in which the event occurred is created to increase the validity of recall (Tulving and Thomson, 1973).

2) *Focused retrieval.* The interviewer gets the respondent to expend effort and engage in uninterrupted concentration (Kahneman, 1973).

3) *Extensive retrieval.* The more retrieval efforts the respondent makes, the more successful recall will be. Thus, the respondent is encouraged to search through memory even if she thinks that she has recalled everything (Roediger and Payne, 1982).

4) *Varied retrieval.* The use of different retrieval probes is more effective than the use of a single retrieval probe (Anderson and Pichert, 1978).

5) *Multiple representations.* The construct of interest will have different mental representations in the respondent's memory. Each different representation is evoked and probed separately (Fisher and Chandler, 1984).

These procedures have been shown to be effective in enhancing dietary recall (Fisher and Quigley, 1992).

Teachers were used as a source of validation data for student responses to items dealing with instructional practices and classroom behaviors. However, before the teacher data were used to validate student responses, these teacher data underwent validation. A calendar exercise incorporating the above techniques was used for this purpose. Thus, student data were compared to validated teacher data.

Overview of the Report

We describe the procedures used to choose items for investigation and to collect and analyze data in section 2. We present results and general findings in section 3 and provide detailed findings for each item investigated in section 4. In section 4, which is organized by grade and subject, we also discuss findings and provide recommendations for item modifications to correct specific item problems.

2. METHODOLOGY

Survey Development (Item Selection)

Overview

Since resources did not permit all NAEP items to be investigated, three different sets of criteria were used to select items for cognitive laboratory investigations:

1) Fourth grade mathematics background items that were deemed problematic based on secondary analyses of NAEP data were selected.
2) NAEP student items that could be validated through administration of parallel NAEP teacher items were selected.
3) Items that were of special programmatic interest or were otherwise felt to be problematic were selected.

These items were not intended to be a random sample of all NAEP items. Rather, the purpose of these investigations was to enable the development of higher quality student and teacher survey items in the future, through investigation of items known or felt to be problematic or of programmatic interest.

Procedures

The fourth grade 1996 NAEP student mathematics questionnaire contained items asking about the frequency with which mathematics related activities occurred and the frequency with which calculators were used for classwork, homework, and tests or quizzes. Analogous items were also asked of teachers. Secondary analyses were conducted on these items.

If these mathematics items were eliciting valid responses, there should be evidence of reliability or agreement among the responses of survey respondents (i.e., consensual validation). That is, responses to these items should be relatively constant among the students in a class. The presence of substantial within-class variation is an indicator of potential item problems. In addition, when similar items were administered to both students and teachers, student responses should be the same as their teacher's responses.

Student responses were compared with their teacher's responses to identify those items with the greatest mean differences.[1] For all cases in which two or more student responses could be linked with a teacher, variation within a classroom was calculated in four different ways:

1) The absolute value of the deviation of student responses from their class's mean value was determined, and divided by the number of student respondents in the class, to create a "mean deviation" score.
2) Each classroom's standard deviation was calculated and averaged over all classrooms to create a "mean standard deviation."

[1] Behavioral frequency responses were treated as interval data "Almost every day" was assigned a value of 4; "Once or twice a week," a value of 3; "Once or twice a month," a value of 2; and "Never or hardly," a value of 1.

3) The absolute value of the deviation of student responses from their teacher's response was determined for each classroom and averaged over all classrooms, to create a "mean deviation from the teacher's report."

4) The deviation of student responses from their teacher's response was averaged over all classrooms to estimate a "Student - Teacher deviation."

In ranking items according to the amount of student response variation within a class, within class mean deviations and within class standard deviations yielded nearly identical orderings of the items. (See table 1.) Two of the four items with the greatest within class variation were concerned with calculator usage: "Using a calculator for mathematics homework" and "Using a calculator for mathematics class work." These variations may simply reflect the natural variation of these behaviors among students in a class. The other two of the four most variable items ("Talking to the class about your mathematics work" and "Discussing solutions to mathematics problems with other students") may similarly represent teaching practices for which variation among students is to be expected. Certain students may be called upon more frequently than others to talk about their work or may discuss solutions with other students more frequently than other students. Comparisons of student responses with teacher responses for these items revealed the greatest variation.

Table 1. Within Classroom Variations in Student Responses to Mathematics Behavior Items

When you do mathematics in school, how often do you do each of the following?	Mean Dev.	Mean S.D.	Student Mean	S.D.	# Students	# Classes
14. (Use a calculator for math) homework	0.97	1.17	2.33	1.29	6,369	556
7. Talk to class about your mathematics work	0.94	1.15	2.09	1.23	6,297	557
13. (Use a calculator for math) class work	0.92	1.13	2.42	1.27	6,402	557
9. Discuss solutions to mathematics problems with other students	0.86	1.06	2.33	1.14	6,486	557
5. Write a few sentences about how you solved a mathematics problem	0.83	1.03	2.32	1.16	6,449	557
10. Use a computer	0.83	1.02	1.89	1.14	6,472	557
8. Do 10 or more practice problems in mathematics by yourself	0.79	1.00	3.14	1.09	6,466	557
4. Work with objects like rulers, counting blocks, or geometric shapes	0.75	0.94	2.18	1.08	6,488	557
3. Solve mathematics problems with a partner or in a small group	0.73	0.91	2.03	1.03	6,487	556
11. Use a calculator	0.70	0.88	1.97	1.01	6,476	557
15. (Use a calculator) for tests or quizzes	0.65	0.81	1.65	1.07	6,522	557
1. Do mathematics problems from textbooks	0.64	0.83	3.26	0.92	6,335	557
2. Do mathematics problems on work sheets	0.62	0.79	3.15	0.97	6,509	557
6. Take mathematics tests	0.52	0.68	2.39	0.79	6,497	557

NOTE: The stem for items 13 - 15 was "For mathematics, how often do you use a calculator for each of the following activities?"

Teachers generally reported a greater frequency of occurrence of these behaviors than did students. (See table 2.) It was subsequently noted that the question, "How often do your students do each of the following?" can be interpreted in two different ways:

1) How often does the TYPICAL student in your class perform the focal behavior?

2) How often does ANY student in your class perform the focal behavior?

Naturally, the second interpretation will lead to higher behavioral frequencies. This may explain why, for most items, and particularly for those for which a wide range of between student variation was expected, teachers tended to report greater behavioral frequencies than their students. These patterns of variation suggest that these items are not functioning as intended.

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Table 2. Comparisons of Student and Teacher Responses to Mathematics Behavior Items

When you do mathematics in school, how often do you do each of the following?	Absolute Mean Deviation		Overall Mean		Student-Teacher Deviation
	Student	Teacher	Student	Teacher	
7. Talk to class about your mathematics work	0.94	1.44	2.09	2.93	-0.84
9. Discuss solutions to mathematics problems with other students	0.86	1.20	2.33	3.00	-0.67
5. Write a few sentences about how you solved a mathematics problem	0.83	1.05	2.32	2.10	0.23
10. Use a computer	0.83	1.16	1.89	2.49	-0.59
3. Solve mathematics problems with a partner or in a small group	0.73	1.13	2.03	2.90	-0.86
11. Use a calculator	0.70	0.82	1.97	2.03	-0.06
1. Do mathematics problems from textbooks	0.64	0.68	3.26	3.46	-0.20
2. Do mathematics problems on work sheets	0.62	0.79	3.15	2.96	0.18
6. Take mathematics tests	0.52	0.58	2.39	2.32	0.07

NOTE: The item wording is from the Student questionnaire. Only directly comparable items are presented in this table.

Nonetheless, many of the other behavioral frequency items were items for which between student variation was expected to be minimal. And, since these other items referred to class-wide practices, agreement with teacher responses would be predicted to be high—if the items were functioning as intended. The item with the fifth greatest amount of within class variation—"Write a few sentences about how you solved a mathematics problem"—represents a teaching practice that all students in a given classroom should be expected to engage in with roughly equal frequencies. The substantial within class variation suggests possible item problems. Student reports were also discrepant from their teacher's reports—by an average of almost one scale unit. For these reasons, this item was chosen for investigation.

In addition, items that could be validated through administration of ancillary questions to teachers and items of programmatic interest or those that were thought to be problematic were selected. Selection of items for the other fourth grade subjects and eighth grade mathematics and science were based on these criteria. No other secondary analyses were conducted.

Selected items were used to create fourth grade student surveys in mathematics, science, and reading, and eighth grade student surveys in mathematics and science. Because fourth grade teachers usually teach all subjects, only one teacher survey covering all three subject areas was created. Separate surveys in mathematics and science were developed at the eighth grade level because of the departmentalized nature of instruction in most middle schools. Each survey requested information on the frequency of instructional practices such as taking tests, using calculators and computers, classroom presentations, field trips, and homework related to each subject area. In addition, the teacher surveys asked questions about the teacher's professional development activities in the past year.

Protocols for each survey were developed. The protocols provided a variety of optional probes (e.g., word definition and paraphrasing), to be used when deemed appropriate. The protocols were reviewed both internally and by Dr. Robert Belli, a cognitive survey researcher at the University of Michigan's Institute for Survey Research. In addition, interviewers were trained to develop and employ probes, as necessary, during the interviews.

Protocol Refinement

Protocols underwent revisions during the data collection process. These revisions were based on preliminary findings and were intended to increase the utility of the data collected. There were three major types of revisions.

We noticed that individuals responding to items presented in list format were losing context. That is, they would respond to the component of the item that was in a list rather than to the question posed in the item's stem. For example, the stem of an item might ask, *"When you teach mathematics, how often do you do each of the following?"* Several items would then be listed, including an option such as, *"Use computers."* If a respondent answered about his or her use of computers for purposes other than teaching mathematics, he or she is said to have lost context. The context of performing the behavior *for the purpose of teaching mathematics* that appears in the stem is no longer salient at the time of response.

Since our protocol required the respondent to think aloud while responding to an item, it could be argued that this loss of context is artifactual. The process of thinking aloud, focusing on a specific item, might be responsible for the respondent forgetting the item's stem. So, procedures were modified for the examination of items in list format: The respondent was asked to answer all of the listed items, without thinking out loud. After the last item in the list, (s)he was asked to describe what was going on in his or her mind when (s)he was answering the question. In other words, instead of using concurrent think alouds, retrospective think alouds were employed for the investigation of these items. Regardless of whether concurrent or retrospective think alouds were used, respondents continue to lose context, demonstrating that the loss of context was not artifactual.

The second type of modification involved alteration of item wordings. For certain items, there were clear comprehension problems. For example, no fourth grader knew what was meant by "e.g." Rather than demonstrate this over and over, decisions were made to employ alternative item wordings (such as the replacement of "e.g." with "for example") to allow determination of the effectiveness of the alternative wording. Similarly, the term "novels" was changed to "books with chapters" and "undecided" was changed to "not sure."

The third type of modification involved alteration of behavioral frequency scales. Behavioral frequency items were typically associated with very high levels of non-agreement. Rather than continuing to use a four-point frequency scale, a three-point scale was developed and employed. The reduction of the number of points in a rating scale will increase the amount of agreement, if for no other reason than an increase in the number of "chance" agreements. There was little evidence that this procedure substantially increased agreement beyond what might be expected by chance.

Participant Recruitment and Selection

In order to get a heterogeneous group of participants, three San Francisco Bay Area school districts were contacted. Informational materials and consent forms were prepared and sent to teachers in six different schools in these districts. As an incentive for participation, teachers were offered $100 and students $50 for their time. After teachers agreed to participate in the study, they were asked to distribute informational materials and consent forms to their students. Students and their parents were encouraged to either call the American Institutes for Research directly to set up an appointment for an interview or to return the signed consent form to the teacher. Potential participants were screened to allow selection of a diverse sample with respect to the household's annual income level and the race/ethnicity of the student. Each teacher was able to help us recruit between three and eight of his or her students.

Spanish versions of the informational materials were also prepared and distributed to students. Staff fluent in Spanish worked with Spanish-speaking parents. However, children needed to be able to speak and read English in order to participate in the study, since this was a requirement to participate in the NAEP assessment.

A total of 12 teachers (six fourth grade teachers and six eighth grade teachers) and 66 of their students (35 fourth graders and 31 eighth graders), representing five elementary and middle schools were interviewed for the study. One-third (33 percent) of the student sample was from low-income households (below an annual income of $30,000) and about two-fifths (41 percent) of the sample were minority students (mostly of Hispanic origin).

Interview Procedures

Teacher Interviews

The teacher interviews lasted about two hours and consisted of two phases. In the first phase, the survey items were administered. The teacher was asked to read the questions aloud and was reminded to think aloud to provide insights into the cognitive processes that he or she employed in responding to the items. In addition, specific probes and paraphrasing requests were used to obtain additional information about the response process. Typical probes included: "What do you think they mean by [technical term]?" and "What do you think this question is asking?"

The second phase of the interview was designed to validate some of the teachers' responses in Phase 1. For cognitive reinstatement purposes, interviews were conducted in the teacher's classroom. The teacher was asked to reconstruct the past week's activities in class through a calendar exercise. To this end, weekly matrices were designed to help the teacher recall the frequency of certain instructional practices occurring each day. The teacher recalled each day of the week by first thinking of important or atypical events that occurred during the past week (e.g., staff meetings, sick students, and special events). These were written onto the matrix to serve as cognitive anchors and facilitate recall of each day's events. Then, the teacher was asked about the day's lesson in the subject area of interest (e.g., what the teacher taught that day, whether he or she used any special materials such as manipulatives, and whether the teacher utilized technology). To evoke multiple representations, the teacher was also asked to think about a specific student and what this student did during the lesson in question. All of these extensive retrieval activities were intended to facilitate recall. After the interviewer felt this effort resulted in retrieval of a clear representation of the day's lesson, the teacher was then asked to report which of several instructional practices occurred on that day in the subject area of interest. This process was repeated for each subject and each day. Responses were documented on the matrix, as well. Then, the number of days on which each behavior of interest was performed was tallied, producing frequencies for each behavior for the past week. Respondents were then asked whether the past week was typical with respect to instructional practices. If not, they were requested to make adjustments to account for the atypicality of the week, and these frequencies were then compared to the frequencies given in the first phase of the interview. Discrepancies were probed, and the most accurate answer (as determined by the teacher) was noted.

Fourth grade teachers' responses to the following behavioral frequency items were validated through use of a calendar/diary exercise:

READING LESSONS: TEACHER'S BEHAVIORS

- Ask students to talk with each other about what they have read
- Ask students to write about something that they have read
- Ask students to do a group activity or project about what they have read
- Help students understand new words
- Ask students to make predictions about what they read as they are reading it
- Ask students to make generalizations and draw inferences based on what they have read

SCIENCE LESSONS: STUDENT'S BEHAVIORS

- Discuss science in the news
- Do hands-on activities or investigations in science
- Talk about measurements and results from student's hands-on activities
- Use library resources for science
- Use computers for science

SCIENCE LESSONS: TEACHER'S BEHAVIORS

- Talk to the class about science
- Do a science demonstration
- Show a science video or science television program
- Use computers for science (e.g., science software, telecommunications)

MATHEMATICS LESSONS: STUDENT'S BEHAVIORS

- Do mathematics problems from textbooks
- Do 10 or more practice problems by themselves
- Do mathematics problems on worksheets
- Solve mathematics problems in small groups or with a partner
- Work with objects like rulers
- Work with counting blocks or geometric shapes
- Use a calculator
- Take mathematics tests
- Write a few sentences about how to solve a mathematics problem
- Talk to the class about their mathematics work
- Discuss solutions to mathematics problems with other students
- Use a computer

Eighth grade science and eighth grade mathematics teachers' responses to the following behavioral frequency items were validated through use of a calendar/diary exercise:

SCIENCE LESSONS: TEACHER'S BEHAVIORS

- Talk to the class about science
- Do a science demonstration
- Use computers for science

SCIENCE LESSONS: STUDENT'S BEHAVIORS

- Discuss science in the news
- Work with other students on a science activity or project
- Give an oral science report

- Do hands-on activities or investigations in science
- Talk about measurements and results from their hands-on activities or investigations

MATHEMATICS LESSONS: STUDENT'S BEHAVIORS

- Do mathematics problems from textbooks
- Do mathematics problems on worksheets
- Solve mathematics problems in small groups or with a partner
- Work with objects like rulers
- Work with counting blocks or geometric shapes
- Take mathematics tests
- Write a few sentences about how to solve a mathematics problem
- Talk to the class about their mathematics work
- Write reports or do mathematics projects
- Discuss solutions to mathematics problems with other students
- Work and discuss mathematics problems that reflect real-life situations
- Use a computer

Our major motivation for undertaking this validation was to produce the highest quality criterion measures against which student responses could be compared. Major adjustments were the exception rather than the rule; teachers' reconstructed responses were usually the same as their initial responses.

Since the student surveys contained some items that were not included in the teacher survey, the teachers were asked additional questions that could be used to validate the students' answers. For example, the teachers were asked about homework, science field trips, the use of calculators in mathematics, and the use of assessments in mathematics, reading, and science.

Following each teacher interview, we prepared a summary of the interview focusing on item problems.

Student Interviews

Before the student interviews were conducted, teacher responses and any other relevant information from the teacher interviews were recorded on the student protocols to facilitate the identification of discrepancies and the triggering of probes.

The three fourth grade subject area surveys consisted of between 12 to 19 items. Since three subject area surveys (with their associated protocols) could not be administered in a two-hour cognitive interview session, each fourth grader was administered two of three surveys—mathematics and science, mathematics and reading, or science and reading. Because of the departmentalized nature of middle schools, as mentioned earlier, eighth graders answered either a 23-item mathematics survey or a science survey with 23 items.

Similar to the first phase of the teacher interviews, the students were asked to read the questions aloud. This facilitated detection of potential language and comprehension problems. For example, when a student could not read or pronounce a word, it could indicate a comprehension problem. In these cases, the interviewer would make sure to probe the student's understanding of the particular word.

The students were continually encouraged to think aloud and, like the teacher interviews, specific probing and paraphrasing techniques were used to obtain additional information about the student item response process. When a student's response differed from that of his or her teacher, the interviewer tried to determine the reason for the discrepancy by administering additional probes about the item (e.g., asking for further clarification about how estimates were produced or verifying comprehension of the item). For instance, an eighth grade science student indicated that he had not been on a science field trip this year, even though the interviewer knew from his teacher's response that the science class had been on a field trip to the NASA Ames Research Laboratories. With this information in mind, the interviewer asked if the student had been on ANY field trips this year and the student responded that he had been on a field trip to the NASA Ames Research Laboratories! However, the student did not consider this a science field trip. An example of a science field trip in his mind would be to visit a research institute like the American Institutes for Research. Without the teacher's response to validate the student's answer, this item problem (the definition of "a science field trip") might not have been detected.

After each student interview, a summary was prepared focusing on item problems and the reasons for any discrepancies between the student's and his or her teacher's answers.

Analysis

To summarize results, we compared students' responses to their teachers' adjusted responses. Discrepancy rates were calculated across all student-teacher item pairs.

When discrepancies occurred, the student and teacher summaries were analyzed to identify the reasons for the discrepancies. In nearly all cases, the teacher's validated response was considered to be the correct response. However, situations would occasionally arise which strongly suggested that the teacher had misinterpreted the question. These reasons are presented in item-by-item discussions and are used to inform suggested actions.

Teachers' responses to the selected behavioral frequency items that were validated through the calendar exercise were compared with their survey (Phase I) responses. The frequencies and magnitudes of these discrepancies are summarized in the next section.

3. RESULTS AND DISCUSSION

Teacher Self-reported Behavioral Frequency Data

The final estimates produced by teachers after the validation exercise were compared to their responses to the original presentation of these items. These items were rated on a four-point frequency scale:

1) Never or hardly ever
2) 1–2 times per month
3) 1–2 times per week
4) Almost every day

The proportion of responses that were changed as a result of the enhanced recall procedures and the proportion of responses that changed by two or more scale points (defined as a major discrepancy) are summarized in Tables 3 and 4.

Table 3. Discrepancy Rates of Fourth Grade Teachers to Selected Behavioral Frequency Items, by Subject Area

Subject Area	Discrepancy Rate	
	Any Discrepancy	Major Discrepancy
Science	37%	2%
Math	36%	11%
Reading	36%	3%

NOTE: Results are based on the responses of six teachers.

Table 4. Discrepancy Rates of Eighth Grade Science and Mathematics Teachers to Selected Behavioral Frequency Items, by Subject Area

Subject Area	Discrepancy Rate	
	Any Discrepancy	Major Discrepancy
Science	12%	0%
Math	25%	8%

NOTE: Results are based on the responses of three science and three mathematics teachers.

Major discrepancies were relatively rare. They generally resulted from the teacher's misinterpretation of the item's intent. Minor discrepancies reflected both the difficulty of the task (producing behavioral frequency estimates) and gaps between the scale points. Gaps occurred between all of the scale points. Behaviors performed about three times per week could either be classified as "Almost every day" or "1-2 times per week;" behaviors performed approximately three times a month could be classified as "1-2 times per week" or "1-2 times per month;" behaviors that occurred between three and six times per year could be classified as "Never or hardly ever" or "1-2 times per month." Minor changes in a behavioral frequency estimate would result in its classification in an adjacent response category.

Comparison of Student and Teacher Behavioral Frequency Data

From the think-alouds and the validation data provided by teachers, it was possible to compare students' answers with their teacher's responses, identify inconsistencies, and determine the reasons that these inconsistencies occurred. Discrepancy rates for fourth graders are presented in tables 5 – 7. In these tables, the 4-point scale refers to the same behavioral frequency scale used in the teacher questionnaire:

1) Never or hardly ever
2) 1-2 times per month
3) 1-2 times per week
4) Almost every day

As noted in the previous section, very high student-teacher response inconsistency rates were associated with use of this scale. Accordingly, a simpler, 3-point scale was developed and administered to students. In this scale, the first response option was modified and the middle response options were combined:

1) Never
2) Sometimes
3) Almost every day

This alternative scale was implemented for heuristic purposes. In a qualitative study of this kind, with small numbers of respondents, our intention was not to enable the measurement and detection of statistically significant differences. Rather, our intent was to roughly gauge the impact of an alternative scale.

Table 5. Discrepancy Rate for Selected Fourth Grade Science Items, by Type of Scale

When you study science in school, how often do you do each of the following:	4-point scale (n=16)	3-point scale (n=7)
Discuss science in the news	69%	43%
Do hands-on activities in science	75%	0%
Talk about measurements and results from your hands-on activities	75%	29%
Use a computer for science	13%	57%
Use library resources for science	69%	29%
When you study science in school, how often does your teacher do each of the following?		
Talk to the class about science	81%	29%
Do a science demonstration	88%	29%
Show a science videotape or science television program	63%	71%
Use computers for science (e.g., such as science software, telecommunications)	13%	33%

NOTE: The number of students (n) is the modal number of respondents to each item.

Table 6. Discrepancy Rate for Selected Fourth Grade Mathematics Items, by Type of Scale

When you do mathematics in school, how often do you do each of the following:	4-point scale (n=19)	3-point scale (n=6)
Do mathematics problems from textbooks	68%	33%
Do mathematics problems on worksheets	74%	17%
Solve mathematics problems with a partner or in small groups	74%	100%
Work with objects like rulers, counting blocks, or geometric shapes	74%	67%
Write a few sentences about how you solved a mathematics problem	61%	67%
Take mathematics tests	32%	33%
Talk to the class about your mathematics work	89%	100%
Do 10 or more practice problems in mathematics by yourself	79%	50%
Discuss solutions to mathematics problems with other students	58%	100%
Use a computer	37%	0%
Use a calculator	42%	66%
This year in school, how often have you taken mathematics tests where you were asked to provide detailed solutions to problems you had not worked on before?	88%	60%

NOTE: The number of students (n) is the modal number of respondents to each item.

Table 7. Discrepancy Rate for Selected Fourth Grade Reading Items, by Type of Scale

When you have reading assignments in school, how often does your teacher do each of the following:	4-point scale (n=16)	3-point scale (n=7)
Ask you to do a group activity or project about what you have read	50%	57%
Ask you to talk to other students about what you have read	79%	29%
As you to write about something you have read	33%	71%
Help you break words into parts	62%	50%
Help you understand new words	60%	86%
This year in school, how often have you been asked to write long answers to questions on tests or assignments that involved reading?	67%	83%

NOTE: The number of students (n) is the modal number of respondents to each item.

The average discrepancy rate for a 4-point scale item was 62 percent; for a 3-point item, 51 percent. Alternatively, these rates can be presented as their complement: agreement rates. The average agreement rate for a 4-point scale item was 38 percent; for a 3-point item, 49 percent. Through totally random guessing, agreement rates for 4-point scale items of 25 percent and for 3-point scale items of 33 percent would be expected. There is little evidence that decreasing the number of scale points substantially increased the levels of student-teacher agreement, relative to what would be expected by chance. This suggests that the reasons for the high discrepancy rates are associated with factors other than the scale employed.

Discrepancy rates for eighth grade science and mathematics items are presented in tables 8 and 9.

Table 8. Discrepancy Rate for Selected Eighth Grade Science Items

When you study science in school, how often do you do each of the following:	**(n=11)**
Discuss science in the news	18%
Work with other students on a science activity or project	82%
Give an oral science report	55%
Do hands-on activities or investigations in science	73%
Talk about the measurements and results from your hands-on activities or investigations	82%
Go outside to observe or measure things	36%
Design and carry out your own science investigations	55%
When you study science in school, how often does your teacher do each of the following:	
Talk to the class about science	27%
Do a science demonstration	45%
Use computers for science (e.g., science software, telecommunications)	18%
About how often does your science class go on a science field trip?	18%
About how often does a guest speaker come to speak to your science class?	9%
Which best describes the science course you are taking?	67%
About how often do you study science in school?	36%
Do either you or your teacher save your science work in a portfolio?	55%
Do you ever do science projects in school that take a week or more?	27%

NOTE: The number of students (n) is the modal number of respondents to each item.

Table 9. Discrepancy Rate for Selected Eighth Grade Mathematics Items

When you do mathematics in school, how often do you do each of the following:	**(n=20)**
Do mathematics problems from textbooks	65%
Do mathematics problems on worksheets	60%
Solve mathematics problems with a partner or in small groups	55%
Work with measuring instruments or geometric solids	55%
Write a few sentences about how you solved a mathematics problem	50%
Take mathematics tests	25%
Talk to the class about your mathematics work	80%
Do 10 or more practice problems by yourself	38%
Discuss solutions to mathematics problems with other students	60%
Use a computer	45%
Use a calculator	20%
Write reports or do mathematics projects	20%
Work and discuss mathematics problems that reflect real-life situations	65%
Do either you or your teacher have a portfolio with your mathematics work in it?	30%
What kind of mathematics class are you taking this year?	23%

NOTE: The number of students (n) is the modal number of respondents to each item.

The average discrepancy rate for 4-point scale items administered to eighth graders was 49 percent. The agreement rate, the complement of this percentage, was 51 percent. This agreement rate was greater than that of fourth graders (38 percent) for comparable items. It should be noted that there are legitimate reasons to expect high discrepancy rates for some of these behaviors. Some students may be

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called upon to "Talk to the class about your mathematics work" much more frequently than others. However, many of these behaviors are ones for which the within classroom variance would be expected to be minimal. Taking tests is one such example; doing problems from textbooks or worksheets are other examples.

The reasons for the high discrepancy rates for these and other types of items are summarized below.

General Findings

Behavioral Frequency Items

The major reasons for the high discrepancy rates associated with behavioral frequency items were:

1) Many of the behaviors of concern were not being interpreted as intended by the item writers.[2]
2) Many individuals (especially students) lack the cognitive abilities to synthesize a behavioral frequency accurately, particularly when:
   - the behavior does not occur on a regular basis
   - the behavior occurs frequently,
   - the behavior is of low salience, and
   - the time period (i.e., the denominator for rate calculations) is either ambiguous, unspecified, or long.

Behavioral frequency items have been extensively studied by survey researchers (Sudman, Bradburn, and Schwarz, 1995). Respondents usually estimate rare behaviors or events by counting them. Common events or behaviors, which are the focus of many of the behavioral frequency questions, are too indistinct for counting. Instead, estimation strategies have to be employed. The specific estimation strategies employed are dependent on the cognitive skills, abilities, and motivation of the respondent. There is little evidence that the fourth and eighth graders studied possess the skills and abilities required to accurately estimate frequencies for common, low salience behaviors. We were able to demonstrate that even when students understood what sorts of behaviors they were being asked about and could recall specific instances of their occurrence, they were often unable to estimate their frequency of occurrence accurately. Guessing was a common strategy.

When a respondent cannot accurately estimate the numerator for a behavioral frequency, and when the denominator for the behavioral frequency is based on a time period that is vague or ambiguous, high discrepancy rates will be produced. Although many of the items were phrased in the current tense, many of the behaviors of interest do not occur at the same rate throughout the school year. Some days or weeks might be devoted to special projects or to preparation for standardized tests. Furthermore, certain behaviors are likely to be associated with specific units. Students might work with rulers quite a bit for some units and not at all for others. As one teacher pointed out, "What are my students going to do? They're not going to average things out over the year." In other words, even when respondents realize the item is asking about current behaviors, teachers will usually try to answer about the entire school year, while students will often respond about a shorter, more recent period or about a period of high salience.

There were other issues that further contributed to these discrepancy rates. These included additional time frame issues, item comprehension problem, loss of context, and other factors.

[2] Item comprehension issues are discussed in greater detail in the next section.

Time Frame Issues

The time period of interest was not always interpreted as intended by the item writers. For example, many behavioral frequency items begin with phrases such as:

- "When you study science in school"
- "When you have reading assignments in school"
- "When you do mathematics in school"

These items have implicitly bounded time frames. That is, the intent of these items is to provide an indicator of how often this behavior is performed over the school year. Most respondents realized that these behavioral frequency items were asking about current behaviors. However, there is no explicit linkage to the school year in these items. In fact, the specific period of relevance is quite vague and lends itself to many different reasonable interpretations.

Time frame issues were exacerbated by problems with the associated scale when the denominator for the frequency calculations was an event that did not occur daily. For example, science lessons typically do not occur every day. Since this is generally the case, the "Almost every day" response option can be interpreted literally (in which case it would never be selected) or can be interpreted as meaning "almost every day that we have science."

The latter interpretation is an example of an explicit time frame because the item behavior is explicitly linked to the period, "When you study science in school..." Since the respondent does not have science every day, the "almost every day" option cannot literally mean "almost every day." It probably means "almost every day that I have science." However, the other response options ("once or twice a week" and "once or twice a month") implicitly link the behaviors to the calendar year. This creates a conflict between the item's explicit and implicit time frame. If science lessons are provided three times a week and the focal behavior occurs about twice a week, respondents employing an implicit time frame will answer "almost every day" and respondents employing an explicit time frame will answer "once or twice a week."

Conflicts between explicit and implicit time frames can occur with other kinds of items. Consider a health survey item that asks:

In the past twelve months, how often have you had the following health problems? Did you have the following problems daily or almost every day, once or twice a week, once or twice a month, or never or hardly ever?

(a) Headaches
(b) Upset Stomach
(c) Morning sickness
(d) Runny nose

In responding to items a and b, most respondents would use the explicit time frame and report about their health over the past year. In responding to the item about morning sickness, very few women with morning sickness would use the explicit time frame (the past 12 months) for their rate estimates. They would respond with respect to the implicit time frame—the portion of their pregnancy when they had morning sickness. When a shift occurs in the implicit time frame, this shift may carry over to subsequent items. If explicit and implicit time frames are in conflict, interpretation of responses becomes challenging.

Item Comprehension

The first stage of the item response process is comprehension and interpretation of the item's meaning. If failure occurs at this stage -- that is, if the respondent does not understand what the item is asking, there is a strong possibility of an inaccurate response. Several item comprehension problems were found with both fourth and eight grade students, as well as with teachers.

Numerous words and phrases were not understood by many fourth graders. These included:

- undecided
- e.g.
- novels
- geometric shapes
- telecommunications
- science demonstration
- practice problems
- break words into parts
- pulleys
- chemicals
- group activity or project

Words and phrases were often interpreted in ways other than intended by the item writer. "Talk to the class about your mathematics work" generally evoked images of formal presentations in the minds of students. However, teachers would also think of less formal discussions. "Discuss solutions to mathematics problems with other students" was interpreted as cheating by at least four students. "Read on your own" could be interpreted as either referring to reading without anyone else's assistance or as reading on your own volition.

In some cases, attempts are made to facilitate comprehension of a technical term through the use of examples. It was noted that, in many cases, respondents would not generalize the construct. Instead, they would only respond to the examples provided. For example, one item asked whether students had ever done any hands-on activities or projects in school with any of the following:

- Electricity (for example, batteries and flashlights)
- Chemicals (for example, mixing or dissolving sugar or salt in water)

Although some students could appropriately generalize these constructs, others would report about baking cakes or making lemonade as examples of activities with chemicals.

Eighth grade students also had trouble understanding terms such as:

- integrated or sequential mathematics
- applied mathematics (technical preparation)
- simple machines
- levers
- pulleys
- portfolio

- content area
- oral science report
- design and carry out your own science investigation
- practice problems
- e.g.
- science software
- telecommunications
- science demonstration

Like their students, teachers did not have consistent interpretations of what was meant by "science demonstration."

Even students with good reading skills have difficulties with long, linguistically complex items. An example is an eighth grade mathematics item, where students were asked how much they agreed (on a five-point scale) with the following statement: "Describing mathematical concepts and ideas is as important as doing mathematical operations such as addition and multiplication in solving problems." Half of the eighth graders (or 10 out of 20 students) checked the middle point "undecided" and one student skipped the item altogether. Seven of these students explicitly indicated that they chose "undecided" because they did not understand the item.

A serious problem for teachers was their comprehension of the phrase, "students in your class." This phrase was associated with two different kinds of comprehension problems. The first type of problem was associated with items such as:

How often do the students in your class do each of the following?

Do mathematics problems on worksheets?

Talk to students about their mathematics work?

For this item, "students in your class" was interpreted by some teachers as asking about their students' behaviors, regardless of where they were performed. Other teachers interpreted the item as asking about behaviors performed by students while they were IN the classroom.[3]

More seriously (from a measurement perspective), it is unclear whether the teacher should be responding about the typical student or the frequency with which the behavior is performed by any student. The issue is moot when whole class activities are being reported upon. However, many of the items did not deal with whole class activities. This was clearly shown to be a problem for the following items:

How often do the students in your class do each of the following?

Use a computer?

Some teachers respond for the typical student; others, for any student. The "any student" interpretation is more likely for rare events. For example, if a teacher is asked how often the students in her class punch or kick each other, it is very unlikely that (s)he will respond with respect to the typical student.

[3] We believe the latter interpretation (behaviors performed while in the classroom) is the intended interpretation. This belief is predicated on the assumption that the teacher and student questionnaires were attempting to measure identical constructs. Since the student item begins with the phrase, "When you do mathematics in school," it is clear that the item is intended to measure within school behaviors.

Loss of Context

Items that were presented in a list format (e.g., "How often do you do each of the following?") produced problems because of lost context. That is, the respondents often forgot the stem and responded to the item as a stand-alone item. This problem was not restricted to fourth graders. For instance, five out of 20 eighth graders lost context when they were asked about the use of computers for mathematics at school. (See below.)

When you do mathematics in school, how often do you do each of the following?
Fill in one box on each line.

	Almost every day	**Once or twice a week**	**Once or twice a month**	**Never or hardly ever**
1. Do mathematics problems from textbooks	☐	☐	☐	☐
2. Do mathematics problems on worksheets	☐	☐	☐	☐
4. Solve mathematics problems with a partner or in small groups	☐	☐	☐	☐
5. Work with objects like rulers, counting blocks, or geometric shapes	☐	☐	☐	☐
6. Write a few sentences about how you solved a mathematics problem	☐	☐	☐	☐
6. Take mathematics tests	☐	☐	☐	☐
7. Talk to the class about your mathematics work	☐	☐	☐	☐
8. Do 10 or more practice problems in mathematics by yourself	☐	☐	☐	☐
9. Discuss solutions to mathematics problems with other students	☐	☐	☐	☐
10. Use a computer	☐	☐	☐	☐

When these students responded, they had lost the mathematics context of the question. As a result, they overreported their computer usage by answering about their use of a computer anywhere and for any purpose. This finding was not due to probing effects (i.e., the interviewer asking probes after each question) since the students were instructed to answer all questions in a list before probing took place. Fourth grade students, eighth grade students, and teachers demonstrated loss of context to a variety of different items, indicating that this is a general survey design problem.

The next section contains a listing of all of the questionnaire items investigated and a summary of responses to these items. When validating data were obtained from teachers, tables comparing students' responses with their teacher's responses are presented. The reasons for discrepancies are discussed, along with other issues that were noted. Recommendations for item modifications are also provided.

Responses are summarized for fourth grade science items, followed by fourth grade mathematics items, fourth grade reading items, eighth grade science items, and eighth grade mathematics items. At the end of each of these sections we briefly discuss specific findings and present a tabular summary of discrepancy rates.

4. ITEM-BY-ITEM ANALYSES

Fourth Grade Science Student and Teachers

Student Item Only:

1. How much do you agree with each of the following statements? Fill in one box on each line.

Learning science is mostly memorizing.

Agree ☐
Not sure ☐
Disagree ☐

Student Responses	Frequency
Agree	15
Not sure	6
Disagree	2

Discussion

At least six students had very egocentric interpretations of this question. They interpreted the question as asking whether or not they agreed that they were able to remember the things they learned in science. For example, one student agreed that learning science is mostly memorizing because "I remember everything we did in science." Another student disagreed because "I don't remember a lot." A third student responded "not sure" because "we may or may not remember what we did on a science project." Other students misinterpreted the question. Below are some of the students' interpretations of "mostly memorizing":

- That you can remember some of the answers from science
- Science is mostly memorizing so you don't have to forget something
- If it's easy to remember the science you study
- If you can memorize what you do
- They're asking if I'm learning
- Paying attention to what they tell you
- It's like something you'd need to know when you get to middle school

Two students said "not sure" because they did not have science that often, and another student responded "not sure" because he did not understand the question.

Recommendations

Many fourth grade students are not able to comprehend this question. They either interpret it as asking about themselves or misinterpret it altogether. Due to the high level of abstraction of the item, we suggest that this item not be administered to fourth graders.

Student Item:

2. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Electricity (for example, batteries and flashlight bulbs)?

Teacher Validation Probe (not a survey item):

Have they done any activities in the area of electricity?

Yes ☐
No ☐

Discrepancy rate 17% (4 out of 23 responses)

Teacher Responses	Student responses	
	No	Yes
No	19	4
Yes		

Discussion

This question is a good example of one with seemingly good agreement between teachers and students, but with problems that surface during the student interview probes.

Questions 2, 3 and 4 were very difficult for fourth graders to understand. The format (a single check box, to be checked if the option was true) was different from that of the other questions and so was confusing. There were many words used that are not in the average fourth grader's vocabulary (i.e., electricity, apply, flashlights, bulbs, batteries). The format also leaves ambiguous the interpretation of the absence of a check for an item. Some students left the box unchecked because they did not do that activity. Other students left the box unchecked because they did not understand the question. Still other students checked the box when they did not understand the question.

Fourth graders do not always attend to all of the subordinate clauses in an item. Some fourth graders focused on the word "ever" and reported activities outside their fourth grade science class. One student said he helped his Dad change light bulbs, and so checked this item. Another included activities in the third grade and so checked this item. A third student used a literal interpretation of "hands-on activities" and said he would never do hands-on activities because "that might be dangerous!"

Specifying the context of "4th grade science class" in the item may not be a sufficient solution. Teachers cover a wide range of content each year. When science is discussed, the teacher does not usually preface her presentation with "Now we will have a science lesson." So, a lesson on nutrition may be a science lesson but might not be seen as science by the student. This issue seems to be associated with

frequent science underreporting by the student (relative to the teachers' reporting of science behaviors and activities).

A final general issue is that fourth graders often respond with respect only to the examples that are given. The examples become the focus of the question for fourth graders. Thus, examples need to be used sparingly.

Recommendations

The response options for questions 2, 3 and 4 should be changed to a "yes/no" format. The context of the item should be clarified to focus students' answers on their 4th grade activities:

In your 4th grade class, have you done activities or projects to learn about electricity?

Yes ☐
No ☐

Even with such modifications, these questions may not be able to be reliably answered by fourth graders, unless the concepts can be greatly simplified. It might be wiser to ask the teacher if any of his or her students have done any electricity projects for science this year.

Student Item:

3. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Chemicals (for example, mixing or dissolving sugar or salt in water)?

Teacher Validation Probe (not a survey item):

Have they done anything involving chemicals?

Both:

Yes ☐
No ☐

Discrepancy rate 70% (16 out of 23 responses)

Teacher Responses	Student responses	
	No	Yes
No	6	16
Yes		1

Discussion

Students seemed to understand the concept of the question. Several appropriate examples of activities related to chemistry were given. However, some may reflect an exclusive focus on the examples used in the item:

- "baking a cake using sugar and salt"
- "we pour in what they tell us to pour -- we did sugar crystals with sewage, hot water and a stick"
- "dissolving sugar in water"
- "making crystals"
- a popcorn experiment
- activities with sugar, salt and water
- "My mom made me lemonade this morning"
- "using a stethoscope to listen underwater"

As with the previous question, some students took a literal interpretation of the word "ever" and checked "Yes" to the item when they had done chemical activities in other grades and outside of class.

A final source of discrepancy between the students' and teachers' answers may be due to an incorrect response on the part of the teacher. At least two teachers used science kits where vinegar was used on rocks to test for calcite. Some students from both classes listed this activity. However, only one teacher remembered the activity or categorized it as an activity involving chemicals.

Recommendations

Ask the teacher if his/her students have done any chemistry activities or projects this year.

Student Item:

4. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Simple machines (for example, pulleys and levers)?

Teacher Validation Probe (not a survey item):

Have they done anything with simple machines?

Both:

Yes ☐
No ☐

Discrepancy rate 13% (3 out of 23 responses)

Teacher Responses	Student responses	
	No	Yes
No	20	3
Yes		

Discussion

None of the teachers reported doing activities with simple machines. However, three students said they had done activities with simple machines. One student said he weighed rocks, used tape measures and nails and interpreted these to be activities with simple machines (weights and a tape measure). The other two students reported on activities using a literal interpretation of "have you ever": activities done in the second grade and a robot made "one time" that walked by itself with a LEGO machine set. The unanchored time context and the difficult words (very few of the students understood what pulleys and levers were) contributed to the overreporting by students.

Recommendations

This activity happens infrequently and will be difficult to make comprehensible to fourth graders. It may be easiest to simply drop this item or ask the teacher about the activity.

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Student Item:

5. About how much time do you usually spend each day on science homework?

I don't have science ☐
None ☐
½ hour ☐
1 hour ☐
2 hours ☐
More than 2 hours ☐

Teacher Validation Probe (not a survey item):

About how long do you think it takes your students to do their science homework?

_____ minutes per assignment

Discrepancy rate	67% (14 out of 21 responses; 2 missing)
Number children reporting more frequently	5
Number children reporting less frequently	0
Students reporting they didn't have science	9

Teacher Responses	Student Responses					
	I don't have science	None	½ hour	1 hour	2 hours	More than 2 hours
0	9	7	3	1		
15 minutes					1	
30 minutes						
1 hour						
2 hours						
More than 2 hours						

Discussion

There were a number of problems with this item:

- Most of the students misinterpreted the first response option "I don't have science" as "I don't have science homework." All agreed that they did have a science class. Several of the students choosing "none" saw that option as identical to "I don't have science" which, again, they read as "I don't have science homework."
- Some students also took an evaluative interpretation of the options. One student interpreted the "none" option as "you don't do your homework." Other students felt the options measured their abilities – that the amount of time spent on homework reflected how difficult or easy the homework was for them.
- Many of the students who chose the non-zero options were responding in terms of homework in general, combined across subject areas. Similarly, they were not sure which homework counted as science homework. Two students asked if their social studies homework should be included.
- Many students did not understand the fraction "½ hour" and misread it as "1 to 2 hours." Thus they would pick "none" or "1 hour" as the smallest options they saw.
- Finally, students who correctly interpreted the question (e.g., "I look at the clock to see how much time I spend doing science homework"), and understood each response option were blocked when their science homework amounted to less than ½ hour each week. So, when they expressed spending about 5-10 minutes a week on science homework, they chose "½ hour" as the smallest non-zero option.

Recommendations

Rephrasing and offering different choices in response options may help clarify them for fourth graders. Rephrasing the question may help clarify for fourth graders that the question is about science lessons:

About how much time do you spend doing science homework?

I am not taking science this year ☐
The teacher doesn't give us science homework ☐
About 15 minutes a day doing science homework ☐
About 30 minutes a day doing science homework ☐
About 1 hour a day ☐ *(Since few students, if any, spend*
About 2 hours a day ☐ *more than 15 to 30 minutes doing*
More than 2 hours a day ☐ *science homework, these 3 options may be deleted – or replaced with "more than 45 minutes a day.")*

Student Item:

6. In the last two years, have you participated in a science fair, festival, or special science day?

Yes ☐
No ☐

Teacher Validation Probe (not a survey item):

About how many of your students participated in a science fair, festival, or special science day in the last two years?

_____ **students**

Discrepancy rate 43% (10 out of 23 responses)

Teacher Responses	Student responses	
	No	Yes
No (0 students)	11	5
Yes (any # of students)	5	2

Discussion

Two teachers responded that at least one of their students participated in a science fair, festival, or special science day in the last two years. The students of one teacher participated in a science open house last year. The other teacher said that they had a science fair for fourth graders last year, but this year the school building was under construction and there was not enough space to house the displays. The students who said "no" when this teacher said "yes" were confused as to the context of the question. One student interpreted the question narrowly to mean: "when you share a science project." One student was referring to only the past year and ignored the introductory phrase "in the last two years." One student seemed to understand the question, but did not participate with the other students in the science fair.

The five students who said they had participated in a science fair in the last two years, when their teachers said there had been no such activity misunderstood the intent of the question. For example, one student said "I went to a festival where I played baseball and kickball 2 years ago," another said "I went to a science fair in January in the cafeteria. It was for kids in 5th, 6th, 7th, and 8th grade. I went in to see it for one minute and went in a circle to see activities." He did not present at the fair; he considered his attendance at the fair to be participation. Although this might be a valid interpretation, it does not appear to be the interpretation intended by the writer of the item.

Recommendations

Changing the wording of the question may help to clarify the context. However, students have such varying views of "science fair" that it may be difficult to get students all to answer in terms of the same concept. If the concept includes participation **and** excludes visiting without participating, then the following question may be easier for fourth graders to understand:

In the last two years, have you ever done a science project that was shown at a science fair, science festival, or special science day?

Yes ☐
No ☐

Student Item:

7. When you study science in school, how often do you do each of the following? Fill in **one** box on each line.

Teacher Item:

These questions refer to your science instruction in general. About how often do your science students do each of the following? Fill in one box on each line.

Both:

Discuss science in the news?

Original Scale (both):		*Revised Scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	69% (11 out of 16 responses)
Number children reporting more frequently	6
Number children reporting less frequently	5

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	4	2	2	
1-2 times/ month			1	
1-2 times/ week	5		1	1
Almost every day				

Discrepancy rate	43% (3 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	1	1	
1-2 times/ month	1	1	
1-2 times/ week	1	2	
Almost every day			

Discussion

Students' interpretations of the phrase "science in the news" varied widely. Many thought of the media. These students saw "science in the news" as referring to others in the media discussing science:

- "the news – what you watch on TV; they do experiments that they have tried"
- "if you heard it in the news"
- "if I watched the news on television"
- "news about science in the newspaper; when they do in science when they read the news"
- "the news people"
- "if there is science in the news (I don't watch the news)"
- "watching TV and science programs"
- "I watch Mysteries of Science on TV"

or as whether or not the student has been in the media discussing science:

- "like playing that you were a news reporter"
- "if you've ever been on the news talking about science"

However, some decided that it was sharing or listening:

- hearing about science but not talking about it
- "sharing what you did with the class" (as news)

For both the 3- and 4-point response scales, the overreporting and underreporting was about equal. There was not one consistent conceptualization of "science in the news" by students. Even teachers did not consistently define the construct. Thus, the responses were almost random.

Recommendations

The definition of "science in the news" needs to be specified. For example, if the desire is to know how often teachers try to find real-life examples for science topics, then the item might be reworded. Since the students often cannot distinguish science instruction from other instruction, this item should only be administered to teachers:

> ***How often do you talk to your class about something in science that you heard on radio or television or read in newspapers or magazines?***
>
> *Almost every day* ☐
> *Sometimes* ☐
> *Never* ☐

(In order to keep the item simple, it is assumed that, when news events are discussed, the teacher tries to relate them back to the topic at hand. Also, the 3-point scale does seem to be easier for students to use, especially for items such as this, which are usually done on an irregular basis.)

Student Item:

8. When you study science in school, how often do you do each of the following? Fill in **one** box on each line.

Do hands-on activities in science?

Teacher Item:

These questions refer to your science instruction in general. About how often do your science students do each of the following? Fill in one box on each line.

Do hands-on activities or investigations in science?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	75% (12 out of 18 responses)
Number children reporting more frequently	4
Number children reporting less frequently	8

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	3	2	1	1
1-2 times/ week	2	3	2	2
Almost every day				

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Discrepancy rate	0% (0 out of 7 responses)
Number children reporting more frequently	0
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month		3	
1-2 times/ week		4	
Almost every day			

Discussion

This item makes salient important issues associated with asking science behavioral frequency items of fourth graders. For this item, teachers either responded "1-2 times per week" or "1-2 times per month." They explained that the activity was, by and large, sporadic, depending on whether or not they were using science kits, or working on a specific project. Most of the teachers averaged over the year, but doubted that their students could do this. And, in fact, most of the students, when they did understand the question, responded primarily in terms of recent projects and frequencies.

Lack of understanding and subsequent guessing contributed to most of the underreporting of students. When they did not know what "hands-on activities" meant, they tended to choose "never or hardly ever." One student felt her "class does not do science" and there was no option for this answer. One student felt that hands on activities were only done at home.

Even the zero error-rate for the group using the 3-point scale did not reflect a true correspondence between students' and teachers' answers. The students who responded "sometimes" didn't understand the question, gave examples of hands-on activities at home, or thought only of one recent activity. Finally, one student who did seem to have the same definition of "hands-on activities" as his teacher answered: "every day we use the kits, we do hands-on activities almost every day."

Recommendations

Any revised version of the items needs to overcome two problems: conveying to teachers and students a similar concept of "hands-on activities" and getting students to average over time, or at least getting teachers and students to use a similar time reference period. This item should probably just be asked of teachers.

Student Item:

9. When you study science in school, how often do you do each of the following? Fill in **one** box on each line.

   Talk about measurements and results from your hands-on activities?

Teacher Item:

These questions refer to your science instruction in general. About how often do your science students do each of the following? Fill in one box on each line.

Talk about measurements and results from students' hands-on activities?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	75% (12 out of 16 responses)
Number children reporting more frequently	3
Number children reporting less frequently	9

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	4	2	1	1
1-2 times/ week	2	3	2	1
Almost every day				

Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	0
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month	1	3	
1-2 times/ week	1	2	
Almost every day			

Discussion

This item has many sub-parts and is quite complex. Students needed to combine the concepts of measurements in science, results in science, talking about measurements and results and hands-on activities, to retain the context of their present 4th grade science class, and to ascertain that the activity could include formal presentations in front of class, informal discussions, or discussions with their teacher. This item was simply beyond the comprehension level of most of the students. Even teachers had different interpretations of the item:

- only teacher-led discussions or formal presentations should be included
- questions to the class and informal conversations should be included

Nine students, when probed, responded only that they had no idea what the question was asking. Of those, four responded "never or hardly ever" or "never," three responded "1-2 times/month," one responded to the 3-point scale "sometimes" and one responded "almost every day." This shows that students use many of the response options, even when they are guessing.

Students gave some very interesting examples of what was meant by "talk about measurements and results from your hands-on activities:"

- "grab a ruler and measuring it with your bare hands, like measuring an inch"
- "talking about measuring paper to draw inches in math"
- "they want to know did you do measurements at school or at home"
- "we never talk about measurements about our hands in science"
- "using rulers to measure, plotting X and Y axis"
- "how much I stand up in front of the class and tell them about my experiments and
- inventions. I usually don't talk about this stuff 'cause I like to keep my inventions secret!"
- "we talk about measurement of something"
- "getting a ruler or something, you measure something, it should come out the way you
- want it to come out"

Recommendations

Delete the item or ask as a shorter question with a clearly specified context:

After a science demonstration, do you talk about what happened with other students?

Yes ☐
No ☐

Student Item:

10. When you study science in school, how often do you do each of the following? Fill in **one** box on each line.

    Use a computer for science?

Teacher Item:

These questions refer to your science instruction in general. About how often do your science students do each of the following? Fill in one box on each line.

Use computers for science?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	13% (2 out of 16 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	14	1		
1-2 times/ month	1			
1-2 times/ week				
Almost every day				

Discrepancy rate	57% (4 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	3

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	2		1
1-2 times/ month	3	1	
1-2 times/ week			
Almost every day			

Discussion

One teacher's initial response to this item was "never or hardly ever." In the past week, it was used one (out of three) science days. Accordingly, the teacher adjusted her estimate to "once or twice a month." The teacher explained that due to the completion of construction, her class had recently moved from a portable into a regular classroom. When in the portable, it was more difficult to use resources such as computers. Thus, in her initial response she was thinking of instruction in the portable, as opposed to the classroom. Four of her students responded "never or hardly ever." They might have been thinking of their science instruction in the portable, as well.

One student lost context and overreported his computer usage in science. He uses a computer at home "almost every day," but not necessarily for science. Thus, he not only lost the context of "when you study science *in school*" but also the use of a computer for science only. Another student had used a computer for a science project on Hawaii a few weeks earlier. Because this event was salient in his mind, the student chose "once or twice a month" as opposed to "never or hardly ever," which was his teacher's response. This is an example of Tversky's availability heuristic – if information about a type of activity is easily accessible in memory, the individual will assume this ease of accessibility is indicative of the fact that the event occurs frequently.

One teacher's initial response was "never or hardly ever." In the past week, it was used four (out of four) days. The teacher adjusted her estimate to "once or twice a month." Her initial estimate did not consider the use of computers as library resources, to get information about science research projects.

Another teacher did not perceive any difference between this item ("About how often do your science students use computers for science?") and item 27 ("When you teach science, about how often do you use computers for science (e.g., science software, telecommunications)?"). Thus, the teacher lost the context of the questions, not realizing that one question asked about her students' behavior and the other about her own behavior.

Recommendations

The item appears to work relatively well for students. However, the use of computers in science does not seem to be a very common instructional tool at the fourth grade level. Response variance is minimal.

The teacher item could be improved. It should be clarified whether the use of computers as library resources is supposed to be included in the teachers' responses or not. In addition, the first part of the stem: "These questions refer to your science instruction in general" should be deleted to focus teachers on their students' behaviors. The stem would then read as follows:

> ***About how often do your science students do each of the following? Fill in one box on each line.***

Student Item:

11. When you study science in school, how often do you do each of the following? Fill in **one** box on each line.

Teacher Item:

These questions refer to your science instruction in general. About how often do your science students do each of the following? Fill in one box on each line.

Both:

Use library resources for science?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	69% (11 out of 16 responses)
Number children reporting more frequently	6
Number children reporting less frequently	5

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	1	2		
1-2 times/ month	5	4	3	1
1-2 times/ week				
Almost every day				

Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	2
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	4	2	
1-2 times/ month		1	
1-2 times/ week			
Almost every day			

Discussion

A general issue relating to most of the science items is: *What is science to a fourth grader?* Teachers cover a wide range of content each year. When science is discussed, the teacher probably does not preface her presentation with "Now we will have a science lesson." So, a lesson on nutrition may be a science lesson but might not be seen as science by the student. Similarly, a lesson on geology may be perceived as "learning about rocks" and not linked to any broader subject area by a fourth grader. (There is little reason for them to make such linkages.) Furthermore, reading science news in a magazine might be considered as being reading rather than science. This issue seems to be associated with frequent science underreporting by the student (relative to the teacher's reporting of science behaviors and activities).

Some of the underreporting was due to the issue discussed above. Another source of both under- and overreporting was the term "library resources." At least five students either did not know what the term meant or did not have a clear understanding of it. In addition, at least two students lost the science context of the question. One student said: "We don't have a library, but we have books and we use them every day." Another student explained: "If I don't have books I go to the library so I can do my homework." However, this student does not have science homework.

Finally, one student included the use of a library for science at another school last year. This interpretation is legitimate given the unanchored timeframe of the question.

One teacher included two sets of encyclopedias in the classroom for the students to use, as well as CD-ROMs as library resources. Another teacher did not include the public library in her response.

Recommendations

The term "library resources" is not clear to fourth graders. The term should either be clarified or the item not administered to fourth grade students. The term is not clear to teachers either: Should library resources (e.g., encyclopedias and CD-ROMs) in the classroom be included? And what about science resources from public libraries – should they be included in the teachers' responses? Clear instructions need to be provided.

Student Item:

12. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

When you teach science, about how often do you do each of the following? Fill in one box on each line.

Both:

Talk to the class about science?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	81% (13 out of 16 responses)
Number children reporting more frequently	7
Number children reporting less frequently	6

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week	3	3	3	7
Almost every day				

Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week	1	4	1
Almost every day			1

Discussion

At least five students had problems defining science. Students either underreported because they did not recognize when they were being taught science (see discussion on previous item), or they overreported because they defined science very broadly (e.g., as geography, history, and family).

In one class, science teaching was only associated with use of "Foss kits," also referred to as units. At other times, science time was used to teach students social skills. When kits were used, science was taught daily. The teacher's estimates for this item was modified based on review of the past week, because when the teacher responded she was thinking about the weeks in which the science units were employed. However, averaged over the year, these activities were engaged in less frequently. So, she changed her response from "almost every day" to "once or twice a week." However, at least three of her students were not able to average science teaching over the course of the school year and therefore responded "almost every day," which led to overreporting. These students appear to have interpreted this item to be asking about the days that science was taught. That is, "When your teacher teaches science, how often does she talk to the class about science?" Such an interpretation is reasonable, particularly when asking about rare events.

In another class, science teaching also revolved around units. These units were used about every six weeks. Science was not taught every day. For example, last week science was only taught on two days—and this was the food pyramid. The teacher did not immediately think of the food pyramid and nutrition as science. This strongly suggests that science teaching, particularly in states without a science curriculum will be difficult to define. Furthermore, regardless of whether or not there is a curriculum, students will have problems recognizing the fact that they are being taught something "as part of science."

Two students had problems defining "talk to the class about science," which led to underreporting. They defined the term in the following ways:

- The teacher just tells us what to do, she doesn't tell us what it is.
- The teacher doesn't tell us about science, we just do the projects.

Finally, one student ignored the stem of the question and responded with respect to how often she (the student) talked to the class about science.

Recommendations

Fourth graders have trouble defining "science," the basic construct of the question. Errors arise when they do not recognize when they are being taught science or define science too broadly. They also have difficulty averaging instructional behaviors in science over time, because science often is taught in units, as opposed to on a daily basis. This also creates problems for teachers, who are a better source of information about this than are fourth graders.

Student Item:

13. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

T4S25. When you teach science, about how often do you do each of the following? Fill in one box on each line.

Both:

Do a science demonstration?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	88% (14 out of 16 responses)
Number children reporting more frequently	4
Number children reporting less frequently	10

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	1		1	
1-2 times/ month	1			
1-2 times/ week	8	1	1	3
Almost every day				

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Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	1	1	
1-2 times/ month	1	4	
1-2 times/ week			
Almost every day			

Discussion

There were several sources of discrepancies between the students' and teachers' responses. At least five students lost the context of the question. That is, they interpreted the question as asking about how often they (the students) did science demonstrations. Below are some of their interpretations:

- We never demonstrate science. The teacher just tells us what to do.
- I don't because I never do. I raise my hand but the teacher never calls on me, and I might make a mistake and everyone would laugh at me.
- When we do something, we have to show it to the class.

Another source of discrepancy was the lack of understanding of the term "science demonstration." At least four students did not have a clear understanding of this term.

Four students underreported their teachers' behavior because they did not recognize when they were being taught science (see previous discussion).

Another three students overreported their teachers' behavior because they interpreted the question as: "When we have science, how often does the teacher do a science demonstration?" Thus, they were not able to average science teaching over the course of the school year.

Some of the teachers were not clear on how to define "science demonstration." One teacher included student participation in the science demonstrations, whereas another teacher did not. A third teacher included setting things up for students to enable them to do the activity as part of the science demonstration.

Recommendations

This question is too hard for fourth grade students to answer. They either lose context, do not understand the constructs of "science demonstration" and "science," or are unable to average science teaching over the course of the school year due to the relatively infrequent occurrences of science teaching. This item should not be administered to fourth graders.

The intent of the teacher item has to be clarified, with a clear definition of "science demonstration."

Student Item:

14. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

When you teach science, about how often do you do each of the following? Fill in one box on each line.

Both:

Show a science videotape or science television program?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	63% (10 out of 16 responses)
Number children reporting more frequently	10
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	2	5	1	1
1-2 times/ month		4	3	
1-2 times/ week				
Almost every day				

Discrepancy rate	71% (5 out of 7 responses)
Number children reporting more frequently	2
Number children reporting less frequently	3

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever		2	
1-2 times/ month	3	2	
1-2 times/ week			
Almost every day			

Discussion

At least eight students had trouble estimating the frequency with which their teacher showed a science videotape or science television program. Three students interpreted the question as asking: "When we have science, how often does the teacher show a science videotape or science television program?" That is, rather than averaging over a week or a month, the implicit denominator for their rate calculations were the days on which science was offered. This lead to overreporting.

Three students misinterpreted the question. One student indicated that the question made no sense to him. He thought it was asking how often he or other students show videotapes. He said it was asking: "If you did a science thing on videotape." Another student included watching science programs (Mysteries of Science) at home in his response. Finally, a third student responded "never or hardly ever" because "the class is too noisy, three boys always interrupt, we don't get finished with our lesson. We never get videotaped because people make faces." Thus, she interpreted the question as the class being videotaped as opposed to the class watching videotapes.

Recommendations

Fourth graders have a hard time estimating the frequency with which their teacher shows a science videotape or science television program. They tend to overreport this behavior by their teacher. Some students also misinterpret the question. They either forget that the question is asking about their teacher, as opposed to themselves, or include science programs they watch at home. If this item is asked, it should be explicitly linked to days on which there is science instruction.

Student Item:

15. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Use computers for science (e.g./such as, science software, telecommunications)?

Teacher Item:

When you teach science, about how often do you do each of the following? Fill in one box on each line.

Use computers for science (e.g., science software, telecommunications)?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	13% (2 out of 15 responses) (1 missing)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	13	1		
1-2 times/ month	1			
1-2 times/ week				
Almost every day				

Discrepancy rate	33% (2 out of 6 responses) (1 missing)
Number children reporting more frequently	0
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	2		
1-2 times/ month	2	2	
1-2 times/ week			
Almost every day			

Discussion

In spite of the low discrepancy rates, this item had problems. The first 11 students answered a version of the question that included "e.g.": "Use computers for science (e.g., science software, telecommunications)?" However, at least five of these students did not know what "e.g." meant. So it was decided to change "e.g." to "such as," which worked much better.

An even bigger problem was the word "telecommunications." At least nine students did not know what it meant. As one student put it: "Like a fourth grader can read that! My Mom and Dad probably can't read it!" Another student checked "never or hardly ever" because "she [the teacher] never taught us that word." When students attempted to define it, they came up with the following:

- On TV they show a web site
- Talk with the person in the computer
- Doing research on the computer
- When you talk to other people about science [through a computer as opposed to in groups]

The term "science software" also created problems. At least three students did not know what it meant. Some students defined it as:

- A disk of science
- Use a computer for software
- Looking up stuff on disc and saving it
- Like the movie [video] we saw

Recommendations

This item is an example of how examples in a parenthesis can hurt much more than help. The item would work much better for fourth graders without the examples:

Does your teacher ever use a computer to teach you science?

Yes ☐
No ☐

Student Item:

16. About how often does your science class go on a science field trip?

3 or more times a year ☐
1 or 2 times a year ☐
Never or hardly ever ☐

Teacher Item:

About how often do your science students go on a science field trip?

3 or more times a year ☐
1 or 2 times a year ☐
Never or hardly ever ☐

Discrepancy rate	39% (9 out of 23 responses)
Number children reporting more frequently	4
Number children reporting less frequently	5

Teacher Responses	Student Responses		
	Never or hardly ever	1 or 2 times a year	3 or more times a year
Never or hardly ever	5	2	1
1 or 2 times a year	5	9	1
3 or more times a year			

Discussion

The term "science field trip" is not clear to some students. Four students overreported going on science field trips because they included field trips to missions, Indian reservations, and going to the library to read science books. In addition, one of these students considered a field trip where they had discussed science-related issues as a science field trip. Another student's class had gone to NASA, but the student did not consider this to be a science field trip and therefore responded "never or hardly ever." When asked for an example of a science field trip, he replied "Going to a place like this [Cognitive Survey Lab] or going to labs at Stanford Hospital [where his mom works]." Two other students in his class who had been to NASA responded similarly ("never or hardly ever").

Even teachers had trouble defining "science field trips." One teacher correctly decided that a field trip whose primary purpose was science is a science field trip. She thought of other field trips with science components (e.g., stopping off to see a seismograph and learning about candle-making), but she would not consider these to be science field trips. However, another teacher responded "1 or 2 times a year," but provided examples that were *not* science field trips. They went to Mission San Juan Bautista. She was responding to "field trips" and wanted to report all field trips, assuming this was our interest.

Only one of the teacher's science students was interviewed and the student provided the same response as the teacher because she counted a science trip they went on last year.

Finally, one student responded that the class went on a field trip for science this year. (According to the teacher, they had not gone on one yet, but would be going to the planetarium. However, this fact is not relevant to the issue that was uncovered.) This student categorized this one trip as "never or hardly ever" rather than as "1 or 2 times a year." Although the item is asking about discrete events, the scale includes both vague quantifiers ("never or hardly ever") and precise quantifiers ("1 or 2 times a year," "3 or more times a year"). The vague quantifier "hardly ever" clearly refers to things which have occurred. So, "never or hardly ever" was logically interpreted as 0 or 1 time and a "one trip" response was classified as being part of this response option. We would recommend that the final response option be changed to a precise quantifier (i.e., "Never").

Recommendations

Some students cannot clearly define a science field trip. This relates to difficulties fourth graders have defining "science," as discussed earlier. If the item is administered to students, the scale should be changed, as discussed above. Additionally, the item should be anchored to the current school year:

This school year, how many science field trips did your class go on?

None ☐
1 or 2 ☐
3 or more ☐

Similar changes should be made to the teacher item, as well.

Teacher Item Only:

T28. Counting this year, how many years in total have you taught the following subjects? (Include any full-time or part-time assignments, but not substitute assignments.)

Science

2 years or less ☐
3-5 years ☐
6-10 years ☐
11-24 years ☐
25 years or more ☐

Teacher Responses	Frequency
2 years or less	1
3-5 years	2
6-10 years	
11-24 years	1
25 years or more	2

Discussion

One teacher had a more inclusive interpretation of science as opposed to math. (Math was the first item in the list. It is written up in the fourth grade math section.) She included home economics as part of her science experience but not as part of her math experience, even though students use fractions such as half cups in their cooking lessons. Accordingly, she reported more years of science than math teaching experience.

Conversely, another teacher reported less science than math teaching experience. Even though her career was almost exclusively at the elementary grades, she said that she taught science for 3 - 5 years and had taught math 11–24 years. She did not consider herself to be very well prepared to teach most areas in science. Science teaching for most of her career was minimal – the science lessons that she prepared and taught were rare events. Science was not in the curriculum. She completed preparation for teaching a science curriculum/program a few years ago; her teaching subsequent to using the new program was not considered as science teaching. Her previous science pedagogical experiences were too episodic and of too poor a quality for her to count them as time spent teaching science.

These interpretations appear to be idiosyncratic and overall the item worked as intended.

Recommendations

None. Keep the item as is.

Teacher Item Only:

T29. How often do you use each of the following to assess student progress in science? Fill in one box on each line.

Multiple-choice tests

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	
Once or twice a month	1
Once per grading period	1
Once or twice a year	
Never or hardly ever	4

Discussion

The item is asking about discrete events—that is, things that can only take on integer values. However, the scale employs both specific and vague quantifiers. "Never or hardly ever" means something that happens zero or one time per year. "Once or twice a year" means something that occurs one or two times per year. So, something that occurs once a year can be classified in either category.

One teacher indicated that she had three grading periods in the year. Her class was presently in the second grading period. Accordingly, for her something that had happened once so far could be answered as either "Never or hardly ever," "Once or twice a year," or "Once per grading period"!

The length of a grading period can be idiosyncratic. Without knowing the exact length of a grading period, responses may be difficult or impossible to interpret. One teacher stated that she generally gives one test per unit. Units typically last six weeks. Their grading period is nine weeks. Since this is more than "c - once per grading period," she chose "b - once or twice a month" as her response to item 29 (since all of her tests include multiple choice items).

For items 29 and 30, another teacher initially responded "Once per grading period." This appeared to be a socially appropriate response. She indicated later that she really had not given the students any tests. Since many of her students take science with other teachers (in Spanish), "testing would have to be done cooperatively. So, we really haven't had any tests." Similarly, for an item asking about homework, the teacher indicated that she really does not give science homework. She thinks she might have given one homework assignment. By the time she responded to "Homework," it was clear that the linkage to "to assess student progress in science" had been lost.

Recommendations

Change the scale:

Once or twice a week	☐
Once or twice a month	☐
Three or four times a year	☐
Once or twice a year	☐
Never	☐

Teacher Item Only:

T30. How often do you use each of the following to assess student progress in science? Fill in one box on each line.

Short or long written responses (e.g., a phrase or sentence; or several sentences or paragraphs)

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	2
Once or twice a month	1
Once per grading period	2
Once or twice a year	
Never or hardly ever	1

Discussion

One teacher had only given one science test this year, but students write short or long written responses every day. However, these are rarely looked at. So, she estimated that per student, she uses this information about "once or twice a month."

Another teacher does not use short or long written responses for tests, since she does not give science tests. However, she has her students write in their "Science Journal" every day, so she chose "once or twice a week."

Also, see discussion about issues with the rating scale in item 29.

Recommendations

It is not clear if this item refers to tests, assignments, or both. The intent (of which we are uncertain) needs clarification. Nonetheless, the rating scale should be modified, as suggested in item 29.

Teacher Item Only:

T31. How often do you use each of the following to assess student progress in science? Fill in one box on each line.

Portfolio collections of each student's work?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	
Once or twice a month	1
Once per grading period	2
Once or twice a year	3
Never or hardly ever	

Discussion

It appeared that the teachers understood the term "portfolio collections".

There is a problem with the rating scale, as discussed in item 29.

Recommendations

The rating scale should be modified, as suggested in item 29.

Teacher Item Only:

T32. How often do you use each of the following to assess student progress in science? Fill in one box on each line.

Homework

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	
Once or twice a month	
Once per grading period	1
Once or twice a year	1
Never or hardly ever	4

Discussion

Two of the six teachers lost the context of the question. That is, they lost the linkage to "to assess student progress in science." They both interpreted the item as: "How often do I give science homework?" However, since one of the teachers never gives homework, her answer was "never or hardly ever."

There is a problem with the rating scale, as discussed in item 29.

Recommendations

In order to avoid the loss of context, the item should be made into a stand-alone item:

How often do you use homework to assess student progress in science?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Item Only:

T33-36. In comparison with other fourth grade teachers, how well prepared are you to teach each of the following? Fill in one box on each line.

	Excellently	Very well	Fairly well	Poorly
33. Biology/life science	☐	☐	☐	☐
34. Chemistry	☐	☐	☐	☐
35. Physics	☐	☐	☐	☐
36. Earth science	☐	☐	☐	☐

Response Category	Subject Area			
	Biology/ life science	Chemistry	Physics	Earth science
Excellently				1
Very well	1			1
Fairly well	5	3	3	4
Poorly		3	3	

Discussion

For one teacher, "Excellently prepared" meant "a science teacher -- someone trained to teach science to fourth graders." "Very well prepared" meant "someone who studied how to teach fourth graders science." "Fairly well prepared" meant "a general understanding," and "Poorly prepared" meant that "one didn't know squat."

For another teacher, "Excellently prepared" and "Very well prepared" meant "someone who majored in science." "Fairly well prepared" meant "someone who is as qualified as most [other teachers]," and "Poorly prepared" meant "someone with very little science background."

For a third teacher, "Excellently prepared" meant "someone with college-level training in the subject and who has taught it for 5 years and attended workshops." "Very well prepared" meant "someone who might have had more experience but less higher level training." "Fairly well prepared" meant "someone who has high school chemistry and *Science on a Shoestring* experience," and "Poorly prepared" meant "someone who never had a college level class." These descriptions seem to be consistent. Accordingly, the scale appears to work as intended.

Recommendations

None. Modifications do not appear to be necessary.

Discussion of Fourth Grade Science Findings

Discrepancy rates. Discrepancy rates for selected items are presented in table 5 (below). For these selected items, the use of a simpler rating scale, using vague quantifiers, was generally associated with lower discrepancy rates. Nonetheless, discrepancy rates were quite high. The reasons for these and other discrepancies are discussed below.

Table 5. Discrepancy Rate for Fourth Grade Science Items, by Type of Scale

When you study science in school, how often do you do each of the following:	4-point scale (n=16)	3-point scale (n=7)
Discuss science in the news	69%	43%
Do hands-on activities in science	75%	0%
Talk about measurements and results from your hands-on activities	75%	29%
Use a computer for science	13%	57%
Use library resources for science	69%	29%
When you study science in school, how often does your teacher do each of the following?		
Talk to the class about science	81%	29%
Do a science demonstration	88%	29%
Show a science videotape or science television program	63%	71%
Use computers for science (e.g., such as science software, telecommunications)	13%	33%

NOTE: The number of students (n) is the modal number of respondents to each item.

Nature of science instruction. There are several factors which must be considered in the development of fourth grade science instructional practice items. The first of these is that science is often integrated with the teaching of other activities. For instance, as one teacher pointed out, a social studies lesson about the pioneers could include discussions of how pioneers made their own candles and soap. It is not difficult to envision how mathematics and reading instruction could also be integrated with science instruction.

Furthermore, science activities are difficult for students to distinguish and label as such. For example, lessons on the weather, earthquakes, or space probes might be seen as current events, science, or just something the teacher was talking about. For this reason, items that ask, "When you study science in school ..." can often lead to underreporting.

A third factor complicating assessment is that some fourth grade teachers do not teach science. They may send their students to another teacher for science lessons. Accordingly, their responses to items about teaching science should be linked to the person providing the instruction: "When your students are taught science, how often does the teacher ..."

Time frame issues. A series of items about science activities begins with the stem: "Have you ever done hands-on activities or projects in school with any of the following?" This stem evoked reports of activities performed in grades other than fourth grade (as well as activities performed outside of school). These responses are logical and consistent with alternative interpretations of the stem:

1) There is no explicit restriction to the fourth grade.
2) There is no explicit linkage between "hands-on activities" and "in school."

Many behavioral frequency items begin with the phrase, "When you study science in school, how often do you do each of the following:" The denominator for responding to these items is explicitly defined as "when you study science in school"—that is, the days when you study science in school. Accordingly, the response option, "Almost every day," is intended to mean "Almost every day that science is studied." However, when events, such as science teaching are episodic in nature, rather than occurring in a predictable, daily fashion, and when other response options are expressed in terms of per week rates ("1-2 times per week") or per month rates ("1-2 times per month"), the explicit denominator for the calculation of rates cannot logically be "days when science is taught." Instead, the denominator for calculating rates consistent with these options is, implicitly, calendar weeks or calendar months. So, if science is taught twice a week and the focal behavior occurs in almost every lesson, either "Almost every day" or "1-2 times per week" are valid ways of reporting the same behavioral frequencies, depending on whether the implicit or the explicit time frame is employed.

Discrepancies are exacerbated by the fact that teachers generally interpret the item in terms of its implicit denominator: "every school day."

Comprehension. Many of the words and phrases used in these items were not familiar to all fourth graders. Words and phrases that were not consistently interpreted by fourth grade students included:

- Hands-on activities
- ...with electricity
- chemicals
- simple machines
- levers
- pulleys
- participation in a science fair, festival, or special science day
- science in the news
- talk about measurement and results
- library resources
- science demonstration
- e.g.
- science software
- telecommunications
- science field trip

"Participation in a science fair, festival, or special science day" was sometimes interpreted merely as attendance at the event.

Attempts were made to define certain constructs through examples:

- Electricity (for example, batteries and flashlights)
- Chemicals (for example, mixing or dissolving sugar or salt in water)

Students would frequently respond only to the examples; they were not always able to generalize the construct of interest.

Fourth grade students have difficulty understanding abstract constructs. "Learning science is mostly memorizing" was usually interpreted in ways other than intended by the item writer.

Teachers were inconsistent in their interpretation of the following phrases:

- library resources
- science field trip
- science demonstration

Teachers did not know whether to include CD-ROMs and encyclopedias in the classroom as "library resources." They were uncertain whether a field trip with science components should be considered as a "science field trip." Fourth grade field trips frequently provide educational experiences in a number of different subjects. Finally, there was no clear agreement about the critical components of a "science demonstration."

Loss of Context. When items are presented in list format, both students and teachers would frequently lose context. They would respond to the listed option as a stand-alone item instead of responding with respect to the conditions specified in the stem. When students were asked:

> When you study science in school, how often do you do the following?
>
> **Use a computer for science?**

at least one student responded about use of a computer both inside and outside of school. The context of studying science in school was lost. Similarly, when teachers were asked:

> These questions refer to your science instruction in general. About how often do your science students do each of the following?
>
> **Use a computer for science?**

at least one teacher lost context and responded about her use of computers for science. And, when a teacher was asked:

> How often do you use each of the following to assess student progress in science?
>
> **Homework?**

at least one teacher responded about the frequency with which she assigns homework.

In another situation, inappropriate maintenance of context was responsible for inappropriate responses by nine (of 21) students. The item asked:

> About how much time do you usually spend each day on science homework?

I don't have science	☐
None	☐
½ hour	☐
1 hour	☐
2 hours	☐
More than 2 hours	☐

For these nine students, the concept of science homework was made so salient that they interpreted "I don't have science" as "I don't have science homework." Even though they had science (class), they selected the option intended to indicate that they weren't getting any science lessons.

"Check all that apply" items. A series of items began with:

Have you ever done hands-on activities or projects in school with any of the following?

Several options, each followed by a check box, were listed underneath this stem. When students did not understand the options (or the question), students would leave the box unchecked. This makes it impossible to distinguish true "No" responses from "Don't know" responses.

Fourth Grade Mathematics Student and Teachers

Student Item:

1. When you do mathematics in school, how often do you do each of the following? Fill in one box on each line.

   Do mathematics problems from textbooks?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Do mathematics problems from their textbooks?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	68% (13 out of 19 responses)
Number children reporting more frequently	12
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	5	3	2	2
1-2 times/ month				
1-2 times/ week				5
Almost every day	1			1

Discrepancy rate	33% (2 out of 6 responses)
Number children reporting more frequently	2
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week		4	2
Almost every day			

Discussion

The discrepancies in this item were mostly due to students overreporting the frequency of use of textbooks for doing mathematics problems. As shown above, a total of 14 out of 25 students overreported this behavior. Only one student reported this behavior taking place less frequently than the teacher did and this was due to a recording error on the part of the student.

At least four students ignored the words "from textbooks" and thus interpreted the question in a more general way: How often do you do math or math problems? This may reflect the lack of a textbook or a lack of comprehension of the term textbook. At least two students explicitly did not have a clear definition of "textbooks." One student interpreted textbook as "a book you write math notes in," like a math journal. Another student thought textbook referred to "a class book"—any book you use for math in class.

Three students lost the school context of the question and included the use of math textbooks for doing homework.

The reasons described above all led to students reporting the use of textbooks for doing mathematics problems more frequently than their teachers.

Recommendations

Students do not appear to have a common understanding of the term "textbook." Consider deleting this term from the question. In order for students not to lose the school context of the question, "in class" could be added:

Do mathematics problems in class?

Student Item:

2. When you do mathematics in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Do mathematics problems on worksheets?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	74% (14 out of 19 responses)
Number children reporting more frequently	10
Number children reporting less frequently	4

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				4
1-2 times/ month				
1-2 times/ week	3		2	6
Almost every day	1			3

Discrepancy rate	17% (1 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week	1	1	
Almost every day			4

Discussion

A total of 15 out of 25 students reported different frequencies than their teachers in this item. Ten students overreported the use of worksheets for doing math problems, and five students underreported this behavior. There were several reasons for the discrepancies.

At least six students did not have a clear definition of "worksheets" which led to both underreporting and overreporting of the behavior. Some students interpreted "worksheets" as tests, others thought it meant copying down from the teacher on a piece of paper, and one student interpreted the word to mean "math folder."

Similar to the previous item, four students overreported the use of worksheets because they lost the school context of the question and included the use of worksheets for homework.

Two students included tests they do on worksheets in their responses, which led to overreporting of the behavior since their teachers did not include the use of worksheets for this purpose. Thus, these students had a more inclusive definition of worksheets than their teachers did.

Some teachers included homework in their responses and others did not. The wording of the teacher item does not convey a clear intent as to whether homework should be included or not. The item stem asks, "How often do the students in your class do each of the following?" The phrase, "How often do the students in your class" can be interpreted as either asking about "your students" or asking about what "students do while in your classroom." With the first interpretation, homework should be included; with the second, homework should be excluded.

Recommendations

The term "worksheet" does not have a clear meaning to fourth graders. They either misinterpret the term or overreport the frequency with which they use worksheets because they include homework in their responses or tests they do on worksheets. The item is a candidate for deletion.

The intent of the teacher item should be clarified to deal with the issue of homework inclusion. That is, is this item intended to deal with activities in the classroom or with activities of the students who comprise the class?

Student Item:

3. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Solve mathematics problems with a partner or in small groups?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Solve mathematics problems in small groups or with a partner?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	74% (14 out of 19 responses)
Number children reporting more frequently	6
Number children reporting less frequently	8

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever		1	1	
1-2 times/ month	2	2	4	
1-2 times/ week	1		2	
Almost every day		1	4	1

Discrepancy rate	100% (6 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	6

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week	2		
Almost every day	1	3	

Discussion

Regardless of the scale employed, this item had a high error rate. A total of four-fifths of the students (20 out of 25) reported solving math problems with a partner or in small groups with different frequencies than their teachers. Fourteen students underreported this behavior and six students indicated that they engaged in these activities more often than their teachers reported.

The discrepancies were due largely to the fact that students and teachers had different definitions of what "solving math problems with a partner or in a small group" meant. Some students underreported the behavior because they defined it as cheating, sharing, or helping each other. Other students overreported the behavior because they included informal discussions with their classmates.

Recommendations

Fourth graders do not have a common understanding of either "solving math problems" or "with a partner or in a small group." We recommend only asking teachers about this instructional practice.

Student Item:

4. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Work with objects like rulers, counting blocks, or geometric shapes?

Teacher Items:

How often do the students in your class do each of the following? Fill in one box on each line.

Work with objects like rulers?

Work with counting blocks or geometric shapes?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	74% (14 out of 19 responses)
Number children reporting more frequently	9
Number children reporting less frequently	5

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	1	2	3	4
1-2 times/ week		3	2	2
Almost every day	1			1

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Discrepancy rate	67% (4 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	4

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week		2	
Almost every day		4	

Note: Teacher responses to the two listed items were combined into a single teacher response. Two of the six teachers provided different responses to the two items (e.g., one teacher responded "once or twice a week" to the first item and "once or twice a month" to the second item). In these cases, the most frequent response was chosen as the overall teacher response.

Discussion

A total of 18 students (or 72%) provided different responses about the use of objects like rulers, counting blocks, or geometric shapes than their teachers. There was no systematic bias since nine students overreported this behavior and another nine students underreported the behavior. Many different problems with this item were detected, as described below.

Five students underreported the use of rulers, counting blocks, or geometric shapes because they only focused on one of the examples (e.g., counting blocks). Thus, the construct was not generalized.

Five students did not know what "geometric shapes" meant. However, only in two cases did this lead to discrepancies where students underreported the behavior.

Three students lost the context of math, which led to overreporting because they included the usage of measuring instruments in other classes or for other purposes (e.g., using a ruler to make a drawing). One teacher also lost the math context of the question and included the use of rulers in a variety of activities.

At least two students overestimated the behavior due to time estimation problems. For example, one student was not able to average the behavior over the school year and answered with respect to the future.

Recommendations

Consider changing the items in the following way:

Student item: Work with rulers, blocks, or shapes during math lessons

Teacher item: Work with rulers, counting blocks, or geometric shapes in math

Also, anchoring the time frame (e.g., in the past week) and changing the response options accordingly might help alleviate time estimation problems.

Student Item:

5. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Write a few sentences about how you solved a mathematics problem?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Write a few sentences about how to solve a mathematics problem?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	61% (11 out of 18 responses; 1 missing)
Number children reporting more frequently	6
Number children reporting less frequently	5

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week		2	6	6
Almost every day	2		1	1

Discrepancy rate	67% (4 out of 6 responses)
Number children reporting more frequently	1
Number children reporting less frequently	3

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week		1	1
Almost every day		3	1

Discussion

At least two students did not understand the question, which led to overreporting of the behavior. These students interpreted the question to mean: correcting a problem on the board, doing daily edits, writing down what the problem means, or a definition of a word.

At least two students had trouble estimating time using the old four-point scale, which led to both under-and overreporting. Another issue related to time is the problem with estimating behavioral frequencies. One student overreported the behavior because he was thinking of the beginning of the year when they had done a lot of problem solving and writing in math. Another student underreported because the class was doing standardized testing during the week of the interview. These students were not able to average the behavior over the course of the school year.

Two students included writing they do for their math homework, which led to overreporting of the behavior. Thus, they lost the context ("in school") of the question.

Another student had trouble with the format of the question and lost context completely. She forgot the stem of the question and interpreted the question literally – she thought she had to write sentences about how she solved a mathematics problem!

Recommendations

The concept of "writing a few sentences about how you solved a mathematics problem" is not clear to some fourth graders. Consider:

Answering a math question by writing sentences.

Also, simplifying the scale or making the item dichotomous should alleviate some of these time estimation problems. As mentioned earlier, it is very important that the context of the question be provided and maintained. Similar to the previous question, "during math lessons" could be added to the question to insure the maintenance of context.

Student Item:

6. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Take mathematics tests?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	32% (6 out of 19 responses)
Number children reporting more frequently	2
Number children reporting less frequently	4

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month		4	1	
1-2 times/ week		4	9	1
Almost every day				

Discrepancy rate	33% (2 out of 6 responses)
Number children reporting more frequently	2
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month		4	2
1-2 times/ week			
Almost every day			

Discussion

In spite of the relatively low discrepancy rate, the item was problematic because of the definition of "mathematics tests." What counts as a math test? Some teachers included only monthly tests; other teachers included both monthly and weekly tests. Similarly for the students, some students included weekly tests (e.g., "times" tests), whereas other students only counted the "big math tests" (i.e., the monthly tests). As one student put it "the small tests [i.e., the weekly tests] are not real tests." In addition, one student included standardized testing and overreported because the interview took place during a week of testing. These differences in the definition of the construct led to both over- and underreporting and accounted for most of the discrepancies.

There were a few other item problems, as well. At least one student overreported because he was not able to average the behavior over time. Three weeks earlier, he had taken math tests every day. One student was not able to match her verbal response (one test a week) to the response options and checked "once or twice a month."

Recommendations

The term "mathematics tests" is not clear. Should weekly tests (the so-called "times" tests or quizzes) be included? And what about standardized testing? Teachers often do not consider these in their reporting. Consider:

Students: Take mathematics tests and quizzes that your teacher scores

Teachers: Take mathematics tests and quizzes. Do not include standardized tests.

Student Item:

7. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Talk to the class about your mathematics work?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Talk to the class about their mathematics work?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	89% (17 out of 19 responses)
Number children reporting more frequently	4
Number children reporting less frequently	13

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	1	1		
1-2 times/ month				
1-2 times/ week	6		1	3
Almost every day	3	1	3	

Discrepancy rate	100% (6 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	6

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week			
Almost every day	3	3	

Discussion

This item is subject to individual variation with respect to the focal behavior. That is, discrepancies may reflect within class differences. Nonetheless, there are many indications of problems.

Teachers and students had very different interpretations of what "talk to the class about your mathematics work" meant. Three of the six teachers did not perceive much of a difference between this item ("Talk to the class about their mathematics work") and the succeeding item on the teacher questionnaire: "Discuss solutions to mathematics problems with other students." This led to teachers having more informal interpretations of the construct, where they would include group projects. In contrast, at least nine students had more formal interpretations (e.g., standing in front of the class and talk about math), which led to students underreporting the behavior compared to their teachers.

Another source of discrepancy arose due to teachers reporting about the typical student as opposed to the frequency with which *any* student performed the behavior of interest. Thus, underreporting occurred in four cases when students felt that they were not called upon as frequently as the typical student. The reverse also happened in one case, where a student overreported the behavior because she felt that she spoke more often in front of the class than other students.

Two students underreported the behavior because they interpreted the item as asking about whether they cheat in math. They explained that their teachers do not want them to share and that they are not supposed to show what grade they got or how they solve the math problems.

Two respondents (one student and one teacher) lost context. One student included other subjects (e.g., social studies), which led to overreporting. One of the teachers initially responded with respect to her own behavior, as opposed to her students' behavior.

Recommendations

Teachers have a hard time determining whether "formal" and/or "informal" presentations should be included. If the intent of the item is to get at formal presentations, an item asking about how often "*Students speak in front of the whole class about their mathematics work*" could be considered.

A decision must be made about whether the teacher item is referring to *any* student or the *typical* student and the stem modified accordingly.

We propose changing the student item to make it parallel to the proposed change to the teacher item: *"Speak in front of the whole class about your mathematics work."*

Student Item:

8. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Do 10 or more practice problems in mathematics by yourself?

Teacher Validation Probe (not a survey item):

How often do your students do 10 or more practice problems in mathematics, by themselves, in class?

Original scale (both):		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	79% (15 out of 19 responses)
Number children reporting more frequently	6
Number children reporting less frequently	9

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever		2	1	1
1-2 times/ month			1	1
1-2 times/ week			1	
Almost every day	1	1	7	3

Discrepancy rate	50% (3 out of 6 responses)
Number children reporting more frequently	1
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week			1
Almost every day		2	3

Discussion

Response discrepancies were due to item-specific reasons: the definition of "practice problems," the loss of context, and difficulties with rate estimation.

Students interpreted the term "practice problems" in various idiosyncratic ways, which led to both over- and underreporting. Below are some of these interpretations:

- When the teacher puts a problem on the board and we have to figure it out
- [Practice problems] make it easier to do harder problems; practice problems are less difficult than the pages in a textbook
- Practice, like when you keep on trying to see if the answer is right
- An exercise that helps you remember things
- Practicing math at home

In addition, two students included small tests (quizzes) and times tables in their definition of "practice problems," which led to overreporting of the behavior.

At least five students lost context and included homework or practicing math at home in their responses.

Two students had trouble with recall and time estimation and overreported the frequency.

Recommendations

The term "practice problems" is not clear to most fourth graders. The intent of the item should be clarified (e.g., how are practice problems different from problems on worksheets?) and the item should be either revised accordingly or deleted.

As mentioned earlier, maintaining the context of the item (in this case, the context of math behaviors in the classroom) is very important.

Simplifying the scale will alleviate some of these problems.

Student Item:

9. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Discuss solutions to mathematics problems with other students?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	58% (11 out of 19 responses)
Number children reporting more frequently	0
Number children reporting less frequently	11

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	2			
1-2 times/ month				
1-2 times/ week		1	5	
Almost every day	7		3	1

Discrepancy rate	100% (6 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	6

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week			
Almost every day		6	

Discussion

The term "discuss solutions to mathematics problems with other students" is unclear to both teachers and students.

As mentioned earlier, three of the six teachers did not perceive much of a difference between this item ("Discuss solutions to mathematics problems with other students") and the preceding item on the teacher questionnaire: "Talk to the class about their mathematics work."

Four students explicitly interpreted the item as asking about cheating and therefore answered "never or hardly ever." As one student put it: "You should not talk to other students about your answers because if you tell them, they will never learn!" Other students had more formal or idiosyncratic interpretations of the question than their teachers, which led to underreporting, as well. In addition, two students thought that this item and "Solve mathematics problems with a partner or in small groups" were similar.

Two respondents (one student and one teacher) lost context. One student included homework in the answer and one of the teachers initially responded with respect to her own behavior, as opposed to her students' behavior.

Two students could not read the word "solutions."

Recommendations

If the intent of the item is to get at informal discussions, an item asking about how often *"Students talk with other students about how they solve a math problem"* could be considered.

Fourth graders' literal interpretation of this item, as with "Solve mathematics problems with a partner or in small groups," makes it hard to ask about these behaviors without some students interpreting them as cheating. Consider not asking fourth graders about these types of instructional behaviors.

Student Item:

10. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Use a computer?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	37% (7 out of 19 responses)
Number children reporting more frequently	5
Number children reporting less frequently	2

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	8	1		2
1-2 times/ month	2	4	1	1
1-2 times/ week				
Almost every day				

Discrepancy rate	0% (0 out of 6 responses)
Number children reporting more frequently	0
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	6		
1-2 times/ month			
1-2 times/ week			
Almost every day			

Discussion

In spite of the relatively low discrepancy rate, the item had one main problem. At least four students lost the context of the item and reported use of a computer anywhere and for any purpose. One teacher also lost context initially and included students' computer usage in other subjects than math.

One student underreported because he did not include math computer games in his response.

Recommendations

To avoid the loss of context, we propose the following revisions:

Student item: Use a computer for math work in school

Teacher item: Use a computer for math

We assume that math computer games should be included. If not, this should be clarified in the item.

Student Item:

11. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

    Use a calculator?

Teacher Validation Probe (not a survey item):

About how often do your students use a calculator to do their math class work?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	42% (8 out of 19 responses)
Number children reporting more frequently	5
Number children reporting less frequently	3

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	11	2	2	1
1-2 times/ month	3			
1-2 times/ week				
Almost every day				

Discrepancy rate	66% (4 out of 6 responses)
Number children reporting more frequently	2
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever		2	
1-2 times/ month	2	2	
1-2 times/ week			
Almost every day			

Discussion

Three students overreported their usage of calculators because they included the Dollar Word Game that they do on their calculators. (The Dollar Word Game is a calculator game, where each letter is assigned a value corresponding to the number of the letter in the alphabet, [e.g., E=5, Z=26]. The object is to find words for which the point values of the letters sum to 100.) Their teacher did not count this game, since it is not part of math lessons.

At least two students had trouble averaging the use of calculators over the course of the school year. Their teacher reported that her students had used calculators a lot in the beginning of the school year, but some students were not able to include this usage in their estimates which led to underreporting.

One student lost context and included calculator usage both at school and at home.

One student had a different math teacher in the beginning of the school year. He included calculator usage in this class in his response, which led to apparent overreporting.

Recommendations

In a multiple subject classroom, instruction in mathematics can occur in the context of other subjects.

As mentioned earlier, anchoring the time frame (e.g., in the past week) and changing the response options accordingly would help alleviate these time estimation problems.

To avoid the loss of context, we propose the following revision:

Student item: Use a calculator for math in school

Student Item:

12. Do you have a calculator that you can use to do mathematics schoolwork?

Teacher Validation Probes (not survey items):

Do all of your students have calculators?
Do you provide calculators to students who can not afford them?

Both:

Yes ☐
No ☐

Discrepancy rate 36% (9 out of 25 responses)

Teacher Responses	Student responses	
	No	Yes
No	5	3
Yes	6	11

Discussion

In spite of the relatively low discrepancy rate, there were problems with this item. At least three students interpreted the term "can use" as "are allowed to use," which led to students responding "no." Thus, even though students have access to calculators they respond "no" to the item because they are not allowed to use them for math.

Similar to the item problem described above, two students who have access to calculators responded "no" to the item because they do not use them in their math class. Conversely, one student correctly responded "yes" because she owns a calculator. However, her teacher's response was "no" because not all of the students in her class have access to calculators. This student was not one of them.

Recommendations

We proposed the following revision:

Do you have a calculator, either at school or at home, that you can for when you want?

Student Item:

13. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

Classwork?

Teacher Validation Probe (not a survey item):

About how often do your students use a calculator to do their math class work?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	26% (5 out of 19 responses)
Number children reporting more frequently	5
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	14	2	2	1
1-2 times/ month				
1-2 times/ week				
Almost every day				

Discrepancy rate	67% (4 out of 6 responses)
Number children reporting more frequently	4
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever	2	4	
1-2 times/ month			
1-2 times/ week			
Almost every day			

Discussion

A total of 9 students (or 36%) overreported the use of calculator for math classwork for various idiosyncratic reasons. Two students lost the context of the question. One of these students interpreted the question as: "*How often do you do classwork?*" Thus, the student forgot both the math and the calculator contexts of the question. The other student included calculator usage in other subjects.

One student included classwork done at home. That is, the student interpreted classwork as work that could be done both in class and at home.

Another student interpreted "never or hardly ever" as "never in my whole year." Since she had used a calculator in January (a couple of months earlier), she said "once or twice a month"—the closest option to "never or hardly ever."

One student included the Dollar Word Game mentioned earlier.

One student had a different math teacher in the beginning of the school year. He included calculator usage in this class in his response, which led to apparent overreporting.

One student chose "once or twice a month" because "when the teacher got no sleep or is nice, she allows us to use them [the calculators]!"

Recommendations

To deal with loss of context, the following revision should be considered:

How often do you use a calculator during math lessons?

Student Item:

14. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

Homework?

Original scale (both):		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Teacher Validation Probe (not a survey item):

Do your students use calculators for their math homework?

Yes ☐
No ☐

Discrepancy rate 80% (4 out of 5 responses; 14 missing)

Teacher Responses	Student Responses			
		Yes		
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
No	1	1		
Yes	3			

Discrepancy rate 50% (3 out of 6 responses)

Teacher Responses	Student Responses		
		Yes	
	Never	Sometimes	Almost every day
No			
Yes	3	3	

Discussion

Three teachers indicated that they did not know whether their students used calculators to do their math homework. Thus, it was not possible to validate the item for these teachers' students, which is the reason that information is missing for 14 of the 25 students. In fact, the one case where the student indicated that she uses a calculator for her math homework and the teacher said "no" is an example of the teacher simply not knowing what students do at home.

In another case, a student lost context interpreting the question as: How often do you do math homework?

Some of the students who said that they never used a calculator for their math homework even though their teachers said they probably did, provided explanations such as:

- The teacher doesn't want students to get addicted to using calculators because they give you the answers.
- Mom won't let me.

Recommendations

In order for students not to lose context, the item should be revised in the following way:

How often do you use a calculator for your math homework?

Student Item:

15. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

Tests or quizzes?

Original scale:		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Teacher Validation Probes (not survey items):

Are students ever allowed to use calculators for math tests?

What are your rules about the use of calculators on math tests?

Can they use them for all math tests?

Yes ☐
No ☐

Discrepancy rate 21% (4 out of 19 responses)

Teacher Responses	Student Responses			
	Never or hardly ever	Yes		
		1-2 times/ month	1-2 times/ week	Almost every day
No	15	2		
Yes	2			

Discrepancy rate 83% (5 out of 6 responses)

Teacher Responses	Student Responses		
	Never	Yes	
		Sometimes	Almost every day
No	1	1	
Yes	4		

Discussion

Only one teacher indicated that her students are allowed to use calculators for math tests. However, she also indicated that they are only allowed on certain types of tests with harder problems. All of her six students responded that they are not allowed to use calculators for tests or quizzes. As some of the students explained:

- We would get busted and would get a detention
- The teacher tells us to clear our desks of everything – it is a rule and there are no exceptions

Another problem was related to interpretation of the term, "Tests or quizzes." The teacher and students were thinking of different tests (e.g., teachers did not include standardized tests).

At least two students lost the math and calculator context of the question. Thus, they interpreted the question as: How often do you have tests or quizzes?

One student did not know what "quizzes" meant.

Recommendations

In order to deal with the item problems described above, we propose revising the item as follows:

How often do you use a calculator for math tests?

Student Item:

16. About how much time do you usually spend each day on mathematics homework?

I am not taking mathematics this year ☐
None ☐
15 minutes ☐
30 minutes ☐
45 minutes ☐
1 hour ☐
More than 1 hour ☐

Teacher Item:

Approximately how much mathematics homework do you assign to students in this class each day?

None ☐
15 minutes ☐
30 minutes ☐
45 minutes ☐
One hour ☐
More than one hour ☐

Discrepancy rate	61% (14 out of 23 responses) (2 missing)
Number children reporting more frequently	10
Number children reporting less frequently	4

Teacher Responses	Student Responses						
	I am not taking math. this year	None	15 minutes	30 minutes	45 minutes	1 hour	More than 1 hour
I am not taking math. this year							
None							
15 minutes			7	6	2	1	1
30 minutes			4	2			
45 minutes							
1 hour							
More than 1 hour							

Discussion

One teacher does not assign math homework. If students do not finish their math work at school, they are supposed to complete it at home. So, the time spent on math at home will vary from student to student. For this reason, the teacher did not respond to the question and validation information is therefore missing for her two students.

One teacher initially responded "30 minutes," since she gives two math homework assignments a week, of about 30-40 minutes duration. She then adjusted her response and answered in terms of "each day." Decomposition of the item might be considered (e.g., how many days a week do you assign math homework; how long does the typical assignment take). Or, the timeframe might be shifted to ask about the typical week. Furthermore, when students respond to an item like this -- asking about an event that occurs fairly frequently, but not daily, they will often respond with respect to the typical amount of time in which they engage in this activity. That is, if math homework is given three times a week and it usually takes 15 minutes to complete, they will respond 15 minutes per day. However, the item writer probably intended that the answer reflect the total amount of time per week, divided by the number of days in a week.

Two students ignored the word "homework" in the question, which led to overreporting because they answered with respect to how much time they spent on math each day. Another student ignored the word "mathematics" and answered with respect to time spent on all homework.

Two students did not have a good sense of time and overreported the amount of time they spent doing math homework every day.

Two students underreported because they are above average in math. They are good at math and felt that their math homework was easy.

One student included time spent on math homework at school and at home. This could be considered overreporting.

One student used contextual information from the scale to respond to the question. He is good at math and spends less time than other students. So, he picked the lowest non-zero option on the scale (15 minutes).

One student felt that the word "usually" could be taken out. Another student thought the boxes were too close together.

Recommendations

Decomposition of the item might be considered (e.g., how many days a week do you assign math homework; how long does the typical assignment take). Or, the timeframe might be shifted to ask about the typical week.

To deal with some of the issues described above, we propose the following revised wording:

About how long does it usually take to do your math homework?

I don't have math homework	☐
15 minutes	☐
30 minutes	☐
45 minutes	☐
1 hour	☐
More than one hour	☐

Given that none of the fourth graders responded "I'm not taking mathematics this year" and that this option does not apply to fourth graders, we propose deleting it.

We also propose adding another question to get a sense of the frequency of math homework:

How often does your teacher give you math homework?

Every day	☐
Three or four times a week	☐
One or two times a week	☐
Never or almost never	☐

Student Item Only:

How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Undecided/Not sure	Disagree
17. I am good at mathematics	☐	☐	☐

How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Undecided	Disagree
17. I am good at mathematics (2 missing)	8	3	0

(revised) How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Not sure	Disagree
17. I am good at mathematics (1 missing)	6	5	0

Discussion

Seven of the first 13 fourth graders who were interviewed had trouble with the word "undecided" in the scale. They either could not read it or did not understand what it meant. Below are some of their definitions of the word.

- I am alright at math (as opposed to good or bad at math)
- Not very good at it sometimes
- The middle of something
- Not that good (agree = being smart, undecided = not that good, disagree = not being good)

In addition, one student, who did not know what undecided meant, chose that option because he thought the answer choices were a scale, and he considered himself in the middle.

Given the problems with the word "undecided," it was changed to "not sure" half way through the interviews. This revision seemed to work much better.

The item seemed to work as intended. However, one student chose "not sure" because she did not "want to brag." Her dad told her that girls were better at reading and boys were better at math. She thought that "not sure" meant "sort of good, sort of bad." It might be advisable to provide answer choices that describe a range of math abilities. Some students pick "not sure" because they want to say that they have moderate math abilities. Furthermore, one student included spelling in his answer to Question 17.

Recommendations

Using "not sure" instead of "undecided" eliminated the "undecided" comprehension problem and is an improvement.

If finer self-assessment descriptions are desired, consider changing the question to ask explicitly about math abilities if that is the intent of the question.

How good are you at math? Are you:

Very good ☐
Good ☐
Okay ☐
Bad ☐

Student Item Only:

How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Undecided	Disagree
18. Learning mathematics is mostly memorizing facts	☐	☐	☐

How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Undecided	Disagree
18. Learning mathematics is mostly memorizing facts (1 missing)	6	4	2

(revised) How much do you agree with each of the following statements? Fill in one box on each line.

	Agree	Not sure	Disagree
18. Learning mathematics is mostly memorizing facts (1 missing)	6	5	0

Discussion

Seven of the 25 students (or 28%) did not understand this question. For example, two students chose "not sure" because they did not understand what it meant. The term "memorizing facts" appeared to create particular problems. A couple of students had the following definitions:

- I don't know that much factors
- Do you do multiplication of factors

However, one student appeared to have a clear definition of what "memorizing facts" meant. She defined it as: "A day before a test, you need to get them into your brain (for example, 8x8=64)."

As previously noted, "undecided" is not a term that is familiar to all fourth graders.

Recommendations

Several fourth graders do not understand this question, in particular the term "memorizing facts." Consider deleting it.

Student Item:

19. This year in school, how often have you taken mathematics tests where you were asked to provide detailed solutions to problems you had not worked on before?

Teacher Validation Probes (not survey items):

How frequently do you ask your students to provide detailed solutions to problems on which they had not worked before?

Original scale (both):		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	88% (14 out of 16 responses; 3 missing)
Number children reporting more frequently	14
Number children reporting less frequently	0

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ year	1-2 times/ month	At least once a week
Never or hardly ever	1		4	8
1-2 times/ year				
1-2 times/ month			1	2
At least once a week				

Discrepancy rate	60% (3 out of 5 responses; 1 missing)
Number children reporting more frequently	3
Number children reporting less frequently	0

Teacher Responses	Student Responses		
	Never	Sometimes	At least once a week
Never or hardly ever	1	1	1
1-2 times/ year			
1-2 times/ month		1	1
At least once a week			

Discussion

This question is too long and complicated for fourth graders, as indicated by the high discrepancy rates. Most students had to repeat some or all of the question.

Most of the students (at least 16) misunderstood the question. This often led to overreporting. They specifically had trouble with the term "provide detailed solutions," which many of them chose to ignore. Six students interpreted the question as: "How often do you take math tests?" Other interpretations included:

- Do you do math tests more than once a week or have you done any at all this year?
- How many times do you have to use details (to solve problems)?
- How often do you have math problems that you have to explain your answers?
- How many tests have you taken in mathematics?
- Do you know how to solve math problems like multiplication, fractions, etc.?

Two students left the question blank because they did not understand it.

Two students got the right answer for the wrong reasons. That is, they misunderstood the question but still provided a response that was in agreement with their teacher. These students had the following interpretations of the question:

- Telling answers out – talking in front of the class. He never talks in front of the class to tell answers to a test.
- Writing a story, where there are plots in detail. Solution is the ending of the story.

One of the students who interpreted the question as: *How often do you take math tests?* may have been prompted by the term "detailed solutions" to answer the way he did ("at least once a week"). He did a calculation: he takes two math tests per week but they have only had half a year of math, so that comes to one math test per week.

Two students did not respond to the question because they ran out of time.

Recommendations

This question should not be asked of fourth graders.

Teacher Item Only:

Counting this year, how many years in total have you taught the following subjects? (Include any full-time or part-time assignments, but not substitute assignments.)

	2 years or Less	3-5 Years	6-10 Years	11-24 Years	25 Years or More
1. Mathematics	☐	☐	☐	☐	☐

Counting this year, how many years in total have you taught the following subjects? (Include any full-time or part-time assignments, but not substitute assignments.)

	2 years or Less	3-5 Years	6-10 Years	11-24 Years	25 Years or More
1. Mathematics	1	1	1	2	1

Discussion

One teacher included home economics as part of science but not as part of math, even though the students use fractions (e.g., half cups, a third of a cup) as part of their cooking instruction. Accordingly, she recorded less math than science teaching experience. However, overall the item appeared to work as intended.

Recommendations

None.

Teacher Item Only:

3-6. How often do you use computers for MATHEMATICS instruction for:

	Almost every day	Once or twice a week	Once or twice a month	Never or hardly ever
3. Drill and practice	☐	☐	☐	☐
4. Demonstration of new topics in mathematics	☐	☐	☐	☐
5. Playing mathematical/learning games	☐	☐	☐	☐
6. Simulations and applications	☐	☐	☐	☐

3-6. How often do you use computers for MATHEMATICS instruction for:

	Almost every day	Once or twice a week	Once or twice a month	Never or hardly ever
3. Drill and practice	0	1	1	4
4. Demonstration of new topics in mathematics	0	0	0	6
5. Playing mathematical/learning games	0	2	2	2
6. Simulations and applications	0	0	0	6

Discussion

Two teachers had trouble distinguishing between "drill and practice" and "playing mathematical/learning games," since many math games are drill and practice exercises. This led to double counting.

Some teachers responded to Questions 3 and 5 with respect to *any* students' computer usage, whereas other teachers responded with respect to the *typical* student.

One teacher did not know what using computers for simulations and applications meant. This is probably why she answered "Never or hardly ever."

Recommendations

Consider deleting "playing mathematical/learning games" since they are invariably "drill and practice" exercises.

It should be specified whether the teacher is supposed to respond with respect to *any* student or with respect to the *typical* student.

Providing examples of "simulations and applications" would help teachers understand the question better.

Discussion of Fourth Grade Mathematics Findings

Discrepancy rates. Discrepancy rates for selected items are presented in table 6 (below). For these selected items, the use of a three-point rating scale, using vague quantifiers, did not have consistent impacts on discrepancy rates. Overall, discrepancy rates were quite high -- for some items, levels of agreement were less than would have been expected by random guessing. In addition to lacking the cognitive skills to accurately answer these items, other factors also contributed to the discrepancies discussed in this section.

Table 6. Discrepancy Rate for Fourth Grade Mathematics Items, by Type of Scale

When you do mathematics in school, how often do you do each of the following:	4-point scale (n=19)	3-point scale (n=6)
Do mathematics problems from textbooks	68%	33%
Do mathematics problems on worksheets	74%	17%
Solve mathematics problems with a partner or in small groups	74%	100%
Work with objects like rulers, counting blocks, or geometric shapes	74%	67%
Write a few sentences about how you solved a mathematics problem	61%	67%
Take mathematics tests	32%	33%
Talk to the class about your mathematics work	89%	100%
Do 10 or more practice problems in mathematics by yourself	79%	50%
Discuss solutions to mathematics problems with other students	58%	100%
Use a computer	37%	0%
Use a calculator	42%	66%
This year in school, how often have you taken mathematics tests where you were asked to provide detailed solutions to problems you had not worked on before?	88%	60%

NOTE: The number of students (n) is the modal number of respondents to each item.

Nature of mathematics instruction. In the fourth grade, mathematics instruction is generally restricted to specific mathematics lessons. However, there are certain instances of mathematics activities occurring outside of these lessons. For example, three students overreported their usage of calculators because they included the Dollar Word Game that they do on their calculators. (The Dollar Word Game is a calculator game, where each letter is assigned a value corresponding to the number of the letter in the alphabet, [e.g., E=5, Z=26]. The object is to find words for which the numeric value of the letters sum to 100.) Their teacher did not count this game in her reports of math instruction, since it is not part of math lessons.

Comprehension. Many of the words and phrases used in these items were not familiar to all fourth graders. Words and phrases that were inconsistently interpreted by fourth grade students included:

- textbooks
- worksheets
- solving mathematics problems with a partner or in small groups
- geometric shapes
- write a few sentences about how you solved a mathematics problem

- mathematics tests
- talk to the class about your mathematics work
- practice problems
- solutions
- discuss solutions to mathematics problems with other students
- undecided

"Mathematics tests" was problematic because of issues associated with quizzes and standardized tests. Teachers would generally exclude both; students would sometimes include the former and usually include the latter. "Talk to the class about your mathematics work" generally evoked images of formal presentations in the minds of students. However, teachers would also include informal discussions. "Discuss solutions to mathematics problems with other students" was interpreted as cheating by at least four students! Accordingly, they reported low frequencies of this behavior.

Fourth grade students also had problems understanding abstract questions, such as, "Learning mathematics is mostly memorizing facts." Over one-quarter (28 percent) of the fourth graders could not explain what this statement meant.

Complex sentences with numerous clauses modifying the construct of interest were nearly incomprehensible to fourth grade students. There is no evidence that any fourth grader understood the following question:

This year in school, how often have you taken mathematics tests where you were asked to provide detailed solutions to problems you had not worked on before?

Six (of 19) of the students interpreted this item as asking, "How often do you take math tests?" The two students whose responses to this item were congruent with their teachers' responses (when a 4-point rating scale was employed) misinterpreted the item. Agreement was coincidental.

Attempts were made to define certain constructs through examples:

When you do mathematics in school, how often do you do the following?

Work with objects like rulers, counting blocks, or geometric shapes.

Fourth grade students were not always able to generalize the intended construct. At least five students only responded to rulers.

Loss of context. When items are presented in list format, both students and teachers would frequently lose context. They would respond to the listed option as a stand-alone item instead of responding with respect to all of the conditions specified in the stem. When students were asked:

When you do mathematics in school, how often do you do the following?

Work with objects like rulers, counting blocks, or geometric shapes?

Use a computer?

Three students responded about the use of rulers for non-mathematical purposes and at least four students and one teacher responded about computer usage for mathematical and non-mathematical purposes. The linkage to mathematics in school was lost.

Similarly, when teachers were asked:

How often do the students in your class do each of the following?

Talk to the class about their mathematics work?
Discuss solutions to mathematics problems with other students?

at least one teacher lost context and responded about her own behavior rather than her students' behavior.

Similar loss of context occurred for at least five other items on the fourth grade mathematics student and teacher surveys.

Fourth Grade Reading Students and Teachers

Student Item Only:

1. During the past month, how many books have you read on your own outside of school?

None ☐
1 or 2 ☐
3 or 4 ☐
5 or more ☐

Student Responses	Frequency
None	2
1 or 2	8
3 or 4	7
5 or more	6

Discussion

Even though data from teachers could not be used to validate this item, several problems were detected. The first problem was associated with the specified timeframe: "during the past month." Two students only thought of the last week. One student ignored "month" and answered with respect to the entire "past" (5 books or more). Another student ignored the timeframe altogether and responded with respect to the recent past. The last three students defined "during the past month" in the following ways:

- The month of April (the interview took place on April 16th) [as opposed to during the past 30 days]
- Like during the month or the past month before that
- Before the month maybe; each day; probably next week

Another problem arose when a student attended to only two of the three conditions defining the type of reading of interest. The student attended to the timeframe and the "on your own" conditions but included silent reading she does at school, ignoring the "outside of school" part of the question.

A third problem was associated with different interpretations of "read on your own." "Read on your own" has two distinctly different interpretations: (1) Read by yourself without help from anyone or (2) Read on your own volition – that is, read because you wanted to read it. Three students counted reading they do at home as part of their reading assignments (e.g., 30 minutes of daily reading).

An ESL student had a very literal interpretation of the question. He reads books in Spanish and English regularly but answered "none" because he "doesn't go outside to read!"

One student's answer was influenced by the response options. He thinks he reads a lot so he checked the largest number ("5 or more"). We are unsure if this heuristic produced a correct response.

Recommendations

The timeframe ("during the past month") is difficult for fourth graders to conceptualize. We would propose changing it to "during this school year" – and just asking if students do this. Since the intent of the item seems to be reading for fun, the phrase "outside of school" may be confusing. We propose consideration of the following:

> ***During this school year, did you read any books for fun? Do not count any books you read for school.***
>
> *Yes* ☐
> *No* ☐

Student Item Only:

2. How often do you do each of the following? Fill in one box on each line.

Read for fun on your own time?

Original scale:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Revised scale:

Almost every day ☐
Sometimes ☐
Never ☐

Original Scale		Revised Scale	
Student Responses	**Frequency**	**Student Responses**	**Frequency**
Almost every day	8	Almost every day	1
Once or twice a week	1	Sometimes	6
Once or twice a month	4	Never	
Never or hardly ever	3		

Discussion

Several students seemed to understand what was meant by "reading for fun on your own time." One student did not include the chapter books (her daily 30-minute reading assignment) reported in the previous question because these were assignments and she "never or hardly ever" reads for fun on her own time. Another student distinguished between chapter books for fun and chapter books for homework. He only included chapter books for fun in this question. A third student was only thinking of school time reading "because sometimes the teacher lets us read the joke books and silent read."

Two students had very literal interpretations of what "reading for fun" meant:

- Enjoying the book you are reading
- If the book is fun then reading is for fun

These students would include assigned reading as "reading for fun."

One student had trouble estimating behavioral frequency and another student did not understand the format of the question without help.

Recommendations

This item appears to be intended to capture the presence of volitional reading – that is, how often do students read because they want to read (in preference to another activity). If this is the intent, the item can be revised:

In addition to reading for schoolwork and homework, how often do you read books, magazines, or stories or articles on the computer?

Almost every day	☐
Sometimes	☐
Never	☐

Student Item Only:

3. How often do you do each of the following? Fill in one box on each line.

Talk with your family or friends about something you have read?

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Original Scale		Revised Scale	
Student Responses	**Frequency**	**Student Responses**	**Frequency**
Almost every day	5	Almost every day	
Once or twice a week	4	Sometimes	5
Once or twice a month	1	Never	2
Never or hardly ever	5		

Discussion

Two students did not understand the question because of the formatting and might have lost context. One of these students read the behavioral description as a command and asked: "Is it telling me to do something?" Two other students (one of them an ESL student) thought the question was asking: "How often do you read aloud to your family or friends?"

Two students had trouble with time. One student gave an example from kindergarten, which indicated that he had trouble with an unanchored timeframe. Another student understood almost every day as "almost every time," since he tells his friends at recess about the books he reads almost every time he reads a new one.

Recommendations

In order for students not to lose the context of the question and avoid rate estimation problems, we propose the following revision:

In the past week, did you talk with your family or friends about something you had read?

Student Item Only:

4. How often do you do each of the following? Fill in one box on each line.

Read a story or a novel? (Version 1-- 13 students)
Read a story or a book with chapters? (Version 2 -- 10 students)

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Original Scale		Revised Scale	
Student Responses	Frequency	Student Responses	Frequency
Almost every day	6	Almost every day	5
Once or twice a week	5	Sometimes	2
Once or twice a month	2	Never	
Never or hardly ever	2		

Discussion

The first 13 students were administered this version of the question:

Read a story or a novel?

However, it became clear that "novel" is not a fourth-grade word. Eight of the 13 students did not know what it meant. Here are some of their definitions of novel:

- A really long book – a novel doesn't have chapters
- Fairytales or something
- A chapter or a book that's long

Two students who could not read the word "novel" answered with respect to stories only. Another student responded "never or hardly ever" because he did not know what "novel" meant. However, when told that novel is a book, he said he would have answered "almost every day."

Due to these interpretation problems, the question was changed to:

Read a story or a book with chapters?

After this revision, one student had a literal interpretation of "books with chapters." She said: "I don't read a book with chapters every day because I can't finish it." She did read another book but she did not include that because it was not a book with chapters. However, the second version of the question seemed to work better than the first version.

Three students included stories read both in school and outside of school, whereas one student responded "never or hardly every" because "I never read stories unless it is at school." The question does not specify whether stories or books read in school should be included.

Two students reported about non-fiction reading. One student changed her answer from "once or twice a week" to "almost every day" after thinking of history, science, and social studies books. In fact, the question does not specify which books to include.

Recommendations

"Novel" is not a fourth grade word and should be replaced with "book," "chapter books," or "books with chapters."

The intent of the item has to be clarified before alternatives can be proposed. Should books read in school be included? Should non-fiction books or stories read for subjects other than English be included? Assuming the intent is to find out about the frequency with which books are read, both in class and at home, the following revision should be considered:

Read a story or read from a book with chapters

Student Item:

5. When you have reading assignments in school, how often does your teacher do each of the following? Fill in one box on each line.

   Ask you to do a group activity or project about what you have read?

Teacher Item:

How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

Ask students to do a group activity or project about what they have read?

Original scale:		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	50% (7 out of 14 responses; 2 missing)
Number children reporting more frequently	5
Number children reporting less frequently	2

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	3			
1-2 times/ month	1	3	2	1
1-2 times/ week	1		1	2
Almost every day				

Discrepancy rate	57% (4 out of 7 responses)
Number children reporting more frequently	2
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			1
1-2 times/ week	2	3	1
Almost every day			

Discussion

At least five students misunderstood the question, which led to discrepancies with their teachers' responses. One student read "group activity" as "graph activity," which led to underreporting. Another student defined group activity as an activity with the whole class, which led her to overreport the behavior.

Three students overreported the behavior because they had a more inclusive definition of "group activity or project" than their teachers. One student defined these activities as "looking up words together or answering question about their book, which they do because they sit at tables arranged in horse shoes." Another student defined it as "a little group with other kids sharing your books – one reads a line or paragraph, then another student."

Three students included book reports in their responses. As one student said: "Each time we read a book, we have to write about it." There is some textual support for this interpretation, since "or projects about what you have read" can be understood as a separate clause, in distinction to a "group activity." However, this interpretation only led to one discrepancy.

One student's average was biased due to use of the "availability heuristic" (Tversky). That is, the class had just started engaging in group activities in reading, so the behavior was very salient in the student's mind. This saliency led to overreporting.

One of the teachers did not know what was meant by "group activity or project" and initially lost the reading context of the question.

Recommendations

Fourth graders do not have consistent interpretations of "group activities or projects" in reading. If the question is administered to fourth graders, it could be slightly clarified by adding "group" to "projects"—"group activities or *group* projects," in order to avoid students including book reports in their responses. However, this will not overcome the poor behavioral frequency estimation abilities of fourth graders nor will it be adequate to convey the constructs of interest to fourth graders.

The teacher item could be improved by repeating the context of the question:

Ask students to do a reading group activity or a project about what they have read?

Student Item:

6. When you have reading assignments in school, how often does your teacher do each of the following? Fill in one box on each line.

Ask you to talk to other students about what you have read?

Teacher Item:

How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

Ask students to talk with each other about what they have read?

Original scale:		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	79% (11 out of 14 responses; 2 missing)
Number children reporting more frequently	7
Number children reporting less frequently	4

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	2	2	1	1
1-2 times/ month	3	1		
1-2 times/ week	1			3
Almost every day				

Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	0
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month		1	
1-2 times/ week	1	3	
Almost every day	1		1

Discussion

At least five students had trouble estimating the frequency of this activity, which led to both under- and overreporting. There were issues with the 4-point response option scale, with the unanchored time frame (one student gave an example from 2nd grade), and with comprehension of the construct of interest (i.e., talking to other students about what you had read.)

Students had various idiosyncratic interpretations of the question:

- Talk in front of the class
- Talking to her friends about what she has read without the teacher asking her to do that. She said: "We read every day in school and they are always talking about what they have read and I tell them what I have read."
- Asking about book reports
- We never get in pairs—we only do this when we have book reports.

An ESL student did not understand the question and left it blank.

Recommendations

Similar to the previous item, fourth graders do not appear to have a common understanding of the construct being assessed. Simplifying the scale seemed to improve some of the frequency estimation problems, but this revision might not be sufficient to justify administration of the item to fourth graders.

Student Item:

7. When you have reading assignments in school, how often does your teacher do each of the following? Fill in one box on each line.

Ask you to write something about what you have read?

Teacher Item:

How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

Ask students to write about something they have read?

Original scale:		***Revised scale:***	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	33% (5 out of 15 responses)
Number children reporting more frequently	1
Number children reporting less frequently	4

Teacher Responses	**Student Responses**			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week	1	2	8	1
Almost every day	1			2

Discrepancy rate	71% (5 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	4

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week			1
Almost every day		4	2

Discussion

Three students lost the context of the question. Two of these students included social studies and science in their responses, respectively, and the third student forgot that the question was asking about how often the *teacher* asks the them to write about something they have read.

Two students only considered monthly book reports in their answers, which led to underreporting.

One teacher included reading as part of history instruction. However, two of her three students provided the same response ("once or twice a week") by chance. The third student thought "sometimes" meant "not that often" and since they do it every week, he checked "almost every day."

One student was not able to categorize his judgment into one of the initial four categories. And an ESL student misunderstood the question.

Recommendations

In spite of the relatively low discrepancy rate, fourth graders do not seem to have a shared understanding of the item's intent. They either define it narrowly (only book reports) or lose context and include all types of reading. The issue of loss of context is nearly impossible to resolve, since students have reading assignments in social studies, science, and other areas – as well as the intended area of reading (only).

The teacher item could be improved by repeating the context of the question:

Ask students to write about something they have read during reading instruction?

Student Item:

8. When you have reading assignments in school, how often does your teacher do each of the following? Fill in one box on each line.

Help you break words into parts?

Teacher Validation Probe (not survey item):

Help students break words into parts?

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	62% (8 out of 13 responses; 3 missing)
Number children reporting more frequently	4
Number children reporting less frequently	4

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	2		2	
1-2 times/ month				
1-2 times/ week	3		3	2
Almost every day			1	

Discrepancy rate	50% (2 out of 4 responses; 3 missing)
Number children reporting more frequently	0
Number children reporting less frequently	2

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week	1	2	
Almost every day		1	

Discussion

Most of the discrepancies (at least six) were due to individual variation. That is, some students need more help breaking words into parts and others need less. Nonetheless, several problems with the item were identified.

Four students lost the context of the question. For example, one student thought of students helping each other break words into parts, as opposed to the teacher. She said: "We never do that – we never help each other break the words."

Another four students did not understand what "break words into parts" meant. One student defined it as "like making sentences, like writing." Another student chose "never or hardly ever" because he did not understand the question.

At least two students had trouble estimating behavioral frequencies.

Recommendations

This item should be deleted. Many fourth graders are unfamiliar with the construct being assessed. In addition, this item is an indicator of student reading ability: good readers should report this less frequently than poor readers. Accordingly, it cannot be used as a student-level indicator of the impact of instructional practices on behaviors.

Student Item:

9. When you have reading assignments in school, how often does your teacher do each of the following? Fill in one box on each line.

   Help you understand new words?

Teacher Item:

How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

Help students understand new words?

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	60% (9 out of 15 responses; 1 missing)
Number children reporting more frequently	4
Number children reporting less frequently	5

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	1	1	1	1
1-2 times/ week		1	3	2
Almost every day	2		1	2

Discrepancy rate	86% (6 out of 7 responses)
Number children reporting more frequently	0
Number children reporting less frequently	6

Teacher Responses	Student Responses		
	Never	Sometimes	Almost every day
Never or hardly ever			
1-2 times/ month			
1-2 times/ week			
Almost every day		6	1

Discussion

Similar to the previous question, most of the discrepancies (about 12) were due to individual variation. As an above average student explained: "You stop learning new words in 3rd grade. Some kids might learn new words, but not me!"

Three students lost the context of the question. For instance, one student only responded with respect to social studies.

Four students thought this question was similar to the previous one ("Help you break words into parts?") and answered it the same way.

Recommendations

Given the problems students encountered with the previous item, as well as the perceived similarity between this item and the previous one, we propose asking fourth graders only this question. In order to deal with the loss of context, however, we propose revising it the following way:

Help you understand new words when you are reading stories?

Student Item:

10. Do you and your teacher review your progress in reading by looking at your work together?

Teacher Validation Probe (not a survey item):

Do you review their progress in reading by looking at their work with them?

Both:

Yes ☐
No ☐

Discrepancy rate 14% (3 out of 21 responses; 2 missing)

Teacher Responses	Student responses	
	No	Yes
No	1	1
Yes	2	17

Discussion

In spite of the low discrepancy rate in this item, students had many comprehension problems. What specifically seemed to throw them off was the word "progress." In fact, one student skipped the question because he did not understand "progress." Two of the students who answered differently than their teacher (they both said "no"; their teacher "yes") paraphrased the question as:

- To know if you have done something with your teacher in progress reading.
- If she were to grade his paper in front of him, with him watching, this would be an example of "reviewing progress in reading by looking at your work together." But the teacher does not do this. Instead, the teacher looks over his stuff and returns it with grades or comments.

Other students, whose responses were in agreement with their teachers', had various idiosyncratic interpretations of the item:

- One student appeared to focus on the last half of the question "looking at your work together," saying that students correct each other's tests. She interpreted "review your progress" as "going over and looking up words silently." "The teacher corrects us in math; in reading, we correct papers and she [the teacher] puts on a sticker."
- Another student defined it as: "Like, review it. Like when someone reads too fast and the teacher says 'say it again'." The student appeared to have interpreted "review" to mean "repeat."
- Two students interpreted the item to mean "formal review," specifically parent-teacher conferences. As one of the students put it: "We only do this on report card days and open house."

Finally, there were too many clauses in the question for one student. She didn't keep "in reading" in her mind when searching for representations of the construct in her memory and included math in her response—going over math homework with the teacher.

Recommendations

The item does not appear to have much discriminating power. That is, most of the respondents answer "yes" to the item. It seems to be common teacher practice to review students' progress in reading. However, some students do not appear to have a clear understanding of the construct in spite of the apparent agreement with their teachers' responses. Consider:

Does your teacher ever spend a few minutes talking just with you about:

a) your reading homework, reading tests, or other reading assignments?

Yes ☐

No ☐

Student Item:

11. How often do you use the school library or the public library to do the following? Fill in one box on the line.

Do research for a school assignment?

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Teacher Validation Probe (not a survey item):

Do your students ever use the school library or public library - or do they use the Internet – to do research for a school assignment?

Yes ☐
No ☐

Discrepancy rate	67% (10 out of 15 responses; 1 missing)
Number children reporting more frequently	7
Number children reporting less frequently	3

Teacher Responses	Student Responses			
		Yes		
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
No	3	5	2	
Yes	2	3		

Discrepancy rate	29% (2 out of 7 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never or hardly ever	Yes	
		Sometimes	Almost every day
No	1	1	
Yes	1	4	

Discussion

Similar to earlier items, some of the discrepancies (a total of four) were due to individual variation. The item had a few problems, however.

Two students were more inclusive in their responses than their teachers. One student included checking out books for book reports and doing homework at the library. The other student counted any time spent in the library. A third student included electronic search in her response. Her teacher indicated that the students do not use the library for research, but they do use the Internet. So, in reality the student and teacher were in agreement.

One student misinterpreted the question, which led to disagreement with her teacher. She defined "do research for a school assignment" as: "Like get a book and read it and see if that's the one you want." At least one other student, in spite of response agreement with the teacher, did not know what "research" or "assignment" meant.

Recommendations

Given that some students do not seem to have a common understanding of what is meant by "do research for a school assignment," the construct needs to be defined more clearly. We are unsure of the true intent of the item.

Student Item:

12. This year in school, how often have you been asked to write long answers to questions on tests or assignments that involved reading?

Teacher Validation Probes (not survey items):

Thinking of the last reading test or assignment -- tell me about it.

What kinds of questions did you ask? Did you ask questions that required long written responses? Are these pretty typical of your reading tests and assignments? About what proportion of your reading tests and assignments have questions that require students to write long answers? About how often do you give reading tests and assignments?

Original scale:		*Revised scale:*	
Almost every day	☐	**Almost every day**	☐
Once or twice a week	☐	**Sometimes**	☐
Once or twice a month	☐	**Never**	☐
Never or hardly ever	☐		

Discrepancy rate	67% (8 out of 12 responses; 5 missing)
Number children reporting more frequently	2
Number children reporting less frequently	6

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ year	1-2 times/ month	At least once a week
Never or hardly ever			1	1
1-2 times/ year				
1-2 times/ month				
At least once a week	1		5	4

Discrepancy rate	83% (5 out of 6 responses)
Number children reporting more frequently	4
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never	Sometimes	At least once a week
Never or hardly ever		1	2
1-2 times/ year			
1-2 times/ month		1	1
At least once a week		1	

Discussion

One teacher was not asked the validation probes, which is the reason that five student responses are missing. Of these five students, two students left the question blank – one because he ran out of time and the other because she did not understand the question.

At least seven students did not have a clear understanding of the question. Two of these students defined "long answers" as "long sentences." Another student paraphrased the question as: "How many times have you done reading and spelling tests?"

Five students lost the context of the question. They responded with respect to other subjects (math, social studies, and science) or other grades (3rd grade). It can be argued that the term "tests or assignments that involved reading" does not only apply to reading but can also include other subjects, such as reading in social studies. Thus, these students' interpretations are textually supported.

The revised scale (at least once a week; sometimes; never) does not appear to be an improvement over the original scale, because the response options "at least once a week" and "sometimes" are not mutually exclusive. In fact, the original scale (*at least once a week; once or twice a month; once or twice a year; never or hardly ever*) might be easier for students to answer because it has less discriminating power at the most frequent end compared to the other four-point scale (*almost every day; once or twice a week; once or twice a month; never or hardly ever*).

Recommendations

Fourth graders do not have a common understanding of what is meant by "write long answers to questions on tests or assignments that involved reading." In addition, the question is not specifically tailored to reading but can be answered with respect to social studies or other subjects, as well. Consider:

How often do you have to write paragraphs for English or Reading?

Teacher Item Only:

1. How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

   Ask students to make predictions about what they read as they are reading it?

   Almost every day ☐
   Once or twice a week ☐
   Once or twice a month ☐
   Never or hardly ever ☐

Teacher Responses	Frequency
Almost every day	2
Once or twice a week	2
Once or twice a month	2
Never or hardly ever	

Discussion

Two of the six teachers chose a more frequent option than their validated response due to social desirability. That is, this behavior (asking students to make predictions about what they are reading) was seen as a socially desirable teaching technique by these teachers. When adjusting their response during the validation part of the interview, they both ended up selecting the most frequent of the two options they were choosing between.

One teacher had difficulty verbalizing the difference between this item and the item that follows ("Ask students to make generalizations and draw inferences based on what they have read"). In thinking out loud and discussing what she thought this item was asking, she used the term "inferences." However, when asked about the difference between these items, she decided that the differences referred to the "level of knowledge of the guess" and then provided different definitions.

Recommendations

This item might be prone to social desirability and should be administered and analyzed with caution.

Teacher Item Only:

2. How often do you do the following things as a part of reading instruction with this class? Fill in one box on each line.

   Ask students to make generalizations and draw inferences based on what they have read?

   Almost every day ☐
   Once or twice a week ☐
   Once or twice a month ☐
   Never or hardly ever ☐

Teacher Responses	Frequency
Almost every day	2
Once or twice a week	2
Once or twice a month	2
Never or hardly ever	

Discussion

One teacher lost context and included social studies reading in her response.

Recommendations

Consider revising the item to avoid the loss of context:

Ask students to make generalizations and draw inferences based on what they have read during reading lessons?

Discussion of Fourth Grade Reading Findings

Discrepancy rates. Discrepancy rates for selected items are presented in table 7 (below). These items were selected because they tended to reflect classroom practices rather than individual differences. That is, all students in a class were expected to engage in these behaviors with comparable frequencies. For these selected items, the use of a simpler rating scale, using vague quantifiers, was not generally associated with lower discrepancy rates. Regardless of the scale, discrepancy rates were high. Reasons for these high discrepancy rates are very similar to reasons for high discrepancy rates for fourth grade mathematics and science items:

- many of the behaviors of concern are not interpreted as intended by the item writers, and
- many fourth graders lack the cognitive abilities to accurately synthesize a behavioral frequency, particularly the time period (i.e., the denominator for rate calculations) is either ambiguous, unspecified, or long.

The reasons for these (and other discrepancies) are discussed below.

Table 7. Discrepancy Rate for Fourth Grade Reading Items, by Type of Scale

When you have reading assignments in school, how often does your teacher do each of the following:	4-point scale (n=16)	3-point scale (n=7)
Ask you to do a group activity or project about what you have read	50%	57%
Ask you to talk to other students about what you have read	79%	29%
As you to write about something you have read	33%	71%
Help you break words into parts	62%	50%
Help you understand new words	60%	86%
This year in school, how often have you been asked to write long answers to questions on tests or assignments that involved reading?	67%	83%

NOTE: The number of students (n) is the modal number of respondents to each item.

Nature of reading instruction. Reading practice and instruction is not restricted to formal reading lessons. It occurs for all subjects, and is particularly frequent in history, science, and social studies. (When asked about reading instruction, one teacher asked if she should include "Spanish"!)

Fourth graders would include social studies and science incidents in their responses to the following items:

When you have reading assignments in school, how often does your teacher do each of the following?

Help you understand new words?
Ask you to write something about what you have read?

It is not clear if this represented a loss of context or a more inclusive definition of reading assignments than was intended by the item writer.

Time frame issues. With unanchored time frames—that is, items which ask, "When you have reading assignments in school, how often does your teacher do each of the following?," there is no explicit demand to restrict reporting to the current grade. Although most students responded about their current teacher, some students would base their rate estimates on reading assignments in other grades.

Comprehension. Many of the words and phrases used in these items were not familiar to all fourth graders. Words and phrases that were inconsistently interpreted by fourth grade students included:

- read on your own
- read for fun
- novel
- group activity or project
- (teacher) ask you to talk to other students about what you have read
- break words into parts
- review your progress in reading
- do research for a school assignment
- write long answers to questions on tests or assignments that involved reading

The phrase "read on your own" could be interpreted as either referring to reading without anyone else's assistance or as reading on your own volition. "During the past month," as in the question, "During the past month, how many books have you read on your own outside of school?" was responded to with reports of behavior in the past, in general; the current month; or the intended construct (the past 30 days). Several students retrieved events in the past week and reported only about books read in the past week.

Complex sentences were very difficult for fourth grade students to understand. For the following item, fourth graders failed to internalize all of the aspects of the construct being asked about and were unable to retrieve from memory all of the desired types of relevant representations:

This year in school, how often have you been asked to write long answers to questions on tests or assignments that involved reading?

The students' agreement with their teachers' responses was at the levels expected by chance.

Loss of context. When items are presented in list format, students and teachers often lose context. They respond to the listed option as a stand-alone item instead of responding with respect to the conditions specified in the stem. For example, teachers would report about reading instruction in the context of other subjects when they were asked:

How often do you do the following things as a part of reading instruction with this class?

Ask students to do a group activity or project about what they have read?

Ask students to make generalizations and draw inferences based on what they have read?

Eighth Grade Science Students and Teachers

Student Item Only:

1. How much do you agree with each of the following statements? Fill in one box on each line.

   I am good at science.

   Agree ☐
   Not sure ☐
   Disagree ☐

Student Responses	Frequency
Agree	6
Not sure	4
Disagree	1

Discussion

Several of the students went straight to the body of this question and skipped the stem "How much do you agree with the following statements?" However, for this question (and the following question), ignoring the stem had little impact.

Students used a variety of criteria for deciding whether they were good at science. These included assessment of self-competency ("because the teacher gives me stuff and I understand it") and grade reporting ("because I get good grades in it.") These are similar but not identical factors. One student disagreed with the statement because "my science teacher doesn't teach us well."

Recommendations

If the item is intended to determine if a student enjoys science, it should ask, "Do you like science?" If the item is intended to determine if a student gets good grades in science, it should ask, "Do you get good grades in science?" If the item is intended to determine if a student thinks science is easy to understand, it should ask: "Is science hard or easy for you to understand?"

Student Item Only:

2. How much do you agree with each of the following statements? Fill in one box on each line.

   Science is useful for solving everyday problems.

   Agree ☐
   Not sure ☐
   Disagree ☐

Student Responses	Frequency
Agree	8
Not sure	1
Disagree	2

Discussion

One student disagreed because "sometimes we need science, but not every day." He defined "everyday problems" as either problems with a friend or science problems you get every day (i.e., class work). Other students expressed similar confusion. Another student agreed because she "sometimes wonders about stuff in the wild." A third student said "not sure" because he "could not think of examples of everyday problems that related to science."

Recommendations

The intent of this item is not clear. We do not know whether "everyday problems" refers to problems that occur in the normal daily life of an eighth grader, to "real-world problems," such as curing diseases, or to something else. Unless the intent can be clarified, this item should be deleted.

Student Item:

3. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Living things (for example, plants, animals, bacteria)

Teacher Validation Probe (not a survey item):

Your students will be asked about certain kinds of hands-on activities and projects they may have done in science.

Have they done any such activities with living things?

Discrepancy rate 91% (10 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No	1	10
Yes		

Discussion

An unspecified timeframe and the lack of restrictions on where these activities occurred were the main reasons for the ten discrepancies between the students' and teachers' answers. Students who checked "yes" were thinking either of a different grade or a different class. These students were using an appropriate interpretation of the phrase "Have you ever done..." and including activities with living things in sixth or seventh grade and activities with living things in eighth grade lab and ecology class.

Most students did seem to understand the term "living things." However, one student described seeing organs of animals (who used to be living) as an example of living things. The second student accurately recalled the seed germination activity in her 8th grade science class, but the teacher evidently forgot this activity.

One student did not understand the question and left it blank. This is a general problem with question formats that ask students to check "all that apply." If a box is unchecked, it is impossible to know whether the student did not do that activity or did not understand the question. Thus, the resulting data can be difficult to interpret.

Recommendations

Respondents can generally provide more accurate behavioral frequency data for a recent, short, well-defined period (i.e., "In your science class this year") rather than a more ambiguous, all encompassing context and period of time ("Have you ever..."). If the intent of the item is to determine whether students have ever engaged in these behaviors, the item needs to be reworded to make this point

more clear. (Because most of the items dealt with their eighth grade science class, some, but not all, students responded in terms of eighth grade science).

If these items are intended to get at the frequency of behaviors in science class, the wording of the stem should be changed to:

> ***In your science class this year, have you done hands-on activities with any living things (for example, plants, animals)?***

To deal with the issue of interpreting whether a blank is a "No," a "Don't Know," or a "Refused to answer," this item should be made into a "Yes/No" item.

Student Item:

4. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Magnifying glass or microscope (for looking at small things)?

Teacher Validation Probe (not a survey item):

Your students will be asked about certain kinds of hands-on activities and projects they may have done in science.

Have they worked with magnifying glasses or microscopes?

Discrepancy rate 55% (6 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No		6
Yes		5

Discussion

Students seemed to understand the words "magnifying glass" and "microscope" and gave appropriate examples of activities using these objects (e.g., looking at sugar, baking soda, bacteria and salt under a microscope, lighting a match under a magnifying glass). One teacher did report the use of magnifying glasses and microscopes in the classroom (looking at bone marrow under a microscope and magnifying glass).

However, all of the students reported these classroom activities, while only one teacher reported the use of magnifying glasses and microscopes as part of their instructional practices. The teachers did not comment further, except one teacher said he used magnifying glasses and microscopes last year. As in the previous question, the students did not realize that the item was intended to refer only to their eighth grade science class. Some of the students were thinking of activities in science lab, in other grades, or in other classes.

Recommendations

The meaning of the words "magnifying glass" and "microscope" are understood by eighth grade students, but the intended time frame and location restrictions (this year and science class) are unclear because they are not explicit. To correct these problems and to eliminate the problem with blank answers, the item should be changed to:

In your science class this year, have you used a magnifying glass or microscope to look at small things?

Yes ☐
No ☐

Student Item:

5. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Thermometer or barometer (for making measurements)?

Teacher Validation Probe (not a survey item):

Your students will be asked about certain kinds of hands-on activities and projects they may have done in science.

Have they done anything with thermometers or barometers?

Discrepancy rate 36% (4 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No	3	2
Yes	2	4

Discussion

This question was accurately interpreted by most eighth graders. Most students accurately remembered hands-on activities with thermometers, or the lack of such activities in their eighth grade science class.

The discrepancies between teachers' and students' responses were due to a student not understanding the question and thus leaving it blank; to a student being certain that his eighth grade science class did not work with barometers (but not commenting on work with thermometers); a student being sure his eighth grade class did work with thermometers when his teacher said thermometers were not used in class; and a student including activities done in sixth grade. Two of the teachers had the students use thermometers to measure the temperature of liquids. The use of barometers was not mentioned by any of the teachers.

Most of the students reported that they did not know the meaning of the word "barometer." One child said he thought it had something to do with the weather, but didn't know what it was. This child did not attend to the word "thermometer" and so did not answer the question (see discussion of underreporting above).

Recommendations

Most students knew what a thermometer was. Since none of the teachers used barometers in their classrooms, it can probably be deleted. The item can be simplified to:

In your science class this year, have you taken measurements with thermometers?

Yes ☐
No ☐

This proposed revision also eliminates the analytic ambiguity presented by unanswered items.

Student Item:

6. Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

   Simple machines (for example, pulleys and levers)?

Teacher Validation Probe (not a survey item):

Your students will be asked about certain kinds of hands-on activities and projects they may have done in science.

Have they done anything with simple machines?

Discrepancy rate 55% (6 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No	5	6
Yes		

Discussion

None of the teachers reported the use of simple machines in their classes. However, six of the students reported hands-on activities with simple machines. Two students said "yes," but did not know what was meant by pulleys and levers (for one student, his teacher did show a video on how to make small cars do things -- which the student could have misconstrued as a hands-on activity with simple machines). Two other students said "yes," but were reporting on activities performed in the fifth grade. A fifth student reported on the use of Lego building blocks as hands-on activities with simple machines, and a sixth student described an activity where they had to use a pulley to pull up a book. Thus, problems with word comprehension and an unspecified time frame contributed to overreporting of students' responses.

Most of the students did not understand the phrases "simple machines," and the words "pulley" and "lever." One child thought a lever was "something used to balance things."

Recommendations

It is not clear whether this question can be asked at all. Very few students, if any, understood the question, and it would be difficult to simplify the concepts of pulleys and levers. The teachers did not report the occurrence of these activities in the classroom.

Student Item:

7. Which best describes the science course you are taking?

- ☐ **I am not taking a science course this year**
- ☐ **Life science (for example, biology)**
- ☐ **Physical science (for example, physics or chemistry)**
- ☐ **Earth science (for example, geology or astronomy)**
- ☐ **General science (several content areas of science taught separately)**
- ☐ **Integrated science (several content areas of science combined and taught together throughout the year)**

Teacher Validation:

No specific validation probe. Teachers were asked informally about the science course they were teaching. They all responded "general science."

Discrepancy rate 67% (6 out of 9 responses; 2 missing)

Teacher Responses	Student Responses						
	I am not taking a science course this year	Life science	Physical science	Earth science	General science	Integrated science	Checked two or more boxes
I am not taking a science course this year							
Life science							
Physical science							
Earth science							
General science		1			3	1	4
Integrated science							

Discussion

Two students skipped the item. One of these students did not know what was meant by "course," by "content area," or by most of the course names (e.g., "physical science" and "integrated science"). "Content area" was defined as "content of a book -- like a part of a book." The other student was not sure how to answer this question and would therefore skip it. She said: "If I had learned about it, I would check it off like a check list." She didn't know what "integrated science" meant and thought "general science" meant: "without the teacher changing what it's supposed to be." She read "physics" as "psychics."

Four students checked two or more boxes. In fact, one student checked three boxes and another student four boxes. The latter student went down the list and chose all of the topics they had covered this year (life science, physical science, earth science, and integrated science). He said "We have one class that covers all this stuff." One of the students who checked two boxes chose "life science" and "earth science," since this represented things that he thought he had studied this year. The teacher indicated that they had studied the human body and ecology. It is possible that the student interpreted "earth science" to be the same thing as ecology. Finally, another student who only checked one box thought it was possible to choose more than one.

At least six students did not know what "integrated science" meant. However, in spite of their lack of comprehension, two of these student chose that option and defined it as:

- We haven't done one specific course this year, we have done a few such as the circulatory and reproductive system, sex education, and the periodic table.
- Integrated science is low level; general science is a step higher.

Another student defined "integrated science as "the mobility of joints."

One student had trouble understanding the term "general science." He defined it as "something you learn every year (in 6th, 7th, and 8th grade), like formulas or sex education."

Recommendations

Asking eighth graders to describe their science class in terms of the listed categories does not work. The category labels do not correspond to the retrieved representations of the type of class that students encode. If the question is administered to eighth grade students, it should be revised: it should be specified that only one option can be checked and the response options should be simplified.

Student Item:

8. About how often do you study science in school?

- ☐ **Every day**
- ☐ **3 or 4 times a week**
- ☐ **1 or 2 times a week**
- ☐ **Less than once a week**
- ☐ **Never**

Teacher Validation:

No specific validation probe. Teachers were asked informally about how often they taught their current science course.

Discrepancy rate	36% (4 out of 11 responses)
Number children reporting more frequently	3
Number children reporting less frequently	1

Teacher Responses	Student Responses				
	Never	Less than once a week	1 or 2 times a week	3 or 4 times a week	Every day
Never					
Less than once a week					
1 or 2 times a week					
3 or 4 times a week			1	4	3
Every day					3

Discussion

The three students who overreported how often they have science included "science lab" in their responses, whereas their teacher did not. The class has science lab one day per week. If studying science in school includes science labs, these students' responses are correct. However, the responses of their peers who did not include science lab would then be incorrect.

Two students understood the item as: "How often do you study?" That is, they interpreted the item to ask about how often they study science, like how many times they research or review things in science, as opposed to how many times their science class meets. Even though one of the student's response matched the teacher's response, this agreement was coincidental.

Recommendations

If the intent of the item is to determine how often the student's science class meets, it needs to be reworded to ask this. If not, it needs to be reworded so that other students will include science lab courses.

The word "study" is confusing to some students. The item could be reworded to: "*How often do you have science in school?*" or "*How often does your science class meet?*" However, the intent of the item (see above) needs to be ascertained before revision is attempted.

Student Item:

9. Do either you or your teacher save your science work in a portfolio?

Teacher Validation Probe (not a survey item):

Do you or your students keep portfolios of their work?

Both:

Yes ☐
No ☐

Discrepancy rate 55% (6 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No	2	6
Yes		3

Discussion

The term "portfolio" has very different meanings to teachers and students. The students' definitions were usually more inclusive than their teachers. Students gave various definitions of portfolio:

- She (the student) told about her teacher saving some work on a project, in process, in a portfolio. The student was talking about keeping this work over night, so that it could be handed back to the students for completion the next day.
- He (the student) was thinking of one project that involved the teacher collecting all of the students' work, then scanning them into a portfolio.
- She (the student) defined a portfolio as a place where the teacher keeps the students' work. The teacher gave the students their work back at the last day of school.
- Teachers defined a portfolio more narrowly as a set of documents representing the students' eighth grade science work in a folder. All but two students felt the teacher did keep their work in a portfolio, as they more generally defined the term.

One teacher mentioned that the school has a portfolio for all four eighth grade subjects, but not one for science only.

Recommendations

Clearly, the term "portfolio" needs to be more explicit. If the teacher defines it as a specific collection of the work done by the student, the question will need to be more narrowly constructed around that definition. A complete definition, with examples, should be given to more clearly define the term. In order to provide such a definition, further guidance about the type of portfolio (and its use or uses) to be measured is necessary.

Student Item:

10. If you are taking a science course this year, about how much time do you spend doing science homework each week?

I am not taking a science course	☐
None	☐
½ hour	☐
1 hour	☐
2 hours	☐
3 hours	☐
More than 3 hours	☐

Teacher Validation Probes (not survey items):

We're also going to ask them about science homework.

How often do you assign science homework?

_____ days per week

About how long do you think it takes your students to do their science homework?

_____ minutes per assignment

Discrepancy rate	82% (9 out of 11 responses)
Number children reporting more frequently	0
Number children reporting less frequently	9

Teacher Responses (per week)	Student Responses (per week)						
	I am not taking science this year	None	½ hour	1 hour	2 hours	3 hours	More than 3 hours
I am not taking science this year							
None							
½ hour		2	1				
1 hour							
2 hours			3	4	1		
3 hours							
More than 3 hours							

NOTE: Teacher responses to the above probes were combined into a single teacher response.

Discussion

There are several sources of possible discrepancies between students' and teachers' responses. The amount of homework teachers assign varies greatly over the course of the year. Indeed, teachers reported difficulty in estimating the amount of homework because the levels vary so much within the science classes. In addition, students' abilities in science will cause individual variation in the time it takes to complete the same homework assignment. Students' answers sometimes varied from that of the teachers because the students simply completed the homework more quickly than the teacher anticipated.

In addition, the time period of the responses, ranging from "½ hour per week" to "more than 3 hours per week," may not be optimal for science classes where homework can vary greatly from week to week.

Seven students underreported the amount of time it takes them to complete their homework as compared to the teachers because their teachers assigned homework only every month or so. Two of these teachers' students chose the option, "none." The remaining seven students who reported less homework than their teachers (who reported 2 hours per week of homework) had varying problems with or misinterpretations of the item:

- reported ½ hour of homework, but didn't know whether or not to include project work
- reported ½ hour of homework, but was an "A" student, so probably completed his work more quickly
- reported ½ hour of homework, but indicated that they usually don't get difficult assignments
- two students reported 1 hour of homework, but didn't know whether or not to include project work
- reported 1 hour of homework, but admitted to individual variation among students

- reported 1 hour of homework, but was thinking of how much homework he anticipates for next year (he had been reading a brochure on the curriculum of the high school he was attending)

No students overreported the amount of homework assigned. It is possible that teachers were "generous" with their estimates -- or that they averaged projects into their estimates.

Confusions also resulted from various interpretation of "homework." Some projects extend after school hours and so were interpreted by some as homework.

Recommendations

Science homework appears to be comprised of at least two distinct components: "Regular" homework and "Project homework." Further, science homework appears to be episodic, making it difficult for respondents to provide estimates for the average week.

This item would need to be quite specific in order to be more accurate. "Homework" should be carefully defined and examples given. Sacrifices in estimates over the entire year may have to be made in order to elicit more accurate answers. For example, the students may need to be asked:

How much time did you spend last week on science homework? Do not count project work.

I am not taking science this year	☐
I did not do any science homework last week	☐
About ½ hour	☐
About 1 hour	☐
About 2 hours	☐
About 3 hours	☐
More than 3 hours	☐

How much time outside of the classroom did you spend last week on science projects?

I am not taking science this year	☐
I did not work on any science projects last week	☐
About ½ hour	☐
About 1 hour	☐
About 2 hours	☐
About 3 hours	☐
More than 3 hours	☐

Student Item:

11. Do you ever do science projects in school that take a week or more?

Teacher Validation Probe (not a survey item):

Do your students ever do science projects in school that take a week or more?

Both:

Yes ☐
No ☐

Discrepancy rate 27% (3 out of 11 responses)

Teacher Responses	Student responses	
	No	Yes
No		3
Yes		8

Discussion

In the participating schools, long projects are quite common in eighth grade science class. Even the one teacher who ended up saying that he did not give out long projects, had a difficult time making the decision, and, in fact, described a long-term project where students were given sacks of flour to care for as they would newborn babies.

Recommendations

More explicitly defining the phrase "science projects" might be helpful to increase accuracy of the responses. Conversely, if everyone is answering "yes," the item may not have any discriminating power and can be deleted.

Student Item:

12. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

About how often do your science students do each of the following? Fill in one box on each line.

Both:

Discuss science in the news?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	18% (2 out of 11 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	6			
1-2 times/ month	1	3	1	
1-2 times/ week				
Almost every day				

Discussion

According to most of the teachers and students, this activity was not very common. However, definitions of "science in the news" varied, with teachers generally having a more inclusive definition of this activity. One teacher described it as "any information from the news that is relevant for a student's science fair project;" another, as "science one hears about through the mass media (cloning, ecological issues)" whether or not it was related to current student projects. Students defined "in the news" as "having to do with media," "science shows seen on TV," discussing **any** news item in science class (even if it is not science-related), and listening to the news about science. One student underreported since she had a more narrow definition of "science in the news" than her teacher. Another student overreported this activity because he was including science TV programs he watches outside of class. However, since none of these activities occurred very often, the teachers' and students' responses generally were consistent.

One general problem is that students find it difficult to retain the proper context of the answers. Students forget to read the stem "When you study science in school" and often answer questions by including events outside of the classroom, or outside of the relevant subject area. One student skipped the directions, was very confused, then went back and read the directions, changing her answer.

Finally, many students interpreted "Never or hardly ever" to mean "Never." When responding about infrequent events, students often pick the nearest response to "Never or hardly ever." Thus, students may answer "once or twice a month," even when the event occurs only every few months.

Recommendations

Providing an example to illustrate what is meant by "discuss science in the news" may improve the validity of reporting. However, students often respond only in terms of the examples; the examples focus the responses too narrowly. Reinstating the context (of the event occurring when science is studied in school) may also improve the validity of the responses:

In your science class this year, how often do you discuss events in the news that are related to what you are learning in science class?

Every science class	☐
Once or twice a week	☐
Once or twice a month	☐
Hardly ever	☐ *(These two scale choices* **allow students to accurately**
Never	☐ *report infrequent events.)*

Student Item:

13. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

About how often do your science students do each of the following? Fill in one box on each line.

Both:

Work with other students on a science activity or project?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	82% (9 out of 11 responses)
Number children reporting more frequently	2
Number children reporting less frequently	7

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week		1		2
Almost every day		3	3	2

Discussion

This question is a good example of a general problem with rate estimates produced by teachers and students. It is difficult for students to estimate the average frequency for an activity. These estimations are especially difficult when the time period is undefined. Should the frequency be averaged over the last week, the last few months, the school year or only for the period during which the activity was being performed? Many students, even teachers, are influenced greatly by recent events, and thus do not accurately estimate over long periods of time. One teacher responded that, lately, his students work with each other on a science activity "one to two times per week." However, he added that the yearly average would be "almost every day."

Estimating the frequencies of events is especially difficult for items asking about subject areas that are not taught daily. The response option "Almost every day" could be interpreted as "almost every day we have science (we do that activity)" or "almost every day of the week (we do that activity)." Much

of the underreporting of frequencies by students was due to the fact that the students do not have science every day. Some students used a literal interpretation of "Almost every day" and thus did not use that option. However, their teacher interpreted "Almost every day" to mean "almost every day that science class is taught."

Underreporting was also due to students thinking only of projects that are not assigned very frequently. One teacher responded "almost every day," saying that every student has to teach a lesson during each lab activity. Finally, one student did not include science lab activities, whereas her teacher did.

Recommendations

The following version of this item specifies the time period for estimation (although students' responses may still be influenced by the recency of activities), and specifies the meaning of "every day" for classes that are not taught daily. Examples may help to explain what is meant by activities and projects, but still has the problem of focusing the students only on the listed projects or activities.

In your science class this year, how often do you work with other students on a science activity or project?

Almost every science class ☐
Once or twice a week ☐
Once or twice a month ☐
Hardly ever ☐
Never ☐

Student Item:

14. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

About how often do your science students do each of the following? Fill in one box on each line.

Both:

Give an oral science report?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	55% (6 out of 11 responses)
Number children reporting more frequently	6
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	5	4	1	1
1-2 times/ month				
1-2 times/ week				
Almost every day				

Discussion

This item points to several interesting problems resulting in discrepancies between students' and teachers' responses. For infrequent events, students and teachers alike found it difficult to fit their answers into the available response options. One student said the class gave oral science reports at the beginning of the year, but not now. He had difficulty choosing an appropriate response category for this frequency. Another student reported that his class gave oral reports "maybe once or twice the entire year," and another said "once per quarter." All these students had difficulty in finding an appropriate category that fit the frequency of the event. Four chose "once or twice a month," whereas their teachers chose "never or hardly ever." One teacher even explained that his class gave oral reports three times a year for science fair projects, along with oral reports and explaining things to class. This teacher chose "never or hardly ever." One of his students reported these activities took place "once or twice a month."

Another problem that resulted in discrepancies between teachers' and students' responses was the interpretation of "giving an oral report." Some students defined this activity informally (talking to other students, writing a letter about cells to a teacher, talking about chapters), while teachers defined the activity as covering only formal presentations (students standing in front of the class and giving a report). This led to overreporting by students who defined the activity more informally.

Recommendations

The response options should explicitly allow for activities that occur less frequently than every month. If a more formal definition (of giving an oral science report) is agreed upon, then the question might be rephrased as follows.

In your science class this year, how often do you stand up in front of the class and give an oral science report?

Almost every science class	☐
Once or twice a week	☐
Once or twice a month	☐
Only a few times a year	☐
Hardly ever	☐
Never	☐

Student Item:

15. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

About how often do your science students do each of the following? Fill in one box on each line.

Both:

Do hands-on activities or investigations in science?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	73% (8 out of 11 responses)
Number children reporting more frequently	0
Number children reporting less frequently	8

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week	3	5	3	
Almost every day				

Discussion

For many students, this item was difficult to comprehend. Students did not understand the phrase "investigations in science." Some defined it vaguely as: "finding out facts," "looking for information about something in science," "doing research," "doing research outside of class," "researching how they do science," and "reading a book." Other students simply had no idea of what the phrase meant. For these reasons, students underreported the frequency of what they thought were "investigations in science."

Students also underreported because they ignored one part of the two part question, focusing either on "investigations in science" or "hands-on activities," but not both.

Finally, teachers and students alike had difficulty choosing between the response option "once or twice a month" and "once or twice a week." Often, their estimates fell between these points. One teacher expressed that he was "waffling" between the two response options.

One teacher also expressed that the frequency of these activities depends on the unit (i.e., chemistry, astronomy, physics, ecology). To answer about science "in general," with respect to this activity, was difficult.

Recommendations

The term "investigations" needs to be defined precisely, and then simplified -- or eliminated. One possibility for simplifying the question, is:

About how often do you do hands-on activities in your science class?

Almost every science class ☐
Once or twice a week ☐
Once or twice a month ☐
Only a few times a year ☐
Hardly ever ☐
Never ☐

Student Item:

16. When you study science in school, how often do you do each of the following? Fill in one box on each line.

    Talk about the measurements and results from your hands-on activities or investigations?

Teacher Item:

About how often do your science students do each of the following? Fill in one box on each line.

Talk about measurements and results from students' hands-on activities?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	82% (9 out of 11 responses)
Number children reporting more frequently	2
Number children reporting less frequently	7

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month		1	2	
1-2 times/ week	3	4	1	
Almost every day				

Discussion

This question is long, and was quite difficult for students to understand. At least one student had no idea what it meant. Two students rephrased the question as: "sometimes speakers come and we have to measure tables," and "talking about what you do to investigate things."

In addition, this question had some of the same problems as the previous one. Teachers and students varied in their interpretations of what was meant by "talk about." Respondents interpreted the phrase to mean either formally talking in front of class or informally after every activity. For this item, students often defined the activity more formally, thus resulting in underreporting as compared to their

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teachers. Some students also focused on either "hands-on activities" or "measurements" but not both together.

One student simply did not understand the question, and chose "never or hardly ever" as her answer. When there is no option for "don't know," it is difficult to tell if the frequency of the event is "never or hardly ever" or if the student does not know the frequency of the event, or does not understand the question and has no other option.

Finally, one teacher felt that "measurements" and "results" were redundant, since "results include measurements."

Recommendations

Repeating the question in each response category may help students to answer more difficult questions.

In your science class this year, how often do you talk about results from your science projects and other hands-on activities? Include conversations with other students and with your teacher.

I talk about results in almost every science class	☐
I talk about results once or twice a week	☐
I talk about results once or twice a month	☐
I talk about results once or twice a year	☐
I hardly ever talk about results	☐
I never talk about results	☐

Student Item:

17. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Teacher Item:

Do your students...

Both:

Go outside to observe or measure things?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	36% (4 out of 11 responses)
Number children reporting more frequently	4
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	7	3	1	
1-2 times/ month				
1-2 times/ week				
Almost every day				

Discussion

This item referred to behaviors that were very salient to students. Thus, "going outside to observe and measuring things" was easy for students to remember and report. However, the context of the question is unanchored. This activity was not part of the eighth grade science classes included in the study. Overreporting occurred because students either thought of other classes (i.e., science lab), other situations (i.e., a science field trip where they did this once and the student interpreted the "Never or hardly ever category" as "Never" and so picked the closest option of "Once or twice a month"), or other years. When students were thinking of their science class and the present year, their answers were consistent with their teachers.

Recommendations

The question is a good one for students, especially if the context is anchored to a particular time and situation.

For your science class this year, how often do you go outside to observe or measure things?

Almost every day I have science	☐
Once or twice a week	☐
Once or twice a month	☐
Hardly ever	☐
Never	☐

Student Item:

18. When you study science in school, how often do you do each of the following? Fill in one box on each line.

Design and carry out your own science investigation?

Teacher Item:

Do your students...

Design and carry out their own science investigation?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	55% (6 out of 11 responses)
Number children reporting more frequently	3
Number children reporting less frequently	3

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	5	2	1	
1-2 times/ month				
1-2 times/ week	3			
Almost every day				

Discussion

Students had difficulty in understanding this question. They had varying interpretations of the terms "design and carry out" and "science investigation." Many students thought that science investigation was something that happened only with science projects. Another student included one instance of a science project titled "designing a cell" since the project title contained the word "design." Once again, a student interpreted "Never or hardly ever" to mean "Never" and so chose the next, greater frequency option ("Once or twice a month") for an event that occurred much less frequently. Finally, a student included activities done in science lab rather than in science class.

Teachers' reporting of this activity in their science classes varied. One teacher reported "once or twice per week" (all her students reported "Never or hardly ever") and the two others reported "Never or hardly ever" (many of their students reported once or twice a month or once or twice a week).

Recommendations

The construct "design and carry out a scientific investigation" appears to be one that is unfamiliar to most eighth graders. It is also interpreted in different ways by different eighth grade teachers. It should probably be deleted.

Student Item:

19. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

When you teach science in school, about how often do you do each of the following? Fill in one box on each line.

Both:

Talk to the class about science?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	27% (3 out of 11 responses)
Number children reporting more frequently	0
Number children reporting less frequently	3

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week				
Almost every day		1	2	8

Discussion

The teacher version of this question elicited some very interesting responses: "Of course I talk to the class about science. Since I teach science, it's the focal point of what I talk about – I never just lecture," "I talk to the class about science every time I teach science, I don't get the point of the question." All teachers responded that they talk to their class about science "Almost every day."

Students' answers, however, varied from "Almost every day" to "Once or twice per month." One student wondered if they were asking about "science or about what they do." We believe this student was trying to articulate the same confusion that the teachers expressed.

Another student said his science teacher talks to the students only "once or twice per week," since he does not have science class every day. Teachers were responding in terms of the days they taught science class.

Recommendations

The intent of the teacher question needs to be determined and stated explicitly. If the intent of the question is to find out how much time is spend lecturing, as opposed to student-involved activity, then perhaps the following sets of questions would be more appropriate:

Teacher question:

When you teach science in school, about how often do you do each of the following?

Stand up in front of the class and lecture about science topics?

Student question:

In your science class this year, how often does your teacher lecture to the class about science (where you are just sitting and listening)?

Almost every day I have science ☐
Once or twice a week ☐
Once or twice a month ☐
Hardly ever ☐
Never ☐

Student Item:

20. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

When you teach science in school, about how often do you do each of the following? Fill in one box on each line.

Both:

Do a science demonstration?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	45% (5 out of 11 responses)
Number children reporting more frequently	3
Number children reporting less frequently	2

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	3		2	
1-2 times/ month		2	1	
1-2 times/ week		2	1	
Almost every day				

Discussion

In this question, it was unclear which events the phrase "science demonstration" was intended to include. Even the teachers disagreed. One teacher defined it as including demonstrations done either by herself or by guest speakers (her students underreported the frequency of this event, because they did not include guest speakers).

Another teacher defined a science demonstration as "showing something in science" and the third teacher similarly defined it as "something the teacher does or sets up, where students observe and discuss the demonstration." Two of the students of these teachers overreported because one of them included computer demonstrations and the other included science demonstrations done in the science lab.

Recommendations

Examples might help to clarify the intended meaning of the term "science demonstration." However, as mentioned before, examples often focus students on only the specific examples provided. Regardless of how the question is worded, a revised scale is recommended:

Almost every day I have science	☐
Once or twice a week	☐
Once or twice a month	☐
Hardly ever	☐
Never	☐

Student Item:

21. When you study science in school, how often does your teacher do each of the following? Fill in one box on each line.

Teacher Item:

When you teach science in school, about how often do you do each of the following? Fill in one box on each line.

Both:

Use computers for science (e.g., science software, telecommunications)?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	18% (2 out of 11 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	3			
1-2 times/ month	1	6		1
1-2 times/ week				
Almost every day				

Discussion

There were several problems associated with this item. Students did not know what "e.g." meant, and the words "telecommunications" and "science software" are not eighth grade vocabulary words. One student thought "e.g." was a computer program! Another thought "telecommunications" was "communications with a person about science." This caused a lot of confusion but resulted in frequent coincidental agreement between students and teachers.

Asking about the use of computers for science in terms of the teachers' behavior is confusing. It was interpreted differentially by teachers as either:

a) the teacher using the computer or
b) the teacher allowing their class to use the computer.

For teachers who interpreted the item to reflect student behavior, the students' use of the computer for science varied tremendously from student to student. One teacher said that, in general, students are using computers in the science class every day, but each student only uses it about once a month. (Note: For purposes of validation, the teachers' computer usage for science is reported in the table.)

Similar to some of the teachers, two students lost the context of the question and responded with respect to student computer usage as opposed to teacher usage.

Recommendations

Teacher item:

When you teach science in school, about how often do your students do each of the following? Fill in one box on each line.

Use computers for science (e.g., science software, communicating with others about science, researching science topics).

(It has to be clarified whether the teacher is supposed to respond with respect to any student or with respect to the typical student.)

Student item:

In your science class this year, do you use computers?

Student Item:

22. About how often does your science class go on a science field trip?

Teacher Item:

About how often do your science students go on a science field trip?

Both:

3 or more times a year ☐
1 or 2 times a year ☐
Never or hardly ever ☐

Discrepancy rate	18% (2 out of 11 responses)
Number children reporting more frequently	1
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never or hardly ever	1-2 times/ year	3 or more times/ year
Never or hardly ever	3		
1-2 times/ year	1	6	1
3 or more times/ year			

Discussion

This question can be reliably answered by eighth grade students, perhaps because it occurs infrequently, and is a very, salient event. In one case, even though the item was stated in terms of "**science** class" and "**science** field trips," a student said he went on field trips "3 or more times per year," including field trips taken with other classes. Another student responded that she never went on Science field trips, when her teacher had taken them to Great America for Physics day. It could be that she was not present on this trip, forgot about it, or did not consider it science.

Recommendations

The middle and last response options are not mutually exclusive. If a student went on one field trip, (s)he could either check that (s)he "hardly ever" went on field trips, or that (s)he went on field trips "1 or 2 times a year." The third option should be simplified to "Never."

How often do you go on science field trips with your science class?

3 or more times a year ☐
1 or 2 times a year ☐
Never ☐

Student Item:

23. About how often does a guest speaker come to speak to your science class?

Teacher Item:

About how often do you bring a guest speaker to talk to your science class?

Both:

3 or more times a year ☐
1 or 2 times a year ☐
Never or hardly ever ☐

Discrepancy rate	9% (1 out of 11 responses)
Number children reporting more frequently	0
Number children reporting less frequently	1

Teacher Responses	Student Responses		
	Never or hardly ever	1-2 times/ year	3 or more times/ year
Never or hardly ever	3		
1-2 times/ year	1	4	
3 or more times/ year			3

Discussion

The results from this question are a good example of chance agreement. Even though their answers were the same, the students of one teacher were thinking of different guest speakers than the teacher. If both students and teachers had remembered all the guest speakers, the proper answer would have been "3 or more times a year" rather than the "one or two times a year" that four students and one teacher indicated. As for the previous question, the use of "Never or hardly ever" prevents the response options from being mutually exclusive.

Recommendations

The middle and last response options are not mutually exclusive. Change as follows:

3 or more times a year ☐
1 or 2 times a year ☐
Never ☐

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Teacher Item Only:

T1. During the last year, how much time in total have you spent in professional development workshops or seminars in science or science education? Include attendance at professional meetings and conferences, district-sponsored workshops, and external workshops.

None ☐
Less than 6 hours ☐
6-15 hours ☐
16-35 hours ☐
More than 35 hours ☐

Teacher Responses	Frequency
None	
Less than 6 hours	
6-15 hours	
16-35 hours	1
More than 35 hours	2

Discussion

The three teachers interviewed had spent at least 16 hours on professional development over the last year. Each had a different idea about what types of classes or training to include. One teacher, at first, did not include district workshops he did not find useful. When he changed his mind and decided to include them, his answer changed to "more than 35 hours." Another teacher felt that "training in anything that would impact my science teaching" should be included. The third teacher was confused by the term "professional meetings" and included district steering committee meetings for science teaching. Some teachers interpreted "last year" to mean the past academic year, others interpreted it to mean the last 12 months. Most of the teachers tried to find reasons to be inclusive -- that is, to include activities rather than to exclude them from their estimates.

Recommendations

The time period to be included needs to be specified. The item already details the types of training to be included, but analysts should be aware that teachers will often err on the side of including marginally appropriate professional development activities in their estimates.

During the past 12 months, how much time in total have you spent in professional development workshops or seminars in science or science education? Include attendance at professional meetings and conferences, district-sponsored workshops, and external workshops.

Teacher Item Only:

T2. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Cooperative group instruction?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	
Not useful	1
Somewhat useful	1
Moderately useful	
Very useful	1

Discussion

Again, teachers were inclusive in their answers. One teacher interpreted these items to include areas that were part of any course or part of any professional development in which he participated. Another teacher felt that professional development in cooperative group instruction was not useful because cooperative group instruction was not useful. "A student is a student." Researchers need to take this into account when analyzing responses about areas whose utility is controversial.

Teachers have generally similar views of the meaning of the response options. Following is a list of the teachers' differing definitions of the four non-zero response options. The teachers use slightly different conceptual scales, and assign different increments to the ordinal scale. Overall, teachers were able to make meaningful distinctions between categories. These response options appear to work.

Not useful

- something that a teacher might have heard about but which was not applicable or relevant for their teaching
- not being able to use it in class
- training for which there was no need or impact

Somewhat useful

- information that you think about and begin to apply in your teaching
- okay – like a C student
- training that was helpful but did not have the greatest impact

Moderately useful

- information that the teacher was able to use in the classroom and try a few times
- something you can use
- courses that were a bit more useful

Very useful

- something that was tried several times and that the teacher would like to continue employing
- courses that really change things
- something that can benefit everybody

Teacher Item Only:

T3. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Interdisciplinary instruction?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	
Not useful	
Somewhat useful	
Moderately useful	2
Very useful	1

Discussion

There was no discussion of this item outside of a general discussion of items in this series.

Teacher Item Only:

T4. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Teaching higher-order thinking skills?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	
Not useful	
Somewhat useful	1
Moderately useful	
Very useful	2

Discussion

One teacher lost the item's context. The teacher forgot the stem ("How useful were any courses you took or any professional development you received in the last five years for each of the following areas?"). He did not take a course in teaching higher-order thinking skills, but still responded that it is very useful.

Recommendations

Combining the question with the stem may help to remind teachers of the context of the answer:

How useful were any courses you took or any professional development you received in the last five years for teaching higher-order thinking skills? Please check one box per line.

I have not received any professional development or taken any courses in this area in the last five years	☐
Not useful	☐
Somewhat useful	☐
Moderately useful	☐
Very useful	☐

Teacher Item Only:

T5. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Teaching students from different cultural backgrounds?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	1
Not useful	
Somewhat useful	1
Moderately useful	
Very useful	1

Discussion

There was no discussion of this item outside of a general discussion of items in this series.

Teacher Item Only:

T6. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Classroom management and organization?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	
Not useful	1
Somewhat useful	1
Moderately useful	
Very useful	1

Discussion

There was no discussion of this item outside of a general discussion of items in this series.

Teacher Item Only:

T7. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Other professional issues?

No courses or professional development ☐
Not useful ☐
Somewhat useful ☐
Moderately useful ☐
Very useful ☐

Teacher Responses	Frequency
No courses or professional development	1
Not useful	
Somewhat useful	
Moderately useful	1
Very useful	1

Discussion

One teacher was confused about this question; he was not sure what was meant by "other professional issues." He answered "No courses or professional development." Another responded with respect to a multimedia course supported by George Lucas' foundation. Still a third interpreted the item as including teaming, advisories, curricular issues, new standards, and school functions.

Recommendations

The use of an "other" category will invariably result in idiosyncratic interpretations, making analysis of response frequencies difficult or impossible. Its value is that it does not compel the respondent to classify training in an ill-suited category. We suggest that a "specify" instruction be added to allow codebacks.

How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

Please specify any courses or training not included in the previous list:

_____

Teacher Item Only:

T8. Think about your plans for your science instruction during the entire year. About how much emphasis will you give to each of the following objectives for your students? Fill in one box on each line.

Understanding key science concepts?

Heavy emphasis ☐
Moderate emphasis ☐
Little or no emphasis ☐

Teacher Responses	Frequency
Heavy emphasis	2
Moderate emphasis	1
Little or no emphasis	

Discussion

This item was interpreted by one teacher as referring to fundamental principles – a basic understanding of how things work. The cardiovascular system and its operation as a system was the example provided. Another defined the item as "concepts the school and the district say students have to learn before they leave class." The periodic table and its meaning was an example that this teacher provided.

Another teacher had a problem figuring out the context of items in this series. He initially answered about the emphasis he would give to each of these in planning lessons. Then, he thought the items were interested in finding out about in-class time. Finally, he went back to his initial interpretation.

Recommendations

This question is asking about a socially appropriate behaviors. It's hard to imagine many teachers reporting that they do not give this a heavy emphasis. It should be noted that there may be a tendency for items in this series to elicit response of heavy or moderate emphasis due to social desirability factors. The teacher who reported "moderate emphasis" commented "it sounds like it should be given more emphasis."

Teacher Item Only:

T9. Think about your plans for your science instruction during the entire year. About how much emphasis will you give to each of the following objectives for your students? Fill in one box on each line.

Developing science problem-solving skills?

Heavy emphasis ☐
Moderate emphasis ☐
Little or no emphasis ☐

Teacher Responses	Frequency
Heavy emphasis	3
Moderate emphasis	
Little or no emphasis	

Discussion

One teacher interpreted this item to include understanding science concepts, questioning, and observational skills.

Teacher Item Only:

T10. Think about your plans for your science instruction during the entire year. About how much emphasis will you give to each of the following objectives for your students? Fill in one box on each line.

Learning about the relevance of science to society and technology?

Heavy emphasis ☐
Moderate emphasis ☐
Little or no emphasis ☐

Teacher Responses	Frequency
Heavy emphasis	1
Moderate emphasis	
Little or no emphasis	1
Missing	*1*

Discussion

One teacher omitted this item on purpose. He said "the relevance of science to technology did not make a lot of sense. It seems as if this item should say "relevance of science and technology for society."

Recommendation

To clarify this item, the following rewording should be considered:

Learning about the relevance of science and technology to society?

Heavy emphasis ☐
Moderate emphasis ☐
Little or no emphasis ☐

Teacher Item Only:

T11. Think about your plans for your science instruction during the entire year. About how much emphasis will you give to each of the following objectives for your students? Fill in one box on each line.

Developing data analysis skills?

Heavy emphasis ☐
Moderate emphasis ☐
Little or no emphasis ☐

Teacher Responses	Frequency
Heavy emphasis	2
Moderate emphasis	1
Little or no emphasis	

Discussion

One teacher thought that "developing data analysis skills" referred to learning how to collect information, how to organize information, and what is learned from information. The teacher commented that "it sounds like it should be given more emphasis." Again, social desirability may be a factor in the responses.

Teacher Item Only:

T12. How often do you use each of the following to assess student progress in science?

Individual projects or presentations?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	
Once or twice a month	2
Once per grading period	1
Once or twice a year	
Never or hardly ever	

Discussion

One teacher particularly liked the option with a grading-period anchor ("once per grading period"). He said it helped him to focus the linkage of the items to the grading period, and made it easier to respond.

One teacher was confused about how to approach this and the next question. She has group projects but evaluates the individual students on their individual contributions. She answered both items in the same way, "to average things out."

Finally, one teacher lost context, forgetting the stem ("How often do you use each of the following to **assess student progress** in science") and responded to the frequency of occurrence of the activities in items in this series.

Recommendations

If the grading period option is kept (which seems reasonable), one should add an item asking about the number of grading periods per semester or per year. In addition, the low-frequency response options should then be linked to grading period, while the high frequency response options can remain unlinked to the grading period. In addition, context could be maintained by embedding the assessment construct in the option:

Use individual projects or presentations to assess student progress in science?

Once or twice a week	☐
Once or twice a month	☐
Two or three times per grading period	☐
Once per grading period	☐
Never	☐

Teacher Item Only:

T13. How often do you use each of the following to assess student progress in science?

Group projects or presentations?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	
Once or twice a month	2
Once per grading period	
Once or twice a year	
Never or hardly ever	1

Discussion

There was no discussion of this item outside of a general discussion of the item.

Recommendations

Change option to reinstate context and change rating scale as in previous item.

Use group projects or presentations to assess student progress in science?

Once or twice a week ☐
Once or twice a month ☐
Two or three times per grading period ☐
Once per grading period ☐
Never ☐

Teacher Item Only:

T14. How often do you use each of the following to assess student progress in science?

Laboratory notebooks or journals?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	1
Once or twice a month	
Once per grading period	2
Once or twice a year	
Never or hardly ever	

Discussion

There was no discussion of this item outside of a general discussion of the item.

Recommendations

Change option to reinstate context and change rating scale, as suggested previously.

Use laboratory notebooks or journals to assess student progress in science?

Once or twice a week ☐
Once or twice a month ☐
Two or three times per grading period ☐
Once per grading period ☐
Never ☐

Teacher Item Only:

T15. How often do you use each of the following to assess student progress in science?

Hands-on activities?

Once or twice a week ☐
Once or twice a month ☐
Once per grading period ☐
Once or twice a year ☐
Never or hardly ever ☐

Teacher Responses	Frequency
Once or twice a week	1
Once or twice a month	2
Once per grading period	
Once or twice a year	
Never or hardly ever	

Discussion

One teacher included guest speakers doing hands-on activities with students. Another teacher responded that "the science lab teacher assesses this" but responded "once or twice a week," estimating the lab teacher's answer. The third teacher noted that these activities could be part of group projects or individual projects and activities.

This raises another general issue: science labs. In some schools, science lab is a separate class; in others, a part of science class. Since both contribute to a student's understanding of science (and, therefore, to their performance on NAEP achievement tests), information about whether the student is taking a separate lab course AND about instructional practices and activities in this course need to be obtained (through a survey of the students' science lab teachers).

Recommendations

Change option to reinstate context and change rating scale, as suggested previously.

Use hands-on activities to assess student progress in science?

Once or twice a week	☐
Once or twice a month	☐
Two or three times per grading period	☐
Once per grading period	☐
Never	☐

Teacher Item Only:

T16. How many computers are there for student use in your classroom?

None available ☐
One within the classroom ☐
Two or three within the classroom ☐
Four or more within the classroom ☐

Teacher Responses	Frequency
None available	
One within the classroom	1
Two or three within the classroom	
Four or more within the classroom	2

Discussion

The item seemed to work; validated through direct observation.

Teacher Item Only:

T17. How difficult is it for your science students to access the computers in your school's computer laboratory?

There is no computer laboratory at my school ☐
It is easy for students to gain access to the computers in the computer laboratory ☐
It is difficult for students to gain access to the computers in the computer laboratory ☐

Teacher Responses	Frequency
There is no computer laboratory at my school	
It is easy for students to gain access to the computers in the computer laboratory	2
It is difficult for students to gain access to the computers in the computer laboratory	1

Discussion

Two teachers had a hard time answering this question because it is easy for students to gain access to the computers in the computer lab before and after school, but it is difficult for students to gain access to the computers in the computer lab during the school day. One ended up answering in terms of access before and after school; another, in terms of use during the school day. A third teacher truly felt her answer would lie somewhere between "It is easy for students to gain access to the computers in the computer laboratory" and "It is difficult for students to gain access to the computers in the computer laboratory." The response options for this question are too simplistic.

Recommendations

The purpose of this question needs to be more explicitly stated, and the response options expanded.

How difficult is it for your students to use your school's computer laboratory:

	Very easy	**Easy**	**Difficult**	**Very Difficult**
a) During school hours?	☐	☐	☐	☐
b) Outside of normal school hours?	☐	☐	☐	☐

Teacher Item Only:

T18. How do you use computers for instruction in science? Fill in all boxes that apply.

Play science/learning games to teach basic skills ☐
Play science/learning games to teach more advanced principles ☐
Providing access to computers as a reward for student performance ☐
Simulations and modeling ☐
Data analysis and other applications ☐
Word processing ☐
I do not use computers for science instruction ☐

Teacher Responses	Frequency
Play science/learning games to teach basic skills	
Play science/learning games to teach more advanced principles	1
Providing access to computers as a reward for student performance	1
Simulations and modeling	2
Data analysis and other applications	2
Word processing	2
I do not use computers for science instruction	1

Discussion

One teacher checked "I do not use computers for instruction in science" and "Providing access to computers as a reward for student performance." He interpreted the latter as allowing students to do homework, play games, or use the Internet on the computer if they had done well in science. He pointed out a clear formatting problem – the question states that respondents can "Fill in all boxes that apply." However, the last option "I do not use computers for science instruction" was intended to be mutually exclusive to all the other options. If this option is picked along with other options, valid interpretations would be difficult.

Another teacher suggested several additional options that could be added for the use of computer in instruction in science: research, CD-ROMs, Internet, productivity software (i.e., HyperCard, Hyper studio, webpage). Her students use HyperCard stacks and she wasn't sure where this use would fall within the provided options, so she chose "simulations and modeling," even though she said they do not actually use computers for simulations and modeling.

A third teacher interpreted "playing science/learning games to teach basic skills" as asking about general education and learning skills. He said that computers are not ever used for this purpose in a science class. Only "Play science/learning games to teach more advanced principles" was interpreted to include science class usage.

Recommendations

Other response options, particularly an Internet option should be considered.

The item should be made into "Yes/No" questions to avoid issues associated with blanks. That is, an unchecked box cannot be unambiguously interpreted as meaning, "No." It can also mean that the respondent didn't know the answer, omitted the item (accidentally or deliberately), or didn't understand the item. This would allow the final option ("I do not use computers for science instruction") to be eliminated or changed to an "Other (SPECIFY)" option.

Teacher Item Only:

T19. Which best describes the space where this class is taught?

A classroom with no access to a laboratory or a water source ☐
A classroom with access to a water source only ☐
A classroom with access to a laboratory only ☐
A laboratory with water source ☐

Teacher Responses	Frequency
A classroom with no access to a laboratory or a water source	
A classroom with access to a water source only	1
A classroom with access to a laboratory only	1
A laboratory with water source	1

Discussion

One problem with this question is that many science teachers use two rooms – a regular classroom and a lab. All the teachers had this problem. One teacher said that, since there is a science lab in other building, she checked "a classroom with access to a laboratory only." This response could be misinterpreted without reference to her explanation. The third teacher also felt that his room was both a classroom and a lab.

Recommendations

We would suggest splitting this question into several questions:

(a) Do you have access to a science lab? *Yes* ☐ *No* ☐

(b) Which best describes the space where this class is taught?

A classroom with no access to a laboratory or a water source ☐
A regular classroom with access to a water source ☐
A regular classroom without access to a water source ☐
A classroom with access to a laboratory ☐
A laboratory with water source ☐

Teacher Item Only:

T20. As part of their work for this science class, do students produce any of the following records of their work? Fill in all boxes that apply.

Notebooks or reports of laboratory work ☐
Reports or other written records of extended science projects ☐
Written reports on specific topics or issues in science ☐
Journals, diaries, or logs of ideas about science or work done for science class ☐
Three-dimensional scientific models ☐

Teacher Responses	Frequency
Notebooks or reports of laboratory work	3
Reports or other written records of extended science projects	3
Written reports on specific topics or issues in science	1
Journals, diaries, or logs of ideas about science or work done for science class	3
Three-dimensional scientific models	3

Discussion

Due to time constraints, there was only a general discussion of this item. No obvious difficulties or problems were noted.

Discussion of Eighth Grade Science Findings

Discrepancy rates. Discrepancy rates for selected items are presented in table 8 (below). There were high discrepancy rates between student and teacher report, even for items for which within-class variation would be expected to be low. There are several reasons for these discrepancies -- as well as for other discrepancies. They are discussed below.

Table 8. Discrepancy Rate for Selected Eighth Grade Science Items

When you study science in school, how often do you do each of the following:	**(n=11)**
Discuss science in the news	18%
Work with other students on a science activity or project	82%
Give an oral science report	55%
Do hands-on activities or investigations in science	73%
Talk about the measurements and results from your hands-on activities or investigations	82%
Go outside to observe or measure things	36%
Design and carry out your own science investigations	55%
When you study science in school, how often does your teacher do each of the following:	
Talk to the class about science	27%
Do a science demonstration	45%
Use computers for science (e.g., science software, telecommunications)	18%
About how often does your science class go on a science field trip?	18%
About how often does a guest speaker come to speak to your science class?	9%
Which best describes the science course you are taking?	67%
About how often do you study science in school?	36%
Do either you or your teacher save your science work in a portfolio?	55%
Do you ever do science projects in school that take a week or more?	27%
Which best describes the science course you are taking?	67%

NOTE: The number of students (n) is the modal number of respondents to each item.

Nature of science instruction. Three factors related to the nature of science instruction contributed to these discrepancies:

3) In the eighth grade, science instruction can include science laboratory activities. Without clear directions, many students will include these activities; many teachers will not, unless they are also teaching science labs.

4) (Science instruction may not occur every day. When this is the case, the behavioral frequency response option "almost every day" can be interpreted literally (in which case, it would almost be never selected) or can be interpreted as meaning "almost every day we have science." In the latter case, it would be selected more frequently.

5) There are two different types of science homework. One is "regular" homework; the other refers to homework related to science projects. Items asking about homework might include regular or both types.

Implicit and explicit time frame issues. The above example, interpreting "almost every day" as "almost every day we have science class," is an example of an explicit time frame, because the item is

explicitly linked to the phrase, "When you study science in school." However, the subsequent response options ("1 – 2 times a week" and "1 – 2 times a month") implicitly link the behavior to the school year. If science is taught three times a week and the focal behavior occurs in two of these classes, the alternatives "Almost every day" and "1 – 2 times a week" can have nearly identical meanings to the respondent.

There was a series of items asking students, "Have you ever done ...?" Although this item uses the word "ever," it is not clear whether the literal interpretation is intended or the contextually derived interpretation (eighth grade, since most of the items ask about eighth grade experiences) is the proper one. Quite a few students would respond affirmatively because of experiences in other grades.

Comprehension. Many of the terms and phrases employed in the items were not understood by all eighth graders. Some of the more problematic words and phrases were:

- simple machines
- levers
- pulleys
- content area
- integrated science
- portfolio
- oral science report
- investigations in science
- measurements and results from your hands-on activities or investigations
- design and carry out your own science investigation
- e.g.
- science software
- telecommunications
- teacher talk to the class about science
- science demonstration

Some of these items were also inconsistently interpreted by teachers. "Talking to the class about science" is an activity that teachers report they do every day. (The question seemed almost silly to some teachers, making them question their interpretation of it.) Teachers also had somewhat different ideas about what a science demonstration involved.

Formatting issues. Two formatting issues are associated with high discrepancy rates. The first deals with items in a list format and is called *loss of context.* The second is a problem inherent in the use of a *Check all that apply* instruction.

Loss of context. Many items are presented in a list format. For example, there is a series of items that begins with, "When you study science in school, how often does your teacher do each of the following?" This stem is followed by several items, including, "Use computers for science (e.g., science software, telecommunications)." Some people do not read the stem; others, as they go through the list, forget the stem. At least two students reported about their own use of computers, rather than their teacher's. Although their responses matched their teachers, due to coincidental agreement, this type of problem occurred frequently, in several different series of items.

Check all that apply items. An example of such an item is:

Have you ever done hands-on activities or projects in school with any of the following? Fill in all boxes that apply.

Magnifying glass or microscope (for looking at small things)? ☐
Thermometer or barometer (for making measurements)? ☐
Simple machines (for example, pulleys and levers)? ☐

If a student does not understand the question, they will often leave it blank. Accordingly, when these data are analyzed, one cannot be certain how a blank box should be interpreted. It can mean "No," "I don't understand the question," or "I don't know if I have done this."

Scale issues. Two rating scale problems were noted: *overlapping response categories* and *gaps between response categories* were noted. In the following scale, there are *overlapping response categories:*

About how often does a guest speaker come to speak in your science class?

3 or more times a year ☐
1 or 2 times a year ☐
Never or hardly ever ☐

If this happened once, either "Never or hardly ever" or "1 or 2 times a year" could be checked.

As noted in the general findings, *gaps between response categories* refers to the fact that behaviors performed with certain frequencies (such as three times a week) fall between two adjacent response categories ("once or twice a week" and "once or twice a month"). Respondents will develop their own idiosyncratic rules for categorizing such behaviors.

Eighth Grade Mathematics Students and Teachers

Student Item:

1. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Do mathematics problems from textbooks

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Do mathematics problems from textbooks

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	65% (13 out of 20 responses)
Number children reporting more frequently	5
Number children reporting less frequently	8

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week			3	5
Almost every day	2		6	4

Discussion

One source of discrepancy was the term "from." One teacher took textbook problems and prepared them on sheets and in other formats. He did not feel that his students would know the source of these problems. This probably contributed to many of the cases of student underreporting.

Another teacher reported that her students do problems from their textbooks almost every day. However, she felt that the students would not realize this since their "textbook" is actually a series of

small books. She thought they would consider a reference-like book they used as their textbook. So, she responded in terms of the frequency with which her students do problems from their reference-like textbook: 1 - 2 times per week. However, five (out of eight) of her students seemed to consider the series of small books as their textbook and reported "Almost every day."

The third teacher pointed out a problem with the phrase *"students in your class."* She commented that mathematics problems from textbooks are begun in school, but are typically finished at home. From the wording of the item *("How often do students in your class do each of the following,")* there is no guidance as to whether this means "your students" or whether it refers to what the students do when they are physically in the classroom. This teacher responded "every day." However, all of her students responded less frequently.

Additionally, one student had a question about the time period of interest. She asked, "Do they want to know about this week, this year, or what?" She tried to answer the question by averaging over the course of the year.

Recommendations

Respondents can generally provide more accurate behavioral frequency data for a recent, short, well-defined period of interest (i.e., "last week") than for an ambiguously defined time period. Serious consideration should be given to asking these items about the last week of classes. If not, the term "generally" can be used as a qualifier (i.e., ".. how often do you generally do each of the following ...")

If these items are intended to get at the frequency of classroom behaviors (and we are assuming that this is their intent), the wording of the stem should be changed to:

Teacher Questionnaire: How often do your students do each of the following when they are in your classroom?

Student Questionnaire: When you do mathematics in your classroom, how often do you do each of the following?

It seems unrealistic to expect students to know the source of problems that teachers provide on sheets or in other formats. They can probably respond more accurately to a simpler item:

Do mathematics problems from books

Student Item:

2. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Do mathematics problems on worksheets?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	60% (14 out of 20 responses)
Number children reporting more frequently	10
Number children reporting less frequently	4

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	2	2	2	2
1-2 times/ week		1		6
Almost every day			1	4

Discussion

One teacher assigns worksheets for homework. However, she reported that her students only do worksheets in school "1 - 2 times/month." Four of her students included homework, and reported a more frequent use of worksheets. Her students who reported "never or hardly ever" were responding to the current unit, for which few worksheets were employed. In other words, there is a time frame issue. That is, because the time frame is not specified, some students answered about the immediate past while the teacher used a semester-long time frame.

Students also seemed to have a more inclusive definition of worksheet than their teachers do. Many students considered any handout with problems to be a worksheet. Teachers more narrowly define this term.

Recommendations

The term worksheet has very different meanings to teachers and students. It does not appear to be an item that can be easily defined for students. Accordingly, it is a candidate for elimination.

The issues of restricting this activity to in-class activity and specifying a period of interest, as discussed in the previous item are also relevant here.

Student Item:

3. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Solve mathematics problems with a partner or in small groups?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	55% (11 out of 20 responses)
Number children reporting more frequently	0
Number children reporting less frequently	11

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week	3	3	1	
Almost every day	2	1	2	8

Discussion

Teachers included informal grouping and problem solving in their responses. At least five children in one class (for which the teacher reported this happening 1-2 times/week) underreported the frequency of this activity because they were not considering informal discussions.

In one class, seating was organized to encourage small group interaction in problem solving. In this class, one student who underreported the frequency of this behavior (in comparison with his teacher) explained that he and his classmates do not work together and that in the group setting they each solve their own problems. Other cases of student underreporting reflect the fact that some students responded to only formal activities.

Recommendations

We suggest a total restructuring of this item, to better assess the construct of interest:

In your classroom, how frequently do your students work in small groups or with a single partner?

Nearly all of the time	☐
Most of the time	☐
About half of the time	☐
Some of the time	☐
Never or almost never	☐

This item can be made into a series of items that asks about the proportion of time devoted to (a) whole class instruction, (b) large group instruction, and individual instruction, as well.

Student Item:

4. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Work with measuring instruments or geometric solids?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

T22. Work with objects like rulers?
T23. Work with counting blocks or geometric shapes?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	55% (11 out of 20 responses)
Number children reporting more frequently	4
Number children reporting less frequently	7

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	8	4		
1-2 times/ month				
1-2 times/ week				
Almost every day	2	2	3	1

NOTE: Teacher responses to items T22 and T23 were combined into a single teacher response.

Discussion

The phrase "work with objects like rulers" creates a logical problem in that it attempts to define a class of objects with only a single example. The salient feature(s) of "ruler" will determine how the item is interpreted. One teacher thought it was referring to things that are used to draw, measure, and/or produce numerical outcomes. She included protractors, compasses, and dice (since they produced numerical outcomes) as examples of objects like rulers. Another teacher interpreted this phrase as referring to devices used to make straight lines. The third interpreted it as referring to measuring devices, but also included compasses as an example.

The use of the term "geometric solids" was confusing to students. Most knew that it referred to three-dimensional objects. However, at least six of the 20 students did not know what it meant. One student thought a protractor was a geometric solid. This term, besides being incomprehensible to many, was also irrelevant for most. Although these students use geometric shapes frequently, they never (or almost never) use geometric solids. The term "measuring instruments" was usually, but not always, interpreted by students as including rulers. At least one student stated that she did NOT think of rulers when answering.

There are issues associated with rare events and whether something that has happened 2 - 3 times should be categorized as "Never or hardly ever" or "Once or twice a month." Such issues contributed to the discrepancies. Other discrepancies were associated with the unanchored time frame -- that is, some students were considering the most recent week while others were considering the entire semester.

Recommendations

The phrase "work with objects like rulers" in the teacher item should be changed *to "work with measuring instruments like rulers and protractors"* (if this is the intent of the item.)

The student item should be changed to "work with rulers, measuring instruments, and geometric shapes."

The issue of specifying a period of interest, as discussed previously, with a different set of categories should help improve the accuracy of reporting.

Student Item:

5. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Write a few sentences about how you solved a mathematics problem?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Write a few sentences about how to solve a mathematics problem?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	50% (9 out of 18 responses) (2 missing)
Number children reporting more frequently	3
Number children reporting less frequently	6

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	2		2	1
1-2 times/ month				
1-2 times/ week	2	2	3	
Almost every day	1		1	4

Discussion

One of the teachers reported that her students "never or hardly ever" wrote a few sentences about how to solve a mathematics problem. However, one of her students said "every day," because he does this on his own to help him remember how he did it. Another of her students included answers that had words in them.

At least three of the students lost context. That is, they forgot the stem ("When you do mathematics in school, how often ...?"). They interpreted it as asking them to "Write a few sentences about how to solve a mathematics problem." One student thought it was a trick question, since he couldn't possibly write a sentence in the small box provided!

Recommendations

For students, the item can be reworded to ask, "How often does your teacher make you write a few sentences that explain how you solve a mathematics problem?"

For items in a series, it is essential that context be provided and maintained. This is a general issue and also applicable to items on the Teacher's Questionnaire.

Student Item:

6. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Take mathematics tests?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	25% (5 out of 20 responses)
Number children reporting more frequently	5
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month		15	4	1
1-2 times/ week				
Almost every day				

Discussion

Teachers were asked if they included standardized tests in their estimates. They all responded negatively. They are responding to this item as asking about tests which they and/or their department develop and administer. Since the incidence of standardized tests is low, their exclusion does not appear to be a major issue, for teachers.

Students were more likely to include standardized tests. This created a discrepancy when one student responded with respect to the most recent week, during which standardized testing occurred on several days. The other four discrepancies were all associated with one class, for which students included weekly quizzes. (The teacher only reported the major tests.)

Recommendations

To avoid underreporting of quizzes, the item can be changed to ask about "tests and quizzes." Conversely, if it is important to distinguish between tests and quizzes, separate items can be asked about each.

Student Item:

7. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Talk to the class about your mathematics work?

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Talk to the class about their mathematics work?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	80% (16 out of 20 responses)
Number children reporting more frequently	7
Number children reporting less frequently	9

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	2	2	2	2
1-2 times/ week	5	2	2	3
Almost every day				

Discussion

Two of the three teachers lost context -- that is, they forgot that the item was asking about how often their students talked to the class about their mathematics work. They initially responded with respect to their own behavior. (The responses presented in the table reflect their best estimates of how frequently their students engaged in the desired behavior.)

Even when teachers understood that the item was referring to their students, there were still major differences in item interpretation. One teacher felt that this required the student to be in front of the class, engaging the other students in dialogue. She explained that students are at the board daily, solving problems. However, "they are not talking to the class -- they are demonstrating what they did."

Another teacher thought only of formal student presentations of their work. During these presentations, the students describe their response process to the class. There are only a few students who can do this, and therefore there are only a few students who are asked to do this, since the teacher does not like to force students to do things. So, her reported frequency was neither an average nor reflective of the typical student.

The third respondent included situations when students talked to individual students or small groups of students about their work.

Students' interpretations of these items were similarly diverse:

- "How often do you raise your hand to give the answer to the question when the teacher is looking for volunteers?" (at least 2 students said this or made similar comments)
- How often you go to the board to show how you solved a homework problem.
- Several believed that the item required you to stand in front of the class.
- Talking to your friends about your math grades. *(There is textual support for this interpretation.)*
- Informal conversations with your friends.

There is a general issue: Whether the teacher is responding to the performance of this behavior by ANY student or by the typical student. The item can be interpreted either way.

Recommendations

Even with adults, it is important that context be maintained in list-formatted items. Adding a little redundancy by changing the item to: *"Students talk to the class about their mathematics work"* should eliminate this problem.

The intent of this item needs to be specified to allow an effective item to be developed. If the intent is to get at formal presentations, an item asking about how often *"Students speak to the entire class about their mathematics work"* can be considered. However, it is not clear whether this wording will elicit situations where a student is called upon to answer a question. If the intent is to get at extended presentations, the following wording can be considered for teachers: *"Students provide a detailed and in-depth description to the entire class about how they solved a mathematics problem"*

Similar wordings can be developed for students.

A decision must be made about whether the item is referring to any student or the typical student, so that the stem can be appropriately modified.

Student Item:

8. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

   Do 10 or more practice problems in mathematics by yourself?

Teacher Validation Probe (not a survey item):

How often do your students do 10 or more practice problems in mathematics, by themselves, in class?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	38% (5 out of 13 responses) (7 missing)
Number children reporting more frequently	4
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	4	1	2	1
1-2 times/ month				
1-2 times/ week				
Almost every day	1			4

Discussion

Data for only 13 students are presented since the validation probe was not administered to one teacher.

The term "practice problems" was confusing. Interpretations included:

- "extra problems to practice what you're doing in class"
- work sheet problems
- practice for the SATs
- "how often you do mathematics problems on your own time just to get better at math"
- homework
- "problems we make up ourselves"
- homework and classwork combined
- "warm-up exercises before a test"
- "problems to practice what we went over in class"
- "problems in class where it is not a test"

At least one student lost context and reported "almost every day" because he was considering practice problems he does at home.

Recommendations

As previously noted, restoration of context (i.e., that this item is asking about classroom behaviors) is necessary.

The adjective "practice" confuses rather than enhances. Since another item asks about worksheets, "practice problems" seems to refer to another type of problem. But, we do not understand what type of problem is the focus of this item. If a clearer definition cannot be provided, the item should be deleted.

Student Item:

9. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Discuss solutions to mathematics problems with other students?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	60% (12 out of 20 responses)
Number children reporting more frequently	1
Number children reporting less frequently	11

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month				
1-2 times/ week	4		2	1
Almost every day	2	1	4	6

Discussion

This is another item for which the teacher could respond about the performance of this behavior by ANY student or by the typical student. The item wording provides textual support for both of these interpretations. The fact that 11 out of the 12 discrepancies were associated with student underreporting is suggestive of the fact that teachers were responding about ANY student.

Teachers typically included both formal and informal discussions. However, many students only considered formal discussions. At least two students thought it was asking about formal discussions of solutions to the problems such as the POW (problem of the week.) Other students felt this item was really the same as item 3 ("Solve mathematics problems with a partner or in small groups") and/or item 7 ("Talk to the class about your mathematics work"). Several other students thought it was asking about how often they help other students with their work.

Recommendations

A decision must be made about whether the item is referring to any student or the typical student, so that the stem can be appropriately modified.

If this item is intended to capture informal discussions in class, this point must be made explicit to the students. Wording such as: *"Talk with other students about how you solved a math problem"* might be able to effectively convey such a concept.

Student Item:

10. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Use a computer?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	45% (9 out of 20 responses)
Number children reporting more frequently	5
Number children reporting less frequently	4

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	10	2		3
1-2 times/ month				
1-2 times/ week				
Almost every day	4			1

Discussion

One teacher interpreted this as asking about any use of a computer in class. For this class, it was rare, since computers were not used until about two weeks prior to our discussions.

However, one student responded about the last 30 days, in which the computer was used fairly often.

Other students responded about computer usage at home since they lost context. In other words, in response to the stimulus, "Use a computer," they responded to their use of a computer anywhere and for any purpose.

Another teacher interpreted the item as asking about any use of a computer, by any student, at home, in other classes, and in this class. There is textual support for this interpretation, especially since there is no restriction to math activities.

Recommendations

As mentioned previously, the time period of interest needs to be made more explicit in the item stem.

As noted earlier, it is important that context be maintained in list-formatted items. Adding a little redundancy by changing the item to: *"Use a computer in mathematics class"* should eliminate this problem.

A decision must be made about whether the item is referring to any student or the typical student, so that the stem can be appropriately modified.

Student Item:

11. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Use a calculator?

Teacher Validation Probe (not a survey item):

About how often do your students use a calculator to do their math class work?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	20% (4 out of 20 responses)
Number children reporting more frequently	4
Number children reporting less frequently	0

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	5		1	1
1-2 times/ month				
1-2 times/ week			3	2
Almost every day				8

Discussion

One teacher prohibited the use of calculators in his classroom and responded "Never or hardly ever." However, one of his students reported about homework and home usage of the calculator (because she lost context) and another admitted to using the calculator in class in spite of the teacher's prohibition.

In another class, the teacher permitted classroom usage. The typical student used calculators 1 - 2 times/week. However, a few (two students) used it more frequently.

Recommendations

As mentioned previously, it is important that context be maintained in list-formatted items. Adding a little redundancy by changing the item to: *"Use a calculator in mathematics class"* should eliminate this problem.

A decision must be made about whether the item is referring to any student or the typical student, so that the stem can be appropriately modified.

Student Item:

12. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Write reports or do mathematics projects?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	20% (4 out of 20 responses)
Number children reporting more frequently	3
Number children reporting less frequently	1

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	4		1	
1-2 times/ month	1	12	2	
1-2 times/ week				
Almost every day				

Discussion

Two students lost context and responded to how often they write reports in school. They included reports for subjects other than mathematics, leading to overreporting. Other errors were errors of estimation. For instance, the student who replied "Never or hardly ever" was able to recall three instances of mathematics projects. Her teacher categorized this as 1 - 2 times/month, as did most of the students in her class. (There may have been more than three such projects.)

Recommendations

To maintain context, the item can be changed to: *"Write reports for math class or do math projects."* This should eliminate the problem.

Student Item:

13. When you do mathematics in school, how often do you do each of the following? Fill in only one box on each line.

Teacher Item:

How often do the students in your class do each of the following? Fill in one box on each line.

Both:

Work and discuss mathematics problems that reflect real-life situations?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	65% (13 out of 20 responses)
Number children reporting more frequently	5
Number children reporting less frequently	8

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever				
1-2 times/ month	3	4	5	
1-2 times/ week				
Almost every day		3	2	3

Discussion

The phrase "reflect real-life situations" was interpreted by teachers as meaning:

- Events taken from the news. None of her students interpreted the phrase in this way. Any agreement with her response of 1 - 2 times/month was coincidental.
- Problems based on something that students are interested in, such as roller skating or walking rates
- Situations that would reflect what students consider to be everyday applications of algebra

Some students' interpretation of the phrase "real-life situations" was more inclusive than their teacher's. Other students recalled specific real-life problems (the Problem of the Week) and responded

with respect to the frequency of that specific problem. On further probing, they could recall other problems but they simply responded to the most salient type of real-life problem.

At least three students did not know what was meant by "real-life situations." One student thought that it was career related.

Recommendations

The phrase "real-life situations" can be interpreted as either referring to things that occur in the real world or situations that are relevant to the life of an eighth grade. If the interest is in the latter, one can ask teachers about *"... problems that deal with situations that are of interest and relevance to your students."* This wording would need to be changed if it were to be asked of eighth graders.

Student Item:

14. Do either you or your teacher have a portfolio with your mathematics work in it?

Teacher Validation Probe (not a survey item):

Do you or your students have portfolios for their math work?

Both:

Yes ☐
No ☐

Discrepancy rate 30% (6 out of 20 responses)

Teacher Responses	Student responses	
	No	Yes
No	5	2
Yes	4	9

Discussion

Some discrepancies arose when students kept their work in a file folder of their own. Since "portfolio" is not an eighth grade word, at least two students interpreted portfolio to mean any folder, causing a discrepancy. Another student thought portfolio meant "a binder with your work in it." So, she responded negatively while her teacher responded positively.

In other classes, there are school-wide portfolios for which math work can be contributed. In this class, the teacher responded positively but some students responded negatively since neither they nor their teacher has such a portfolio. (The school does.)

Recommendations

To eliminate confusion about whether the student, the teacher, or the school keeps a portfolio, the item should focus on one. This can be done by asking, *"Does your teacher have a portfolio or folder for every student in your class, in which he or she keeps their best work?"* It would be simpler to ask the teacher this directly.

Student Item:

15. Do you have a calculator that you can use to do mathematics schoolwork?

Teacher Validation Probe (not a survey item):

Do all of your students have calculators?

Both:

Yes ☐
No ☐

Discrepancy rate 45% (9 out of 20 responses)

Teacher Responses	Student responses	
	No	Yes
No	3	9
Yes		8

Discussion

In spite of the discrepancy rate, this item is functioning as intended. A teacher's response that all of his or her students do not have calculators means that some of their students may have a calculator. In fact, such is clearly the case.

Recommendations

Leave as is.

Student Item:

16. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

    Classwork?

Teacher Validation Probe (not a survey item):

About how often do your students use a calculator to do their math class work?

Both:

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Discrepancy rate	35% (7 out of 20 responses)
Number children reporting more frequently	4
Number children reporting less frequently	3

Teacher Responses	Student Responses			
	Never or hardly ever	1-2 times/ month	1-2 times/ week	Almost every day
Never or hardly ever	6			1
1-2 times/ month				
1-2 times/ week	1	1		3
Almost every day			1	7

Discussion

Due to within class variation in calculator usage, students' answers should not be expected to exactly match their teacher's responses. However, the item had two problems:

1) Two students lost the context of the question. They forgot that the question was asking about their use of calculators for math and answered with respect to how often they do math classwork.

2) One student included homework in his response. He felt that classwork and homework were the same thing.

Recommendations

To deal with the loss of context and the misinterpretation of classwork, we propose a focusing of the item:

How often do you use a calculator in your math class?

Student Item:

17. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

Homework?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Teacher Validation Probe (not a survey item):

Do your students use calculators for their math homework?

Yes ☐
No ☐

Discrepancy rate 25% (5 out of 20 responses)

Teacher Responses	Student Responses			
	Never or hardly ever	Yes		
		1-2 times/ month	1-2 times/ week	Almost every day
No	2	5		
Yes		13		

Discussion

Two students lost the context of the question. They forgot that the question was asking about their use of calculators for math and answered with respect to how often they do math homework.

Recommendations

Again, to deal with the loss of context, we suggest a context-reinstating phrase be added:

How often do you use a calculator for your math homework?

Student Item:

18. For mathematics class, how often do you use a calculator for each of the following activities? Fill in one box on each line.

Tests or quizzes?

Almost every day ☐
Once or twice a week ☐
Once or twice a month ☐
Never or hardly ever ☐

Teacher Validation Probes (not survey items):

Are students ever allowed to use calculators for math tests? What are your rules about the use of calculators on math tests? Can they use them for all math tests?

Yes ☐
No ☐

Discrepancy rate 15% (3 out of 20 responses)

Teacher Responses	Student Responses			
	Never or hardly ever	Yes		
		1-2 times/ month	1-2 times/ week	Almost every day
No	10	2		
Yes	1	7		

Discussion

Two students lost the context of the question. They forgot that the question was asking about their use of calculators for math tests and answered with respect to how often they take math tests or quizzes.

One student indicated that it depends on the unit, and since in his mind the use of calculators for tests is most often not allowed, he said "never or hardly ever." However, the teacher's response was "yes."

Recommendations

Similar to the two other questions in this series, the item should be reworded to avoid the loss of context:

How often do you use a calculator for math tests or quizzes?

Student Item:

19. What kind of mathematics class are you taking this year?

I am not taking mathematics this year ☐
Eighth-grade mathematics ☐
Prealgebra ☐
Algebra ☐
Integrated or sequential mathematics ☐
Applied mathematics (technical preparation) ☐
Other mathematics class ☐

Teacher Validation Probe (not a survey item):

What kind of mathematics class is this?

Eighth-grade mathematics ☐
Prealgebra ☐
Algebra ☐
Integrated or sequential mathematics ☐
Applied mathematics (technical preparation) ☐
Other mathematics class ☐

Discrepancy rate 23% (4 out of 13 responses; 7 missing)

Teacher Responses	Student Responses							
	I am not taking math this year	8th grade math	Pre-algebra	Algebra	Integrated math	Applied math	Other math class	Checked two boxes or more
I am not taking math this year								
8th grade math		5						3
Pre-algebra								
Algebra			1	4				
Integrated math								
Applied math								
Other math class								

Discussion

This question was very hard for eighth graders to answer. They either did not understand parts of the question, did not know how to complete it, or did not know the answer, as described below.

At least 15 students (75%) did not know what "integrated or sequential" math meant. Here are a few definitions:

- Difficult stuff mixed together
- Advanced or high school math
- Different combinations of math or grade levels

In addition, at least 13 students did not know the meaning of "applied math (technical preparation)." One student defined it as "preparation for technology," and another as "a course you apply for, to get to college." Finally, one student did not know what "algebra" meant and another student was not sure what was meant by "other mathematics class."

One teacher was not asked the validation probe, which is the reason that seven student responses are missing. Two of these seven students checked two boxes. So, a total of five students (25%) checked two boxes or more. Four of the five students checked both "eight-grade mathematics" and "pre-algebra." One student felt that these two responses were the same thing. Another student indicated that the question does not specify to only check one, which is a valid point. One student explained that he does prealgebra at home, which was the reason for his checking the two boxes. Since the question does not specify "in school," this appears to be a legitimate interpretation. Finally, one student checked three boxes ("eight-grade mathematics," "prealgebra," and "integrated or sequential mathematics"). He thought integrated and sequential math should be separated into two categories.

Three students either did not know the name of their math class or guessed. They all responded "eighth-grade mathematics."

Recommendations

Asking eighth graders what type of math class they are taking appears to be too hard for them to answer. It would be better to ask their teachers. If the question is administered to eighth grade students, it should be revised: the response options should be simplified and it should be specified that only one option can be checked. Also, none of the students responded "I am not taking mathematics this year," so this option might not be needed for eighth graders.

What kind of mathematics class are you taking this year? Check only one box.

Eighth-grade mathematics ☐
Prealgebra ☐
Algebra ☐
Other mathematics class ☐

Student Item:

20. About how much time do you usually spend each day on mathematics homework?

I am not taking mathematics this year ☐
None ☐
15 minutes ☐
30 minutes ☐
45 minutes ☐
1 hour ☐
More than 1 hour ☐

Teacher Item:

Approximately how much mathematics homework do you assign to students in this class each day?

None ☐
15 minutes ☐
30 minutes ☐
45 minutes ☐
One hour ☐
More than one hour ☐

Discrepancy rate	65% (13 out of 20 responses)
Number children reporting more frequently	4
Number children reporting less frequently	7

Teacher Responses	Student Responses							
	I am not taking math. this year	None	15 minutes	30 minutes	45 minutes	1 hour	More than 1 hour	Two boxes checked
I am not taking math. this year								
None								
15 minutes								
30 minutes			2	4				2
45 minutes			2	3	3	3	1	
1 hour								
More than 1 hour								

Discussion

Most of the discrepancies in this question were due to the fact that time spent on math homework varies from student to student. However, there were problems associated with the item.

- Two students checked two boxes. For example, one student checked "15 minutes" and "30 minutes" because she usually spends about 15-30 minutes per day on math homework.
- One teacher included regular homework and "long-term homework" (project work) in her response. However, two of her students did not include project work in their answers, which led to discrepancies.
- One teacher included work assigned that students might complete in class. In other words, she included homework students might complete either in school or at home.
- One student lost context, answering with respect to how much time she spends on homework each night, as opposed to just math homework.

Recommendations

It should be specified that only one box should be checked. Also, none of the students responded "I am not taking mathematics this year," so this option might not be needed for eighth graders.

About how much time do you spend on math homework each day? Check only one box.

None	☐
15 minutes	☐
30 minutes	☐
45 minutes	☐
1 hour	☐
More than one hour	☐

Student Item Only:

21. How much do you agree with each of the following statements? Fill in one box on each line.

I am good at mathematics.

Strongly agree ☐
Agree ☐
Undecided ☐
Disagree ☐
Strongly disagree ☐

Student Responses	Frequency
Strongly agree	2
Agree	11
Undecided	6
Disagree	1
Strongly disagree	0

Discussion

One student indicated that he did not know what it meant to be good at mathematics and responded "undecided." Another student said "agree," though he thought it was a strange question because he was not sure if it meant good at math or good in math class. He thought those were different things. Finally, one student reported that she was "undecided" and explained: "It all depends... Math is such a broad statement. There is calculus and then there is 2+2."

Recommendations

None.

Student Item Only:

22. How much do you agree with each of the following statements? Fill in one box on each line.

There is only one correct way to solve a mathematics problem.

Strongly agree ☐
Agree ☐
Undecided ☐
Disagree ☐
Strongly disagree ☐

Student Responses	Frequency
Strongly agree	
Agree	
Undecided	2
Disagree	11
Strongly disagree	7

Discussion

Two students chose "undecided" because they thought it was true that for some math problems there is only one correct way to solve them, whereas for other math problems this is not true. Thus, they had trouble thinking abstractly. One of these students would have responded positively to the statement that "Some mathematics problems can be solved in many different ways." Another student was unclear on what was being asked.

Recommendations

None.

Student Item Only:

23. How much do you agree with each of the following statements? Fill in one box on each line.

Describing mathematical concepts and ideas is as important as doing mathematical operations such as addition and multiplication in solving problems.

Strongly agree ☐
Agree ☐
Undecided ☐
Disagree ☐
Strongly disagree ☐

Student Responses	Frequency
Strongly agree	2
Agree	5
Undecided	10
Disagree	2
Strongly disagree	0
Skipped	1

Discussion

This item was very hard for eighth graders to understand. In fact, seven of the students who responded "undecided" chose this option because they did not understand the meaning of the question. Another student was completely confused by the question and skipped it altogether. Even students who were able to provide a response other than "undecided" made comments like:

- This is kind of hard to explain
- I have trouble understanding it
- It is too long and confusing
- It is sort of a mouthful

The phrase "describing mathematical concepts" seemed to create particular difficulties for the students. Below are some of their definitions of this term:

- Ways of doing concepts
- Adding and multiplying
- What you did and how you solved it
- An equation you wanted to solve

Similar to the previous question, two of the students chose "undecided" because they thought describing math concepts and doing math operations are both important. Thus, again they had trouble thinking abstractly.

There is a further logical problem with this item. If a student feels that "describing mathematical concepts and ideas" is much more or much less important than "doing mathematical operations," (s)he will answer "disagree." Thus, disagreement does not inform about whether the student feels concepts and ideas are more or less important than operations – only that they are not equally important.

Recommendations

This question is too abstract, long, and confusing for most eighth graders to understand. It should be drastically simplified or deleted. Consider:

It is more important to learn how to multiply and divide than to learn the theory of math.

Teacher Item Only:

T1. During the last year, how much time in total have you spent in professional development workshops or seminars in mathematics or mathematics education? Include attendance at professional meetings and conferences, district-sponsored workshops, and external workshops.

None ☐
Less than 6 hours ☐
6-15 hours ☐
16-35 hours ☐
More than 35 hours ☐

Responses	Frequency
None	
Less than 6 hours	
6-15 hours	
16-35 hours	1
More than 35 hours	2

Discussion

The phrase during the last year was interpreted by two teachers as referring to the school year and by one as referring to the last 12 months.

There is a general tendency for teachers to want to report engaging in positive behaviors, such as attending professional development workshops. One of the respondents, a first-year teacher, considered Math Department meetings to be professional development. Although such experiences would not be considered professional development by most teachers, the respondent felt that he learned quite a lot about mathematics teaching in these meetings.

Recommendations

Depending on the intent of the item, "During the last year" should be changed to either "Since the end of the last school year" or "During the last 12 months."

To reduce the likelihood of teachers reporting about Math Department meetings, the item could be decomposed and separate questions asked about (a) professional meetings and conferences, (b) district-sponsored workshops, and (c) external workshops. However, the increased burden associated with three items rather than only one might preclude such an approach.

Teacher Items Only:

T2-7. How useful were any courses you took or any professional development you received in the last five years for each of the following areas? If you did not take any courses or receive professional development in the area, please check the first box ("No courses or professional development"). Please check one box per line.

	No courses or professional development	Not Useful	Somewhat Useful	Moderately Useful	Very Useful
2. Cooperative group instruction	☐	☐	☐	☐	☐
3. Interdisciplinary instruction	☐	☐	☐	☐	☐
4. Teaching higher-order thinking skills	☐	☐	☐	☐	☐
5. Teaching students from different cultural backgrounds	☐	☐	☐	☐	☐
6. Classroom management and organization	☐	☐	☐	☐	☐
7. Other professional issues	☐	☐	☐	☐	☐

Responses

	No courses or professional development	Not Useful	Somewhat Useful	Moderately Useful	Very Useful
2. Cooperative group instruction	-	-	2	-	1
3. Interdisciplinary instruction	1	-	-	2	-
4. Teaching higher-order thinking skills	-	-	-	1	2
5. Teaching students from different cultural backgrounds	-	-	1	-	2
6. Classroom management and organization	1	-	1	1	-
7. Other professional issues	-	-	-	2	1

Discussion

General comments. Respondents had little trouble using the rating scale and recognized that the rating scale ordered items in terms of usefulness. Usefulness was correctly interpreted in the context of having an impact on pedagogical practices.

There were several issues that emerged that are important in analysis of findings:

- One of the teachers was a first-year teacher. For all "new" teachers (i.e., those with fewer than four or fewer years' experience), courses taken will include undergraduate courses. For first year teachers, nearly all of the responses will be about their undergraduate courses.
- There is a clear tendency to overreport engagement in these activities. As one respondent pointed out, teachers want people to think they are involved. So, teachers would look for reasons to indicate that they had received each type of training. Receiving any professional development is a loosely defined construct. It includes things that are parts of courses or parts of other training received. For example, teaching higher order thinking skills was part of training that was received in gifted and talented education training. So, the teacher responded affirmatively to item 4, even though this training was not very extensive.
- Related to a desire to report engagement in these activities is "telescoping" -- that is, reporting experiences that occurred outside of the period of interest. One teacher reported taking a course but, on further probing, admitted that it may well have occurred outside of the five-year period of interest.
- Evaluating training with respect to its utility is potentially problematic. That is, excellent training might not be reported as being useful if the teacher is already quite proficient so that the training would have little or no impact on teaching practices.

It should be noted that these items were modified from the way they were asked in the 1995-96 Teacher Questionnaire. The 1995-96 questionnaire merely asked whether the teacher had taken courses or participated in professional development activities in each of the listed areas. This shift in focus still provides information about whether or not a course was taken or professional development was received in an area, and amplifies the value of this information with an assessment of its perceived value.

Specific comments. Item 3 asks about interdisciplinary instruction. One respondent felt very strongly that this was not relevant for eighth grade mathematics -- especially for algebra. This might be a valid point. However, this teacher also was very proud of her "voting project." For this project, students use actual election data to determine the percent of people who actually vote. Clearly, such a project can be labeled interdisciplinary instruction.

Item 5 (Teaching students from different cultural backgrounds) was responded to affirmatively by a teacher who had taken Spanish language courses. Although this may not be what was intended by the item writers, it is clearly an appropriate example of a course that was taken that was relevant to "teaching students from different cultural backgrounds." In fact, two of the three teachers considered foreign language courses to be relevant and appropriate.

Item 6 (Classroom management and organization) was interpreted by one participant to include Internet training. She defined classroom organization as "the way groups are organized to learn things." Since some groups were organized to learn things through the Internet, she felt this was appropriate. This is an example of teachers interpreting terms as inclusively as possible.

Item 7 (Other professional issues) was a difficult item to answer. One teacher immediately commented that she did not know what this meant. With probing, she was able to come up with "Test Development" and responded to this. Another teacher thought of teaching differentially abled students.

The third teacher answered with respect to a planning grant for professional development that supported her partially for a year. Given the diversity of areas responded to, this is a difficult item to interpret.

Recommendations

The addition of a usefulness scale to these items was an attempt to assess the quality of the training received. It appears that respondents can provide such information, but this information is difficult to interpret.

Certain of the items in the list of areas are problematic. "Teaching students from different cultural backgrounds" is often interpreted to include foreign language courses. It is not clear that this is what is desired -- although knowledge of a foreign language can be invaluable for this type of instruction. If this item is intended to get at pedagogical techniques, the phrase *"excluding foreign language courses"* must be added. Alternatively, if the item is intended to include foreign language courses, it may be working. To be sure of this, one should include *"Foreign language classes"* as an explicit listed item. The use of this option, preceding "Teaching students from different cultural backgrounds" should obviate the need for an *"excluding foreign language courses"* instruction.

"Other professional issues" is another problematic item. Given the diversity of interpretation, it should either be eliminated or a *"(SPECIFY)"* instruction should be added to aid interpretation.

Teacher Item Only:

T8-9. What level of exposure, if any, have you had to each of the following topics or areas? Fill in all boxes that apply on each line and at least one box on each line.

	One or More College or University Courses	Part of a College or University Course	Professional Development Workshops or Seminars	Little or No Exposure
8. Methods of teaching elementary mathematics	☐	☐	☐	☐
9. College algebra	☐	☐	☐	☐

Responses

	One or More College or University Courses	Part of a College or University Course	Professional Development Workshops or Seminars	Little or No Exposure
8. Methods of teaching elementary mathematics	1	-	1	-
NOTE: One respondent checked the first three boxes.				
9. College algebra	2	-	-	1

Discussion

One of the teachers, who almost certainly had some exposure in school to elementary mathematics teaching methods, only checked "Professional Development Workshops or Seminars." She started to check the first box and changed her mind. It seems that "top-down processing" came into play, leading her to choose only one box per line[1]. Unfortunately, our questionnaire did not use bold font to emphasize this point (as was done in the 1995-96 NAEP questionnaire). This formatting would, hopefully, be sufficient to ameliorate the problem.

One teacher commented that the option "Professional Development Workshops or Seminars" did not make sense for "College algebra."

Recommendations

The "College algebra" option should be removed from this grid and changed into an item that asks how many college algebra courses the respondent has taken.

[1] Top-down processing refers to the respondent's adoption of a questionnaire response production heuristic (e.g., "Check only one box per line") and its application for all subsequent items.

Teacher Item Only:

T10-14. Have you ever studied any of the following, either in college or university courses or in professional development workshops or seminars? Fill in one box on each line.

	Yes	No
10. Use of manipulatives (e.g., counting blocks or geometric shapes) in mathematics instruction	☐	☐
11. Use of calculators in mathematics instruction	☐	☐
12. Understanding students' thinking about mathematics	☐	☐
13. Gender issues in the teaching of mathematics	☐	☐
14. Teaching students from different cultural backgrounds	☐	☐

Responses

	Yes	No
10. Use of manipulatives (e.g., counting blocks or geometric shapes) in mathematics instruction	3	-
11. Use of calculators in mathematics instruction3	-	
12. Understanding students' thinking about mathematics	3	-
13. Gender issues in the teaching of mathematics2	1	
14. Teaching students from different cultural backgrounds	3	-

Discussion

All of these items were answered affirmatively by the three respondents, with the exception of "Gender issues in the teaching of mathematics." One respondent indicated that she never attended a workshop or seminar totally devoted to this issue, and responded negatively. This is somewhat unusual, given the fact that teachers generally are over-inclusive in their reporting of their training experiences. The negative response may reflect a desire by the respondent to introduce some variance in her responses.

As an example of being over-inclusive, another respondent answered affirmatively to having studied "Gender issues in the teaching of mathematics" because of its peripheral inclusion in some course, workshop, or seminar that she attended.

Some of the courses, workshops, and seminars were in the distant past. A teacher included professional development and courses from 1970 and 1985. However, "ever" means "ever" and the teacher's response reflects an appropriate interpretation of the question.

Finally, one participant validly commented that Question 14 (asking if the teacher had ever studied "Teaching students from different cultural backgrounds") sounded like Question 5 (asking about the usefulness of courses on "Teaching students from different cultural backgrounds").

Recommendations

Teachers tended to be over-inclusive in their reporting of their training experiences, presenting themselves as positively as possible. All of the items were answered affirmatively, with the exception of one teacher's response to one of the five items. Therefore, the items may not have much discriminating power. One might consider limiting the time frame to the past few years, or increasing the specificity of the topics.

Teacher Item Only:

T15. How many computers are there for student use in your classroom?

- ☐ None available
- ☐ One within the classroom
- ☐ Two or three within the classroom
- ☐ Four or more within the classroom

Responses	Frequency
None available	1
One within the classroom	2
Two or three within the classroom	
Four or more within the classroom	

Discussion

The teachers appeared to have no trouble responding to this item. Responses agreed with the interviewers' visual inspection of the classroom.

Recommendations

None.

Teacher Item Only:

T16. How difficult is it for your mathematics students to access the computers in your school's computer laboratory?

☐ There is no computer laboratory at my school.
☐ It is easy for students to gain access to the computers in the computer laboratory.
☐ It is difficult for students to gain access to the computers in the computer laboratory.

Responses	Frequency
There is no computer laboratory at my school.	
It is easy for students to gain access to the computers in the computer laboratory.	3
It is difficult for students to gain access to the computers in the computer laboratory.	

Discussion

This is a new item. The respondents described access issues (consent forms are required by the district for students to be allowed to use the Internet). The original item, which was part of the number of computers item, provided options saying "Available in a computer laboratory (but difficult/and easy) to access and schedule."

One respondent asked, "Does this mean my students? Does it mean during my class time or at other times?" She decided it meant at any time. Another respondent raised an interesting point. While it is easy for individual students to gain access to the computer lab, it is very hard to sign up for a three-day block of time to bring her entire class there.

Recommendations

This item could be more sharply focused, asking about the ease with which a student can use computers in the computer laboratory whenever the student wants to do so.

Teacher Item Only:

T17. How do you use computers for instruction in mathematics? Fill in all boxes that apply.

- ☐ Playing mathematics/learning games to teach basic skills
- ☐ Playing mathematics/learning games to teach more advanced principles
- ☐ Providing access to computers as a reward for student performance
- ☐ Simulations and modeling
- ☐ Data analysis and other applications
- ☐ Word processing
- ☐ I do not use computers for mathematics instruction

Responses	Frequency
Playing mathematics/learning games to teach basic skills	
Playing mathematics/learning games to teach more advanced principles	1
Providing access to computers as a reward for student performance	1
Simulations and modeling	1
Data analysis and other applications	2
Word processing	
I do not use computers for mathematics instruction	1

Discussion

One teacher felt that the graphing calculators that her students used were computers, so she responded affirmatively to "Simulations and modeling." "Simulations and modeling" were a source of confusion for another respondent. She thought of programs that mimic flying or driving (i.e., Flight Simulator). This respondent also checked off "Data analysis and other applications," since she had used software for graphing purposes. However, "Data analysis and other applications" evoked a comment from another teacher. He indicated that this was not really applicable for his class. Finally, a respondent asked, "How do you use word processing for instruction in mathematics?" This is a valid question, pointing out a flaw with the option.

Recommendations

The term "Simulation and modeling" was not understood by all respondents. This term could be clarified by providing examples.

Although the teachers appeared to consider each option, the absence of an "x" can indicate that the respondent did not know the answer, did not understand the option, or did not use computers in this way. It is therefore preferable to format this type of item as a series of "yes/no" questions rather than as a "check all that apply" item.

Teacher Item Only:

T31. Do you permit students in this class unrestricted use of calculators?

☐ Yes
☐ No

Responses	Frequency
Yes	1
No	2

Discussion

One teacher answered "Yes," indicating that students are allowed to use calculators at any time. However, there are restrictions, for behavioral reasons, since some students were playing too many games with their calculators. The teacher recognized the implicit meaning of the question.

Recommendations

None.

Teacher Item Only:

T32. Do you permit students in this class to use calculators for tests?

☐ Yes
☐ No

Responses	Frequency
Yes	2
No	1

Discussion

One of the teachers who answered "Yes," indicated that there was one exception: there was one question on one test for which students were not allowed to use a calculator. The other teacher who answered affirmatively wrote on the survey: "Tests done @ home!" to explain why she permits this. She can not prohibit it, so she allows it.

Recommendations

Some teachers include tests done at home in their responses. Consider specifying "in-class tests" if this is the intent of the item:

Do you permit students in this class to use calculators for your in-class tests?

Teacher Item Only:

T33-35. How well prepared do you feel to teach each of the following in this class? Fill in one box on each line.

	Very Well Prepared	Moderately Well Prepared	Not Very Well Prepared	Not at All Prepared
33. Mathematical concepts	☐	☐	☐	☐
34. Mathematical procedures	☐	☐	☐	☐
35. Computers	☐	☐	☐	☐

Responses

	Very Well Prepared	Moderately Well Prepared	Not Very Well Prepared	Not at All Prepared
33. Mathematical concepts	3	-	-	-
34. Mathematical procedures	3	-	-	-
35. Computers	-	3	-	-

Discussion

One respondent defined "very well prepared," as someone who can explain anything; "moderately well prepared," as someone who needs some help; "not very well prepared," as someone who needs more help in teaching; and "not at all prepared," as someone with no knowledge or experience. Another respondent defined "very well prepared" as "thought through and practiced"; "moderately well prepared," as a teacher who has done some of the above things, but not all; "not very well prepared," as someone who spent about five minutes of preparation time for the class; and "not very well prepared" elicited the response, "I don't know what that means." This response option was so far removed from her experiential base as to be meaningless.

One teacher felt that there was not much difference between Question 33 (Mathematical concepts) and Question 34 (Mathematical procedures). Nonetheless, she was able to define them. Concepts were defined as "overarching, big ideas." Procedures were smaller concerns. For example, "data analysis" was a concept. Building histograms and making stem-and-leaf plots were procedures.

In answering Question 35 (Computers), one teacher responded to how well prepared she felt to use graphing calculators, since she considered them to be a type of computer.

Recommendations

Consider deleting "not at all prepared." One teacher could not envision this phrase being applicable to herself. Furthermore, none of the teachers provided either this option or the proximal "not very well prepared" option as a response.

There is also a technical problem with "not very well prepared" as a response option, which occurs when its complement, "very well prepared" also appears as a response option in the same item. Literally, any response option that is not "very well prepared" (e.g., "moderately well prepared" and "not at all prepared") can be considered to be "not very well prepared." That is, "very well prepared" and "not very well prepared" form a dichotomy, encompassing all responses. If this option is retained, it should be reworded to "not well prepared."

Discussion of Eighth Grade Mathematics Findings

Discrepancy rates. Discrepancy rates for selected items are presented in table 9 (below). As with other subjects and other grade levels, there were high discrepancy rates between student and teacher report, even for items for which within-class variation would be expected to be low. Reasons for these and other discrepancies are discussed below.

Table 9. Discrepancy Rate for Selected Eighth Grade Mathematics Items

When you do mathematics in school, how often do you do each of the following:	**(n=20)**
Do mathematics problems from textbooks	65%
Do mathematics problems on worksheets	60%
Solve mathematics problems with a partner or in small groups	55%
Work with measuring instruments or geometric solids	55%
Write a few sentences about how you solved a mathematics problem	50%
Take mathematics tests	25%
Talk to the class about your mathematics work	80%
Do 10 or more practice problems by yourself	38%
Discuss solutions to mathematics problems with other students	60%
Use a computer	45%
Use a calculator	20%
Write reports or do mathematics projects	20%
Work and discuss mathematics problems that reflect real-life situations	65%
Do either you or your teacher have a portfolio with your mathematics work in it?	30%
What kind of mathematics class are you taking this year?	23%

NOTE: The number of students (n) is the modal number of respondents to each item.

Comprehension. Many of the terms and phrases employed in the items were not understood by all eighth graders. Some of the more problematic words and phrases were:

- geometric solids
- practice problems
- problems that reflect real-life situations
- portfolio
- integrated or sequential mathematics
- applied mathematics (technical preparation)

Teachers would interpret tests in a slightly different way from their students. In responding to items about tests, teachers would not think about (and therefore would exclude) externally mandated tests. Students considered these externally mandated tests to be mathematics tests.

Homework. Mathematics classwork includes assignments that are begun in school. Some students complete these assignments during class. Those who don't complete the assignments in class have to finish them as homework. The assignments, as well as homework intended to be completed entirely outside of the classroom, might be subsequently discussed in class. Accordingly, items dealing with classwork sometimes would include homework behaviors.

Loss of context. Many items are presented in a list format. For example, there is a series of items that begins:

When you do mathematics in school, how often do you do each of the following?

- Write a few sentences about how to solve a mathematics problem
- Use a computer
- Write reports or do mathematics projects

Students would lose context and answer about their overall computer usage in school and their overall frequency of report writing. One student was particularly confused by "Write a few sentences about how to solve a mathematics problem," and thought she was being asked to write a few sentences about how to solve a math problem!

Similarly, there was loss of context for the question:

For mathematics class, how often do you use a calculator for each of the following activities?

- Classwork
- Homework
- Tests or quizzes

At least two students lost the calculator context and responded about the frequency of classwork, homework, and tests or quizzes.

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97–07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97–09	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
97–10	Report of Cognitive Research on the Public and Private School Teacher Questionnaires for the Schools and Staffing Survey 1993–94 School Year	Dan Kasprzyk
97–11	International Comparisons of Inservice Professional Development	Dan Kasprzyk
97–12	Measuring School Reform: Recommendations for Future SASS Data Collection	Mary Rollefson
97–14	Optimal Choice of Periodicities for the Schools and Staffing Survey: Modeling and Analysis	Steven Kaufman
97–18	Improving the Mail Return Rates of SASS Surveys: A Review of the Literature	Steven Kaufman
97–22	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman
97–23	Further Cognitive Research on the Schools and Staffing Survey (SASS) Teacher Listing Form	Dan Kasprzyk
97–41	Selected Papers on the Schools and Staffing Survey: Papers Presented at the 1997 Meeting of the American Statistical Association	Steve Kaufman
97–42	Improving the Measurement of Staffing Resources at the School Level: The Development of Recommendations for NCES for the Schools and Staffing Survey (SASS)	Mary Rollefson
97–44	Development of a SASS 1993–94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98–01	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
98–02	Response Variance in the 1993–94 Schools and Staffing Survey: A Reinterview Report	Steven Kaufman
98–04	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.
98–05	SASS Documentation: 1993–94 SASS Student Sampling Problems; Solutions for Determining the Numerators for the SASS Private School (3B) Second-Stage Factors	Steven Kaufman
98–08	The Redesign of the Schools and Staffing Survey for 1999–2000: A Position Paper	Dan Kasprzyk
98–12	A Bootstrap Variance Estimator for Systematic PPS Sampling	Steven Kaufman
98–13	Response Variance in the 1994–95 Teacher Follow-up Survey	Steven Kaufman
98–14	Variance Estimation of Imputed Survey Data	Steven Kaufman
98–15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
98–16	A Feasibility Study of Longitudinal Design for Schools and Staffing Survey	Stephen Broughman
1999–02	Tracking Secondary Use of the Schools and Staffing Survey Data: Preliminary Results	Dan Kasprzyk
1999–04	Measuring Teacher Qualifications	Dan Kasprzyk
1999–07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
1999–08	Measuring Classroom Instructional Processes: Using Survey and Case Study Fieldtest Results to Improve Item Construction	Dan Kasprzyk
1999–10	What Users Say About Schools and Staffing Survey Publications	Dan Kasprzyk
1999–12	1993–94 Schools and Staffing Survey: Data File User's Manual, Volume III: Public-Use Codebook	Kerry Gruber
1999–13	1993–94 Schools and Staffing Survey: Data File User's Manual, Volume IV: Bureau of Indian Affairs (BIA) Restricted-Use Codebook	Kerry Gruber
1999–14	1994–95 Teacher Followup Survey: Data File User's Manual, Restricted-Use Codebook	Kerry Gruber
1999–17	Secondary Use of the Schools and Staffing Survey Data	Susan Wiley
2000–04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meetings	Dan Kasprzyk
2000–10	A Research Agenda for the 1999–2000 Schools and Staffing Survey	Dan Kasprzyk
2000–13	Non-professional Staff in the Schools and Staffing Survey (SASS) and Common Core of Data (CCD)	Kerry Gruber
2000–18	Feasibility Report: School-Level Finance Pretest, Public School District Questionnaire	Stephen Broughman
2002–04	Improving Consistency of Response Categories Across NCES Surveys	Marilyn Seastrom
Third International Mathematics and Science Study (TIMSS)		
2001–01	Cross-National Variation in Educational Preparation for Adulthood: From Early Adolescence to Young Adulthood	Elvira Hausken
2001–05	Using TIMSS to Analyze Correlates of Performance Variation in Mathematics	Patrick Gonzales

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2001–07	A Comparison of the National Assessment of Educational Progress (NAEP), the Third International Mathematics and Science Study Repeat (TIMSS-R), and the Programme for International Student Assessment (PISA)	Arnold Goldstein
2002–01	Legal and Ethical Issues in the Use of Video in Education Research	Patrick Gonzales

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No.	Title	NCES contact
Achievement (student) - mathematics		
2001–05	Using TIMSS to Analyze Correlates of Performance Variation in Mathematics	Patrick Gonzales
Adult education		
96–14	The 1995 National Household Education Survey: Reinterview Results for the Adult Education Component	Steven Kaufman
96–20	1991 National Household Education Survey (NHES:91) Questionnaires: Screener, Early Childhood Education, and Adult Education	Kathryn Chandler
96–22	1995 National Household Education Survey (NHES:95) Questionnaires: Screener, Early Childhood Program Participation, and Adult Education	Kathryn Chandler
98–03	Adult Education in the 1990s: A Report on the 1991 National Household Education Survey	Peter Stowe
98–10	Adult Education Participation Decisions and Barriers: Review of Conceptual Frameworks and Empirical Studies	Peter Stowe
1999–11	Data Sources on Lifelong Learning Available from the National Center for Education Statistics	Lisa Hudson
2000–16a	Lifelong Learning NCES Task Force: Final Report Volume I	Lisa Hudson
2000–16b	Lifelong Learning NCES Task Force: Final Report Volume II	Lisa Hudson
Adult literacy—see Literacy of adults		
American Indian – education		
1999–13	1993–94 Schools and Staffing Survey: Data File User's Manual, Volume IV: Bureau of Indian Affairs (BIA) Restricted-Use Codebook	Kerry Gruber
Assessment/achievement		
95–12	Rural Education Data User's Guide	Samuel Peng
95–13	Assessing Students with Disabilities and Limited English Proficiency	James Houser
97–29	Can State Assessment Data be Used to Reduce State NAEP Sample Sizes?	Larry Ogle
97–30	ACT's NAEP Redesign Project: Assessment Design is the Key to Useful and Stable Assessment Results	Larry Ogle
97–31	NAEP Reconfigured: An Integrated Redesign of the National Assessment of Educational Progress	Larry Ogle
97–32	Innovative Solutions to Intractable Large Scale Assessment (Problem 2: Background Questions)	Larry Ogle
97–37	Optimal Rating Procedures and Methodology for NAEP Open-ended Items	Larry Ogle
97–44	Development of a SASS 1993–94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98–09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
2001–07	A Comparison of the National Assessment of Educational Progress (NAEP), the Third International Mathematics and Science Study Repeat (TIMSS-R), and the Programme for International Student Assessment (PISA)	Arnold Goldstein
2001–11	Impact of Selected Background Variables on Students' NAEP Math Performance	Arnold Goldstein
2001–13	The Effects of Accommodations on the Assessment of LEP Students in NAEP	Arnold Goldstein
2001–19	The Measurement of Home Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Graders to Questionnaire Items and Parental Assessment of the Invasiveness of These Items	Arnold Goldstein
2002-05	Early Childhood Longitudinal Study-Kindergarten Class of 1998–99 (ECLS–K), Psychometric Report for Kindergarten Through First Grade	Elvira Hausken

No.	Title	NCES contact
2002-06	The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items	Arnold Goldstein
Beginning students in postsecondary education		
98–11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96–98) Field Test Report	Aurora D'Amico
2001–04	Beginning Postsecondary Students Longitudinal Study: 1996–2001 (BPS:1996/2001) Field Test Methodology Report	Paula Knepper
Civic participation		
97–25	1996 National Household Education Survey (NHES:96) Questionnaires: Screener/Household and Library, Parent and Family Involvement in Education and Civic Involvement, Youth Civic Involvement, and Adult Civic Involvement	Kathryn Chandler
Climate of schools		
95–14	Empirical Evaluation of Social, Psychological, & Educational Construct Variables Used in NCES Surveys	Samuel Peng
Cost of education indices		
94–05	Cost-of-Education Differentials Across the States	William J. Fowler, Jr.
Course-taking		
95–12	Rural Education Data User's Guide	Samuel Peng
98–09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
1999–05	Procedures Guide for Transcript Studies	Dawn Nelson
1999–06	1998 Revision of the Secondary School Taxonomy	Dawn Nelson
Crime		
97–09	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
Curriculum		
95–11	Measuring Instruction, Curriculum Content, and Instructional Resources: The Status of Recent Work	Sharon Bobbitt & John Ralph
98–09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
Customer service		
1999–10	What Users Say About Schools and Staffing Survey Publications	Dan Kasprzyk
2000–02	Coordinating NCES Surveys: Options, Issues, Challenges, and Next Steps	Valena Plisko
2000–04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meetings	Dan Kasprzyk
Data quality		
97–13	Improving Data Quality in NCES: Database-to-Report Process	Susan Ahmed
2001–11	Impact of Selected Background Variables on Students' NAEP Math Performance	Arnold Goldstein
2001–13	The Effects of Accommodations on the Assessment of LEP Students in NAEP	Arnold Goldstein
2001–19	The Measurement of Home Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Graders to Questionnaire Items and Parental Assessment of the Invasiveness of These Items	Arnold Goldstein
2002-06	The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items	Arnold Goldstein
Data warehouse		
2000–04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meetings	Dan Kasprzyk

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Design effects		
2000–03	Strengths and Limitations of Using SUDAAN, Stata, and WesVarPC for Computing Variances from NCES Data Sets	Ralph Lee
Dropout rates, high school		
95–07	National Education Longitudinal Study of 1988: Conducting Trend Analyses HS&B and NELS:88 Sophomore Cohort Dropouts	Jeffrey Owings
Early childhood education		
96–20	1991 National Household Education Survey (NHES:91) Questionnaires: Screener, Early Childhood Education, and Adult Education	Kathryn Chandler
96–22	1995 National Household Education Survey (NHES:95) Questionnaires: Screener, Early Childhood Program Participation, and Adult Education	Kathryn Chandler
97–24	Formulating a Design for the ECLS: A Review of Longitudinal Studies	Jerry West
97–36	Measuring the Quality of Program Environments in Head Start and Other Early Childhood Programs: A Review and Recommendations for Future Research	Jerry West
1999–01	A Birth Cohort Study: Conceptual and Design Considerations and Rationale	Jerry West
2001–02	Measuring Father Involvement in Young Children's Lives: Recommendations for a Fatherhood Module for the ECLS-B	Jerry West
2001–03	Measures of Socio-Emotional Development in Middle School	Elvira Hausken
2001–06	Papers from the Early Childhood Longitudinal Studies Program: Presented at the 2001 AERA and SRCD Meetings	Jerry West
2002-05	Early Childhood Longitudinal Study-Kindergarten Class of 1998–99 (ECLS–K), Psychometric Report for Kindergarten Through First Grade	Elvira Hausken
Educational attainment		
98–11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96–98) Field Test Report	Aurora D'Amico
2001–15	Baccalaureate and Beyond Longitudinal Study: 2000/01 Follow-Up Field Test Methodology Report	Andrew G. Malizio
Educational research		
2000–02	Coordinating NCES Surveys: Options, Issues, Challenges, and Next Steps	Valena Plisko
2002–01	Legal and Ethical Issues in the Use of Video in Education Research	Patrick Gonzales
Eighth-graders		
2001–05	Using TIMSS to Analyze Correlates of Performance Variation in Mathematics	Patrick Gonzales
Employment		
96–03	National Education Longitudinal Study of 1988 (NELS:88) Research Framework and Issues	Jeffrey Owings
98–11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96–98) Field Test Report	Aurora D'Amico
2000–16a	Lifelong Learning NCES Task Force: Final Report Volume I	Lisa Hudson
2000–16b	Lifelong Learning NCES Task Force: Final Report Volume II	Lisa Hudson
2001–01	Cross-National Variation in Educational Preparation for Adulthood: From Early Adolescence to Young Adulthood	Elvira Hausken
Employment – after college		
2001–15	Baccalaureate and Beyond Longitudinal Study: 2000/01 Follow-Up Field Test Methodology Report	Andrew G. Malizio
Engineering		
2000–11	Financial Aid Profile of Graduate Students in Science and Engineering	Aurora D'Amico
Enrollment – after college		

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2001–15	Baccalaureate and Beyond Longitudinal Study: 2000/01 Follow-Up Field Test Methodology Report	Andrew G. Malizio
Faculty – higher education		
97–26	Strategies for Improving Accuracy of Postsecondary Faculty Lists	Linda Zimbler
2000–01	1999 National Study of Postsecondary Faculty (NSOPF:99) Field Test Report	Linda Zimbler
Fathers – role in education		
2001–02	Measuring Father Involvement in Young Children's Lives: Recommendations for a Fatherhood Module for the ECLS-B	Jerry West
Finance – elementary and secondary schools		
94–05	Cost-of-Education Differentials Across the States	William J. Fowler, Jr.
96–19	Assessment and Analysis of School-Level Expenditures	William J. Fowler, Jr.
98–01	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
1999–07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
1999–16	Measuring Resources in Education: From Accounting to the Resource Cost Model Approach	William J. Fowler, Jr.
2000–18	Feasibility Report: School-Level Finance Pretest, Public School District Questionnaire	Stephen Broughman
Finance – postsecondary		
97–27	Pilot Test of IPEDS Finance Survey	Peter Stowe
2000–14	IPEDS Finance Data Comparisons Under the 1997 Financial Accounting Standards for Private, Not-for-Profit Institutes: A Concept Paper	Peter Stowe
Finance – private schools		
95–17	Estimates of Expenditures for Private K–12 Schools	Stephen Broughman
96–16	Strategies for Collecting Finance Data from Private Schools	Stephen Broughman
97–07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97–22	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman
1999–07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
2000–15	Feasibility Report: School-Level Finance Pretest, Private School Questionnaire	Stephen Broughman
Geography		
98–04	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.
Graduate students		
2000–11	Financial Aid Profile of Graduate Students in Science and Engineering	Aurora D'Amico
Graduates of postsecondary education		
2001–15	Baccalaureate and Beyond Longitudinal Study: 2000/01 Follow-Up Field Test Methodology Report	Andrew G. Malizio
Imputation		
2000–04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meeting	Dan Kasprzyk
2001–10	Comparison of Proc Impute and Schafer's Multiple Imputation Software	Sam Peng
2001–16	Imputation of Test Scores in the National Education Longitudinal Study of 1988	Ralph Lee
2001–17	A Study of Imputation Algorithms	Ralph Lee
2001–18	A Study of Variance Estimation Methods	Ralph Lee
Inflation		
97–43	Measuring Inflation in Public School Costs	William J. Fowler, Jr.
Institution data		
2000–01	1999 National Study of Postsecondary Faculty (NSOPF:99) Field Test Report	Linda Zimbler
Instructional resources and practices		
95–11	Measuring Instruction, Curriculum Content, and Instructional Resources: The Status of Recent Work	Sharon Bobbitt & John Ralph

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1999–08	Measuring Classroom Instructional Processes: Using Survey and Case Study Field Test Results to Improve Item Construction	Dan Kasprzyk
International comparisons		
97–11	International Comparisons of Inservice Professional Development	Dan Kasprzyk
97–16	International Education Expenditure Comparability Study: Final Report, Volume I	Shelley Burns
97–17	International Education Expenditure Comparability Study: Final Report, Volume II, Quantitative Analysis of Expenditure Comparability	Shelley Burns
2001–01	Cross-National Variation in Educational Preparation for Adulthood: From Early Adolescence to Young Adulthood	Elvira Hausken
2001–07	A Comparison of the National Assessment of Educational Progress (NAEP), the Third International Mathematics and Science Study Repeat (TIMSS-R), and the Programme for International Student Assessment (PISA)	Arnold Goldstein
International comparisons – math and science achievement		
2001–05	Using TIMSS to Analyze Correlates of Performance Variation in Mathematics	Patrick Gonzales
Libraries		
94–07	Data Comparability and Public Policy: New Interest in Public Library Data Papers Presented at Meetings of the American Statistical Association	Carrol Kindel
97–25	1996 National Household Education Survey (NHES:96) Questionnaires: Screener/Household and Library, Parent and Family Involvement in Education and Civic Involvement, Youth Civic Involvement, and Adult Civic Involvement	Kathryn Chandler
Limited English Proficiency		
95–13	Assessing Students with Disabilities and Limited English Proficiency	James Houser
2001–11	Impact of Selected Background Variables on Students' NAEP Math Performance	Arnold Goldstein
2001–13	The Effects of Accommodations on the Assessment of LEP Students in NAEP	Arnold Goldstein
Literacy of adults		
98–17	Developing the National Assessment of Adult Literacy: Recommendations from Stakeholders	Sheida White
1999–09a	1992 National Adult Literacy Survey: An Overview	Alex Sedlacek
1999–09b	1992 National Adult Literacy Survey: Sample Design	Alex Sedlacek
1999–09c	1992 National Adult Literacy Survey: Weighting and Population Estimates	Alex Sedlacek
1999–09d	1992 National Adult Literacy Survey: Development of the Survey Instruments	Alex Sedlacek
1999–09e	1992 National Adult Literacy Survey: Scaling and Proficiency Estimates	Alex Sedlacek
1999–09f	1992 National Adult Literacy Survey: Interpreting the Adult Literacy Scales and Literacy Levels	Alex Sedlacek
1999–09g	1992 National Adult Literacy Survey: Literacy Levels and the Response Probability Convention	Alex Sedlacek
1999–11	Data Sources on Lifelong Learning Available from the National Center for Education Statistics	Lisa Hudson
2000–05	Secondary Statistical Modeling With the National Assessment of Adult Literacy: Implications for the Design of the Background Questionnaire	Sheida White
2000–06	Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy	Sheida White
2000–07	"How Much Literacy is Enough?" Issues in Defining and Reporting Performance Standards for the National Assessment of Adult Literacy	Sheida White
2000–08	Evaluation of the 1992 NALS Background Survey Questionnaire: An Analysis of Uses with Recommendations for Revisions	Sheida White
2000–09	Demographic Changes and Literacy Development in a Decade	Sheida White
2001–08	Assessing the Lexile Framework: Results of a Panel Meeting	Sheida White
Literacy of adults – international		
97–33	Adult Literacy: An International Perspective	Marilyn Binkley
Mathematics		
98–09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings

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2002-06	The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items	Arnold Goldstein
Parental involvement in education		
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Participation rates		
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Postsecondary education		
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2000–16a	Lifelong Learning NCES Task Force: Final Report Volume I	Lisa Hudson
2000–16b	Lifelong Learning NCES Task Force: Final Report Volume II	Lisa Hudson
Postsecondary education – persistence and attainment		
98–11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96–98) Field Test Report	Aurora D'Amico
1999–15	Projected Postsecondary Outcomes of 1992 High School Graduates	Aurora D'Amico
Postsecondary education – staff		
97–26	Strategies for Improving Accuracy of Postsecondary Faculty Lists	Linda Zimbler
2000–01	1999 National Study of Postsecondary Faculty (NSOPF:99) Field Test Report	Linda Zimbler
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2000–10	A Research Agenda for the 1999–2000 Schools and Staffing Survey	Dan Kasprzyk
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96–16	Strategies for Collecting Finance Data from Private Schools	Stephen Broughman
97–07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
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Projections of education statistics		
1999–15	Projected Postsecondary Outcomes of 1992 High School Graduates	Aurora D'Amico
Public school finance		
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Public schools		
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98–01	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
98–04	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.
1999–02	Tracking Secondary Use of the Schools and Staffing Survey Data: Preliminary Results	Dan Kasprzyk
2000–12	Coverage Evaluation of the 1994–95 Public Elementary/Secondary School Universe Survey	Beth Young
2000–13	Non-professional Staff in the Schools and Staffing Survey (SASS) and Common Core of Data (CCD)	Kerry Gruber
2002–02	Locale Codes 1987 - 2000	Frank Johnson
Public schools – secondary		
98–09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
Reform, educational		
96–03	National Education Longitudinal Study of 1988 (NELS:88) Research Framework and Issues	Jeffrey Owings
Response rates		
98–02	Response Variance in the 1993–94 Schools and Staffing Survey: A Reinterview Report	Steven Kaufman
School districts		
2000–10	A Research Agenda for the 1999–2000 Schools and Staffing Survey	Dan Kasprzyk
School districts, public		
98–07	Decennial Census School District Project Planning Report	Tai Phan
1999–03	Evaluation of the 1996–97 Nonfiscal Common Core of Data Surveys Data Collection, Processing, and Editing Cycle	Beth Young
School districts, public – demographics of		
96–04	Census Mapping Project/School District Data Book	Tai Phan
Schools		
97–42	Improving the Measurement of Staffing Resources at the School Level: The Development of Recommendations for NCES for the Schools and Staffing Survey (SASS)	Mary Rollefson
98–08	The Redesign of the Schools and Staffing Survey for 1999–2000: A Position Paper	Dan Kasprzyk
1999–03	Evaluation of the 1996–97 Nonfiscal Common Core of Data Surveys Data Collection, Processing, and Editing Cycle	Beth Young
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Schools – safety and discipline		
97–09	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
Science		
2000–11	Financial Aid Profile of Graduate Students in Science and Engineering	Aurora D'Amico
2001–07	A Comparison of the National Assessment of Educational Progress (NAEP), the Third International Mathematics and Science Study Repeat (TIMSS-R), and the Programme for International Student Assessment (PISA)	Arnold Goldstein
Software evaluation		
2000–03	Strengths and Limitations of Using SUDAAN, Stata, and WesVarPC for Computing Variances from NCES Data Sets	Ralph Lee
Staff		
97–42	Improving the Measurement of Staffing Resources at the School Level: The Development of Recommendations for NCES for the Schools and Staffing Survey (SASS)	Mary Rollefson

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98–08	The Redesign of the Schools and Staffing Survey for 1999–2000: A Position Paper	Dan Kasprzyk
Staff – higher education institutions		
97–26	Strategies for Improving Accuracy of Postsecondary Faculty Lists	Linda Zimbler
Staff – nonprofessional		
2000–13	Non-professional Staff in the Schools and Staffing Survey (SASS) and Common Core of Data (CCD)	Kerry Gruber
State		
1999–03	Evaluation of the 1996–97 Nonfiscal Common Core of Data Surveys Data Collection, Processing, and Editing Cycle	Beth Young
Statistical methodology		
97–21	Statistics for Policymakers or Everything You Wanted to Know About Statistics But Thought You Could Never Understand	Susan Ahmed
Statistical standards and methodology		
2001–05	Using TIMSS to Analyze Correlates of Performance Variation in Mathematics	Patrick Gonzales
2002–04	Improving Consistency of Response Categories Across NCES Surveys	Marilyn Seastrom
Students with disabilities		
95–13	Assessing Students with Disabilities and Limited English Proficiency	James Houser
2001–13	The Effects of Accommodations on the Assessment of LEP Students in NAEP	Arnold Goldstein
Survey methodology		
96–17	National Postsecondary Student Aid Study: 1996 Field Test Methodology Report	Andrew G. Malizio
97–15	Customer Service Survey: Common Core of Data Coordinators	Lee Hoffman
97–35	Design, Data Collection, Interview Administration Time, and Data Editing in the 1996 National Household Education Survey	Kathryn Chandler
98–06	National Education Longitudinal Study of 1988 (NELS:88) Base Year through Second Follow-Up: Final Methodology Report	Ralph Lee
98–11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96–98) Field Test Report	Aurora D'Amico
98–16	A Feasibility Study of Longitudinal Design for Schools and Staffing Survey	Stephen Broughman
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1999–17	Secondary Use of the Schools and Staffing Survey Data	Susan Wiley
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2001–19	The Measurement of Home Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Graders to Questionnaire Items and Parental Assessment of the Invasiveness of These Items	Arnold Goldstein
2002–01	Legal and Ethical Issues in the Use of Video in Education Research	Patrick Gonzales
2002–02	Locale Codes 1987 - 2000	Frank Johnson
2002–03	National Postsecondary Student Aid Study, 1999–2000 (NPSAS:2000), CATI Nonresponse Bias Analysis Report.	Andrew Malizio

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2002-06	The Measurement of Instructional Background Indicators: Cognitive Laboratory Investigations of the Responses of Fourth and Eighth Grade Students and Teachers to Questionnaire Items	Arnold Goldstein
Teachers		
98–13	Response Variance in the 1994–95 Teacher Follow-up Survey	Steven Kaufman
1999–14	1994–95 Teacher Followup Survey: Data File User's Manual, Restricted-Use Codebook	Kerry Gruber
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