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Japanese and American Teachers' Evaluations of Videotaped Mathematics Lessons

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This article describes a novel assessment method used to examine Japanese and American teachers' ideas about what constitutes effective mathematics pedagogy. Forty American and 40 Japanese teachers independently evaluated either an American or Japanese mathematics lesson captured on videotape. Their comments were classified into over 1600 *idea units*, which were then sorted into a hierarchy of categories derived from the data. Next, the authors hypothesized underlying *ideal* instructional scripts that could explain the patterns of responses. Whereas the U.S. teachers were supportive of both traditional and nontraditional elementary school mathematics instruction and had different scripts for the two lessons, the Japanese teachers had only one ideal lesson script that was closely tied to typical Japanese mathematics instruction. The findings suggest that U.S. teachers may have more culturally sanctioned options for teaching mathematics; however, Japanese teachers may have a more detailed and widely shared theory about how to teach effectively.

Key words: Cross-cultural studies; Qualitative methods; Teacher beliefs; Teaching (role, style, methods)

Mathematics educators in both the United States and Japan are continually seeking to improve teaching. In both countries, numerous books and reports provide suggestions and recommendations to practitioners, and ongoing reform efforts are taken seriously. Many of these reform efforts encourage teachers to reflect on their instructional techniques, either individually or collaboratively.

As a result of several large international studies of mathematics teaching, a good deal is now known about how Americans and Japanese teach mathematics and what some of the critical differences are between teaching methods in these two countries (e.g., Stevenson & Stigler, 1992; Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1999). Much less is known, however, about what teachers think constitutes effective pedagogy and the degree to which they are open to alternative peda-

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gogical methods. With reforms in both countries suggesting specific instructional strategies (and different reform efforts sometimes suggesting very different strategies), there is a growing need to document teachers' ideas and opinions regarding these strategies. Another important question is the extent to which opinions are shared among teachers both within and between countries.

Evaluating Videotaped Lessons

Measuring teachers' ideas regarding effective instruction is complicated on several levels. Teachers may find it difficult to express their thoughts when asked very general or decontextualized questions. Kagan (1990), citing Leinhardt (1990), explains that because beliefs are "associated with specific classrooms, events, and students," it is generally best to use indirect tasks that then enable the researcher to make inferences from the data generated by these tasks (p. 420). Pajares (1992) concludes, "it is unavoidable that, for purposes of investigation, beliefs must be inferred" (p. 315). Methods of eliciting teachers' ideas for the purpose of making inferences about their beliefs include questionnaires, interviews, reflecting on cases or case methods, process tracing/think alouds (e.g., while solving a problem), concept mapping, and journals. For reviews of many of these studies see Clark and Peterson (1986), Kagan (1990), and Shavelson and Stern (1981).

Most assessment techniques are either very abstract or so detailed and time-consuming as to allow for only a limited number of participants. Abstract techniques typically require teachers to imagine the classroom context and agree or disagree with ideas generated by researchers—for example, on questionnaires. Although more contextual techniques enable teachers to think about actual classrooms (usually their own) and generate ideas themselves, they tend to have sample sizes that are restricted to only a few participants. Another methodological problem is that the classroom context that teachers imagine or refer to when participating in research projects may not be shared either among teachers or between teachers and researchers. This is a particularly critical issue in cross-national research, which brings varied experiences and perceptions to the foreground of the inquiry.

In the study reported here, we employed a novel assessment method that enabled us to uncover teachers' schemata regarding mathematics teaching and learning in the context of classroom practices, while at the same time capturing the variety of ideas held by a relatively large and diverse sample of Japanese and American teachers. Our study is based on the premise that teachers' opinions can be activated through the process of critiquing an actual classroom lesson captured on videotape. More specifically, watching a lesson should activate the implicit schema or scripts that teachers hold in mind regarding instruction. Scripts are "mental pictures," or what people expect classroom instruction to look like (Stigler & Hiebert, 1999). By comparing their own criteria for good instruction against what they see in the lesson, teachers should be able to produce judgments about the lesson that reflect these scripts. Of course, the particular scripts that are activated in this process might depend, at least to some extent, on the specific nature of the lesson that teachers

view. In order to aggregate data meaningfully from a group of teachers, we limited the study to only two lessons. However, these lessons depict two very different styles of mathematics instruction—one filmed in the United States and the other filmed in Japan.

American and Japanese Teachers' Views on Mathematics Pedagogy

The existing literature reveals that many American teachers hold relatively traditional views on teaching and learning mathematics. They perceive teaching as giving students step-by-step instruction so that they can acquire certain basic skills, and they view students as recipients of the teachers' knowledge and instruction (Battista, 1994; Prawat, 1992). Such beliefs have a long history in the United States, mirror those of the larger society, and reflect the way in which teachers themselves were taught (Battista, 1994). Many efforts to reform mathematics instruction in this country have, thus far, had limited effects on practice and beliefs (e.g., Civil, 1993; Grant, Hiebert, & Wearne, 1994; Peak, 1996).

Japanese teachers are reported to use very different instructional strategies in their mathematics classrooms (e.g., Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). For example, a problem-solving approach to mathematics is widely seen in lessons, particularly when teachers are introducing new concepts to children (Stigler & Perry, 1990). One would expect, of course, that teachers generally hold beliefs that support and complement their classroom practices, and writers often infer that American and Japanese teachers have differing beliefs. However, the specific nature of these beliefs in contrast with one another remains unclear, and to date only two published studies have directly compared American and Japanese teachers' views regarding mathematics pedagogy (Jacobs, Yoshida, Fernandez, & Stigler, 1997; Whitman & Lai, 1990).

A comparison of Japanese and American teachers' beliefs about mathematics teaching and learning was conducted by Whitman and Lai (1990) using a closed-ended questionnaire. The two groups of teachers that they studied had some overlapping preferences but differed in their beliefs about classroom management, the needs of individual students, and provisions for equal educational opportunity. The American participants emphasized the importance of classroom structure and rules and of meeting the needs of individual students. In contrast, the Japanese participants expressed concern about not stigmatizing any students and providing identical instruction to all students.

Jacobs, Yoshida, Fernandez, and Stigler (1997) conducted another comparison of Japanese and American teachers' beliefs about mathematics teaching and learning. This study employed a small sample of teachers from each country to explore the technique of evaluating videotaped lessons. These researchers found that the eight participating teachers had rather coherent belief systems regarding teaching and learning, which differed between the two countries. The four American teachers endorsed a teacher-directed instructional approach—where children learn to acquire skills and procedures by sitting still and paying attention while the

instructor provides clear and frequent explanations, maintains a quick pace, and uses classroom tools such as the blackboard. The four Japanese teachers endorsed a more constructivist approach—where children learn by actively engaging in an activity during which the instructor provides minimal direct instruction, goes at a slow pace, and allows students to use classroom tools to depict their solution strategies. This research indicates that, within countries, there may be a strong consonance between views about good teaching and common classroom practices.

The major goals of the study reported here were (a) to examine teachers' evaluations of videotaped lessons at a level of detail that facilitated inferences about their underlying scripts regarding effective mathematics instruction, (b) to uncover any differences between the evaluations of American and Japanese teachers, and (c) to explore the use of this assessment technique with a relatively large and diverse sample of beginning and experienced teachers.

METHOD

Subjects

Data were collected on 40 American and 40 Japanese teachers. Half the subjects in each country were preservice teachers, and half were experienced in-service teachers. The 20 preservice American teachers (15 female, 5 male) were students at the UCLA School of Education in an elementary school teacher certification program. The 20 in-service American teachers (16 female, 4 male) were recruited from elementary schools in Los Angeles and the surrounding area on the basis of referrals by UCLA School of Education professors, local school principals, and other local in-service teachers. Their classroom experience ranged from 10 to 35 years, with an average of 22.6 years, and they represented 12 different schools. The 20 preservice Japanese teachers (16 female, 4 male) were students at Osaka Kyoiku [Education] University in an elementary school teacher certification program. The 20 in-service Japanese teachers (13 female, 7 male) were recruited from elementary schools in Osaka, one of the largest cities in Japan. They were referred by contacts and announcements from Osaka Kyoiku University professors and other local in-service teachers. Their classroom experience ranged from 8 to 27 years, with an average of 17 years, and they represented 11 different schools. All of the in-service teachers in the sample had taught more than one grade level; most had experience exclusively at the elementary school level.

Design and Procedures

All teachers independently viewed an actual fifth-grade mathematics lesson videotaped either in the United States or Japan. Half the teachers in each country (i.e., half the in-service and half the preservice teachers) were randomly selected to watch one tape, and half watched the other tape. Thus, 10 preservice and 10 in-service teachers in each country saw the American lesson, and 10 preservice and 10 in-service teachers in each country saw the Japanese lesson.

The American lesson was filmed in Chicago, Illinois, and the Japanese lesson was filmed in Nagano, Japan. Both lessons focused on an introduction to finding the area of a triangle. Informal viewings of the tapes by American and Japanese teacher educators indicated that the instructors in both lessons were typical and seemed to be of average ability within their own country. In addition, both lessons closely mirrored researchers' descriptions of typical American and Japanese mathematics lessons (e.g. Stevenson & Stigler, 1992; Stigler et al., 1999). These lessons were videotaped as part of a separate research project on classroom differences in American and Japanese elementary school mathematics lessons. A more detailed description of that study and of the lessons included in this project can be found in several publications (Stigler, Fernandez, & Yoshida, 1992; 1996). A brief overview of each lesson is provided below, as well as in Table 1.

Table 1
Overview of the Japanese and American Lessons on Finding the Area of a Triangle

Segment	Length (min)	Description
		Japanese lesson
1	3.5	Presentation of the problem
2	14.5	Students attempting to solve the problem on their own
3	29.0	Class discussion about the solutions that students came up with, leading to the general formula
4	5.0	Doing further practice problems from the textbook (students working on their own)
Total	52.0	
Segment	Length (min)	Description
		American lesson
1	1.0	Review concept of perimeter
2	8.0	Area of a rectangle: explanation, formula, and practice problems
3	25.0	Area of a triangle: explanation, formula, and practice problems
4	11.0	Students began homework assignment; teacher walked around and helped
Total	45.0	

Note. From J. W. Stigler, C. Fernandez, and M. Yoshida, "Cultures of Mathematics Instruction in Japanese and American Elementary Classrooms," in T. P. Rohlen and G. K. LeTendre (Eds.), *Teaching and Learning in Japan* (p. 221). Cambridge, England: Cambridge University Press. Copyright 1996.

In the American lesson, the teacher starts with a brief review of perimeter, and then moves to finding the area of a rectangle by counting square units. He provides his students with the formula for the area of a rectangle and works through several example problems using the algorithm. The teacher holds up a cutout square unit and explains that with triangles it is difficult to count the number of square units. Using cutouts, he demonstrates that when two identical triangles are combined a rectangle can be formed—first with right triangles and then with nonright tri-

angles cut in several pieces. This leads to the formula for the area of a triangle (1/2 base □ height), and the class works through several example problems using the algorithm. Finally, the students begin working on their homework, which consists of finding the area of various rectangles and triangles using the two algorithms.

The Japanese lesson begins with the teacher asking students what kinds of triangles they have learned about so far. The students name isosceles, equilateral, and right triangles, and the teacher puts paper versions of each kind on the board. She tells the children that their task is to think about how to find the area of any triangle, and then she distributes paper triangles like the ones on the board, along with scissors and glue. The students work independently at their seats, while the teacher takes notes on what each child is doing. Then individual students are called up to the blackboard to show and explain their solutions. Finally, the teacher asks the children to summarize all their solution strategies, and they generate the formula "base □ height / 2". The students spend the last part of the class at their seats working on textbook problems to find the area of various triangles using the algorithm.

Each teacher participant individually viewed one of the lessons in its entirety. The teacher was seated in front of a video monitor, given a VCR remote control, and told to watch the tape and push the pause button whenever he or she had a comment about the instruction. Teachers were asked to specify whether the comment was going to be a "strength" or "weakness" and then to offer their critique. Teachers were also given the opportunity to make summative comments after viewing the entire lesson. The videotapes were dubbed so that they could be watched by nonnative speakers, and the video-viewing sessions were held entirely in the teachers' native language. All of the teachers' comments about the lessons were transcribed in their native language. These transcripts noted the times in the lesson when the teacher stopped the tape and began to talk, and contained a verbatim record of what they said at each "stopping point."

Data Coding

Data coding involved five stages, and the main coders for each stage were the authors of this article. We also enlisted the help of four additional coders—two native English speakers and two native Japanese speakers. Reliability was established between the English speakers and the American author, between the Japanese speakers and the Japanese author, and between the authors (using data translated into English). In the case of disagreements, final coding decisions were made by the authors.

In the first two stages of the coding process, the data was coded in its original language. Stage 1 consisted of dividing the talk into *idea units* (see Jacobs, Yoshida, Fernandez, & Stigler, 1997), defined by distinct shifts in focus or changes in topic. Typically, each stopping point was coded as a new idea unit. However, teachers' remarks at a given stopping point could contain more than one idea unit. For example, a teacher might have stopped the lesson to mention that she liked the fact that the blackboard was being used but that she also thought the pace was too fast;

here her comments would be divided into two idea units. Interrater reliability was calculated by first determining at each stopping point how many idea units the coders agreed on. The number of coding agreements and disagreements were summed for each teacher, and the ratio of agreements to the sum of agreements and disagreements was calculated. Then, these ratios were averaged across teachers, and the interrater agreement for Stage 1 was 90%.

Because teachers did not always classify their own comments as strengths or weaknesses, we undertook this classification as Stage 2 of the coding process. Idea units were coded as strengths if they focused on something that the teacher liked about the lesson or as weaknesses if they focused on something that the teacher disliked about the lesson. Neutral idea units were those that could not be determined to be either strengths or weaknesses. For this code, interrater reliability was calculated by dividing the number of agreed-on idea units (from Stage 1) by the number of agreements in coding as strengths, weaknesses, or neutral. The percentages were then averaged across teachers, and interrater reliability for Stage 2 was 96%.

Idea units coded as neutral accounted for about 7% of the data. They were typically short, offhand remarks such as "Her chalkboard is magnetic" or questions to the interviewer such as "What did the teacher just say?" Neutral idea units were excluded from all further analyses because they did not clearly represent teachers' evaluations of the lessons.

The Japanese transcripts were translated into English, and for all teachers, each idea unit identified as a strength or weakness was summarized into a few short English phrases. Our goal was to capture the main point of the idea unit without losing any important information. For every idea unit, three things were noted: the event or feature in the lesson that the teacher commented on, any suggestions the teacher made (e.g., how to improve the event), and any explanations they gave (e.g., why the event was good or bad). All the subsequent coding and analyses relied exclusively on the summarized English data. However, in those instances where the coding was difficult or unclear, the unsummarized data in the original language served as a reference.

In Stage 3, we coded each idea unit as corresponding to a particular part of the American or Japanese lesson. This coding relied on the division of lesson events as described by Stigler, Fernandez, & Yoshida, 1996 (see Table 1). That is, each lesson was divided into four segments, and each idea unit was linked to exactly one of these segments. The average interrater reliability for this coding was 97%.

In their comments about the lessons, the participants freely raised topics of their choosing, generating their own domains of interest. Sorting through the data, we relied on the grounded theory approach for discovering categories from the data (Strauss & Corbin, 1990). Specifically, in Stage 4, the authors carefully studied teachers' summarized idea units in an *open coding* process until we were able to produce broad but meaningful categories. This process yielded eight main categories that were not mutually exclusive, into which any idea unit could be coded. (These categories will be reported in more detail in the next section.) Average interrater reliability for classifying idea units into main categories was 90%.

The final coding stage employed axial coding—the process of relating subcategories to main categories in order to produce a grounded theory about the teachers' evaluations (Strauss & Corbin, 1990). For each segment of each lesson, unique subcategories were created for all the general categories mentioned above (excluding the "Other" category). The authors generated between 1 and 5 subcategories per main category for each lesson segment, with the subcategories being mutually exclusive and exhaustive. Average interrater reliability for classifying idea units into subcategories was 80%. Table 2 contains an example of how one idea unit was summarized and coded.

Table 2
Example of a Japanese Teacher's Idea Unit and How It Was Coded

Original idea unit	Summarized idea unit			Main categories and Subcategories
	Event/feature	Suggestion	Explanation	
T74: I believe this would be a weak point. Is this the first day that they learned the word *area*? I: Yes, it seems that way. T74: If that's the case, the teacher is throwing so much information at such a fast pace that if I were a child I don't think I'd be able to keep up with the pace. It's all moving so fast, and it just keeps going. I: Are you saying that the teacher is speaking too fast, or that the pace of the lesson is too fast, or both? T74: Both.	Teacher is giving information too fast and speaking too fast.	None	It's the first time they are learning area, and students can't keep up with the pace.	Main category: Pace and timing (F) Subcategory: Pace is too fast (1)

Note. Teacher ID was T74. This idea unit from Segment 2 of the American lesson (see Table 1) was coded as a weakness.

RESULTS

Main Categories

The 80 teacher participants generated over 1600 idea units in their evaluations, each of which had to be carefully studied and coded. The eight main categories into which these idea units were classified were as follows: teacher's presentation of

mathematics content or an assignment, students' involvement, teacher's observation and guidance of students, classroom organization, classroom atmosphere, pace and timing, use of classroom materials, and other. As can be seen from Table 3, these categories worked well for both the American and Japanese teachers, and for both the American and Japanese lessons; only about 1% of the total data was classified as "Other." The data in Table 3, like all other summary percentages reported in this article, were determined by calculating the percentage of idea units of a given type made by each teacher and then averaging across teachers.

Table 3
Mean Percentage of Idea Units Coded into Each Main Category, by Country and Lesson

Main category	US teachers ($n = 40$)		JPN teachers ($n = 40$)		F^b
	US lesson[a]	JPN lesson[a]	US lesson[a]	JPN lesson[a]	
Teacher's presentation of mathematics content or an assignment	38 (18)	27 (11)	55 (19)	56 (21)	33.28**
Students' involvement	31 (12)	29 (15)	35 (17)	31 (21)	0.60
Teacher's observation and guidance of students	10 (6)	11 (7)	12 (11)	11 (9)	0.10
Classroom organization	5 (6)	9 (12)	0	1 (3)	16.14**
Classroom atmosphere	16 (11)	13 (8)	6 (7)	8 (11)	12.17**
Pace and timing	10 (7)	10 (8)	24 (13)	28 (16)	37.26**
Usage of classroom materials	25 (10)	23 (7)	35 (23)	35 (22)	9.34*
Other	2 (4)	2 (5)	0 (1)	0	8.03*
Total number of idea units	517	468	372	244	

Note. Standard deviations are shown in parentheses.
[a]$n = 20$. [b]US vs. JPN teacher comparison.
*$p < .01$. **$p < .001$.

Overall, the American and Japanese teachers differed significantly in the extent to which they discussed the eight main categories ($F(1,79) = 10.04$, $p < .001$). As indicated in Table 3, the Japanese teachers evaluated the instructor's presentation of content, pace and timing, and use of classroom materials more often than the American teachers did. By contrast, the American teachers evaluated the classroom organization and atmosphere more frequently than did their Japanese counterparts. The two groups of teachers were about equal in the frequency with which they discussed the students' involvement and the instructor's observation and guidance. The average frequency with which teachers brought up these main categories was very similar, regardless of which lesson they watched. This held true for both the American and Japanese teachers (U.S. teachers: $F(1, 39) = 1.81$, $p < .11$; Japanese teachers: $F(1, 39) = 0.61$, $p < .76$).

There were only a few differences between the preservice and in-service teachers in how frequently they discussed each of the main categories. Among the American teachers, fewer than half of the main categories produced significant differences

for both the U.S. and the Japanese lessons. There were no significant differences among the Japanese preservice and experienced teachers for any main category for both lessons. Since further analyses also indicated very minimal differences between the preservice and in-service teachers, we explore only country and lesson differences in the remainder of this article.

Subcategories and "Ideal Scripts"

At a broad level, the main categories describe the major issues that the American and Japanese teachers had in mind when evaluating the videotaped lessons. However, the fact that the main categories did not produce significant differences across lessons suggests that they do not reveal teachers' evaluations with sufficient detail. Therefore, it was critical for us to define meaningful subcategories. In addition, we wanted to allow for the fact that teachers' evaluations could depend heavily on what they saw at any given moment in a particular lesson. For example, at the beginning of the Japanese lesson, some teachers complained that the students were not involved enough in the discussion of how to approach the problem, but in the middle of the lesson many of these same teachers happily noted that the students were now involved in sharing their answers to the problem. Hence, our subcategories varied according to the particular events that occurred in each lesson.

We developed subcategories in order to capture the American and Japanese teachers' specific beliefs about the lesson events, as well as the cultural differences reflected in their beliefs. Given the large number of subcategories, in the sections that follow we present tables containing only those that teachers brought up most frequently during each lesson segment.[1] The tables also show the percentage of comments that were coded as strengths for each of these subcategories.

In addition, for each lesson, we hypothesize the underlying instructional scripts that would explain the patterns of responses obtained from our American and Japanese participants. We propose these models as plausible compilations of teachers' evaluations regarding the most effective means for carrying out these particular lessons. As noted in the introduction, studies of teachers' ideas generally require researchers to make inferences based on their best interpretation of the data at hand. In the "ideal scripts" posited here, we stayed as close to the data as possible, and yet we moved one step beyond the quantitative numbers generated from our coding toward a more aggregated view of how these lessons were evaluated.

American Teachers' Evaluations of the Japanese Lesson

Table 4 presents the topics most commonly mentioned by the American teachers as they evaluated the Japanese lesson, and it indicates how often their idea units were positive ones. Our hypothesized ideal script for the American teachers viewing this lesson, as suggested by their critiques, is provided in Figure 1.

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[1] Occasionally, the main categories were not further subdivided, and the numbers reported are the percent of comments that fit the main category.

Table 4
Mean Percentage of American Teachers' Frequently Mentioned Idea Units and Strengths Within Each Segment of the Japanese Lesson

Segment	Events/features	American teachers—Japanese lesson % Idea units	% Strengths
1	Presentation of the problem		
	Content of review	17 (18)	29
	Students' involvement in review	9 (14)	56
	Open-ended problem	25 (24)	97
	Use of manipulatives	26 (24)	65
2	Students attempting to solve the problem on their own		
	Teacher's observation and help	44 (22)	78
	Lack of group work	22 (23)	0
	Classroom atmosphere	20 (23)	67
3	Class discussion about the solutions, leading to the formula		
	Teacher's clarification	16 (12)	74
	Students' involvement as presenters	24 (13)	76
	Discussion of ideas	21 (13)	54
4	Practice problems from the textbook		
	Assigning practice problems	37 (46)	83
	Teacher's observation and help	22 (38)	100

Note. Standard deviations are shown in parentheses.

Reviewing was the first event in the Japanese lesson that the American teachers commented on frequently. Specifically, they wanted to see a more thorough review of the mathematical content and some involvement of students in the review. However, in this same segment of the lesson, the instructor also posed an *open-ended problem*, with which the American teachers were considerably more pleased. They were impressed by the fact that the children had an opportunity to work on such a problem and that they were given manipulatives to assist them in doing so.

During Segment 2, when the Japanese students had time to *work on the open-ended problem* at their seats, the American teachers frequently brought up three topics. One was the importance of the instructor moving around the room to observe and help students, and there was general agreement that this was done well. In addition, many participants commented on the classroom atmosphere during this segment, and about two thirds of their idea units were positive. However, a strongly shared complaint of the U.S. teachers was that the students should have worked on the problem cooperatively in small groups.

The third segment of the lesson, in which the *students presented their ideas and generated the formula* for the area of a triangle, elicited a great deal of praise from the American teachers. They specifically focused on three key features that they felt contributed to this event's effectiveness. Many American teachers complimented the instructor for clarifying the ideas that students presented to the class. Also, they were happy to see that the students had numerous opportunities for

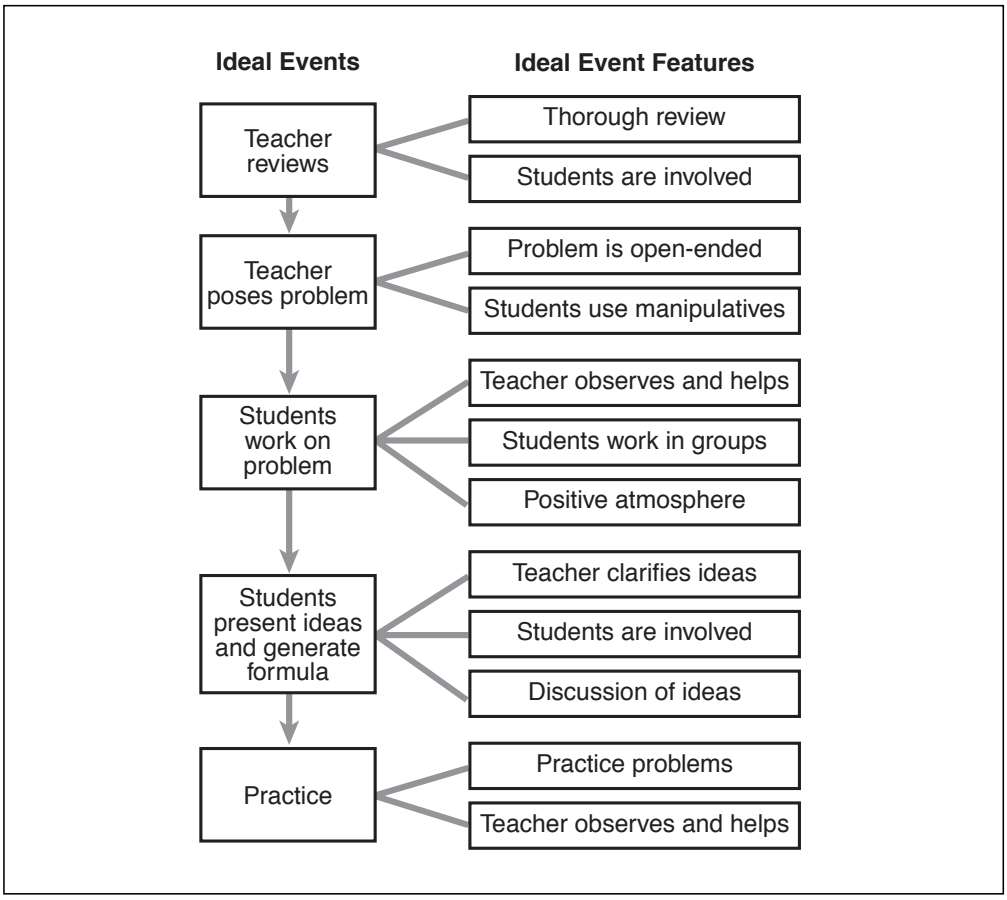

Figure 1. American teachers' ideal script for the Japanese lesson.

involvement, including the chance to present their ideas at the blackboard and to note whether their approach was the same or different from each presented idea. However, the American teachers had divided opinions about whether there was enough class discussion of the students' ideas.

This lesson ended in an appropriate manner in the view of most of the American participants, with the instructor providing time for students to *practice* what they just learned. Generally the American teachers approved of the practice assignment and were supportive of the instructor's efforts to observe and help students as they worked independently.

Japanese Teachers' Evaluations of the Japanese Lesson

Table 5 presents the topics most commonly mentioned by the Japanese teachers as they evaluated the Japanese lesson, and indicates how often their idea units were positive ones. Our hypothesized ideal script for the Japanese teachers viewing this lesson, as suggested by their critiques, is provided in Figure 2.

Table 5
Mean Percentage of Japanese Teachers' Frequently Mentioned Idea Units and Strengths Within Each Segment of the Japanese Lesson

Segment	Events/features	Japanese teachers—Japanese lesson % Idea units	% Strengths
1	Presentation of the problem		
	Specific nature of the problem	52 (39)	0
	Discussion of the problem	13 (21)	0
	Time spent presenting the problem	21 (32)	11
	Use of manipulatives	51 (40)	31
2	Students attempting to solve the problem on their own		
	Teacher's observation and help	65 (37)	49
	Amount of work time	15 (22)	92
3	Class discussion about the solutions, leading to the formula		
	Teacher's clarification	22 (26)	31
	Teacher's extension of students' ideas	14 (23)	5
	Discussion of ideas	25 (22)	18
	Time spent presenting and discussing ideas	24 (26)	6
4	Practice problems from the textbook		
	Nature of practice problems	55 (48)	0
	Timing	46 (52)	0

Note. Standard deviations are shown in parentheses.

The Japanese teachers who evaluated the Japanese lesson had a very different perspective from the American teachers on how that lesson could have been carried out most effectively. The first striking difference between the Japanese and American teachers' ideal scripts is that the Japanese teachers' script does not include a review. In fact, the Japanese teachers rarely used the word *review* when commenting on the beginning of this lesson.

Instead, the focus of their Segment 1 comments was exclusively on the instructor's *posing of a problem.* The Japanese teachers pointed out specific features of this event that they wanted to see, and they were considerably more critical about them than the American teachers were. First, they were extremely disappointed by the specific nature of the open-ended problem that the instructor posed. For example, a number of Japanese participants complained that the instructor gave the students too many different types of triangles to work with. Second, they agreed with one another in regretting that the problem was not actively discussed by the class. Third, they criticized the instructor for failing to provide plenty of time for this process. Finally, like the American teachers, they noted the importance of providing students with appropriate manipulatives to solve the problem. However, the Japanese teachers were more critical on this point.

In Segment 2, when students *worked on the problem*, the Japanese participants focused largely on two features. One frequent topic, which overlaps with a topic raised by the American participants, was the importance of the instructor observing

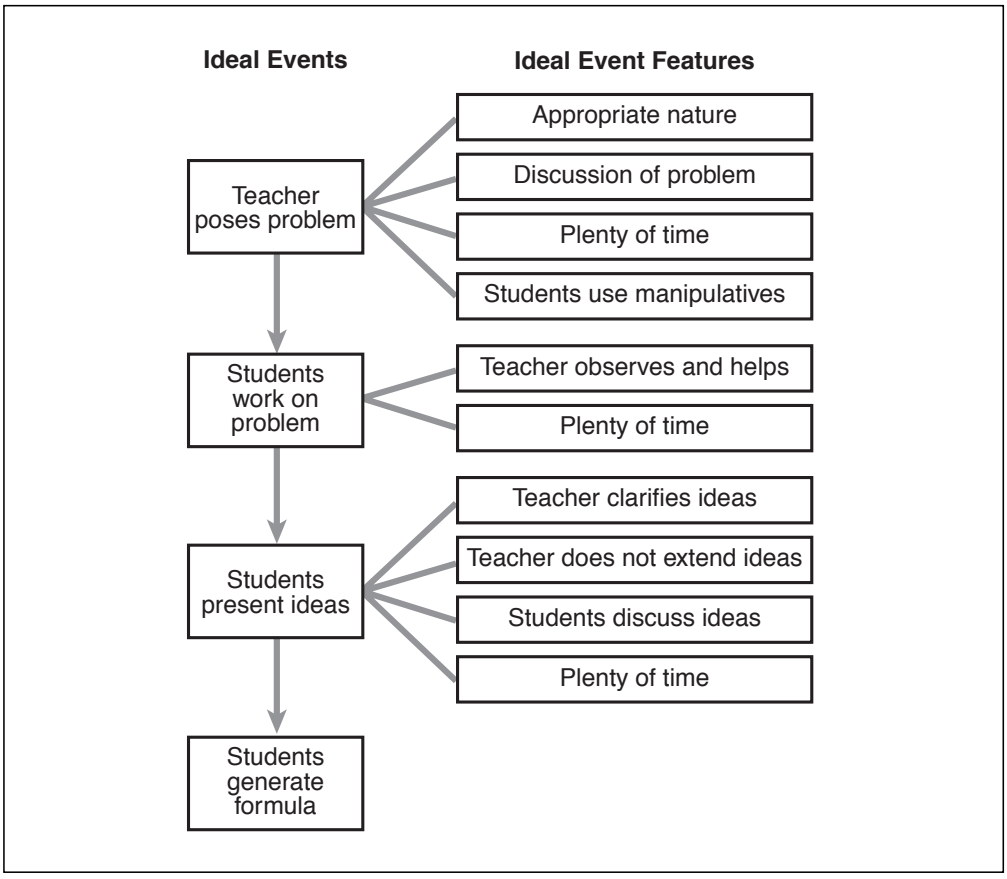

Figure 2. Japanese teachers' ideal script for the Japanese lesson.

and helping her students. Here again, the Japanese teachers' impressions were less favorable than the Americans'. By contrast, however, the Japanese teachers were quite impressed by the amount of time that the teacher devoted to this segment of students' independent work.

The Japanese teachers had a very different take from the American teachers on Segment 3, in which *students presented their ideas and generated the formula*. For example, the Japanese teachers were much more critical than the Americans teachers were of the instructor's attempts to clarify students' presentations. A related opinion expressed by the Japanese teachers was that the instructor should not extend students' ideas at this point in the lesson. For instance, they said that the instructor should not be the one to suggest the formula. Many of the Japanese teachers remarked that there was not enough class discussion, and they went on to say that the instructor should have worked harder to get students involved in discussing one another's approaches. Last, the Japanese participants noted that more time should have been spent in presenting and discussing the various solution methods.

From their comments regarding Segment 3, we hypothesize that most of the Japanese teachers wanted to see two clearly distinguished events: *students*

presenting ideas and then *students generating the formula*. In their ideal script for this lesson, students would first be asked to present their ideas, without any mention of formulas unless the students happened to bring them up. Then the instructor would gradually guide her students to generate the formula.

The Japanese teachers were also very negative about Segment 4, when the *students were assigned practice problems*. Many complained about the specific nature of the practice problems, commenting, for example, that the problems were not related to the hands-on activity just completed. They also frequently offered harsh critiques of the timing of these problems and the pacing of the lesson in general. The Japanese participants suggested that the class time would have been used to better advantage if the teacher had spent more time on the other segments of the lesson, as opposed to work on practice problems. For this reason, practice was not an event that we hypothesized that we should include in the Japanese teachers' ideal script for this lesson.

American Teachers' Evaluations of the American Lesson

The topics most commonly mentioned by the American teachers as they evaluated the American lesson are presented in Table 6, along with the percentage of comments that were coded as strengths. Our hypothesized "ideal script" for this lesson, as suggested by the American teachers' critiques, is provided in Figure 3.

Table 6
Mean Percentage of American Teachers' Frequently Mentioned Idea Units and Strengths Within Each Segment of the American Lesson

Segment	Events/features	American teachers—U.S. lesson % Idea units	% Strengths
1	Review concept of perimeter		
	Content of review	63 (42)	82
	Assess students' prior knowledge	32 (46)	100
2	Area of a rectangle—explanation, formula and practice problems		
	Explanation of formula and terminology	22 (16)	75
	Students answer teacher's questions	24 (19)	48
	Teacher's use of visuals	16 (12)	72
3	Area of a triangle—explanation, formula and practice problems		
	Explanation of formula and terminology	14 (14)	50
	Nature of practice problems	19 (17)	40
	Discussion of formula	16 (14)	33
	Classroom atmosphere	18 (16)	47
	Teacher's use of visuals	11 (15)	67
4	Students began homework assignment		
	Nature and presentation of practice problems	54 (33)	29
	Teacher's observation and help	19 (21)	45
	Classroom atmosphere	16 (20)	17

Note. Standard deviations are shown in parentheses.

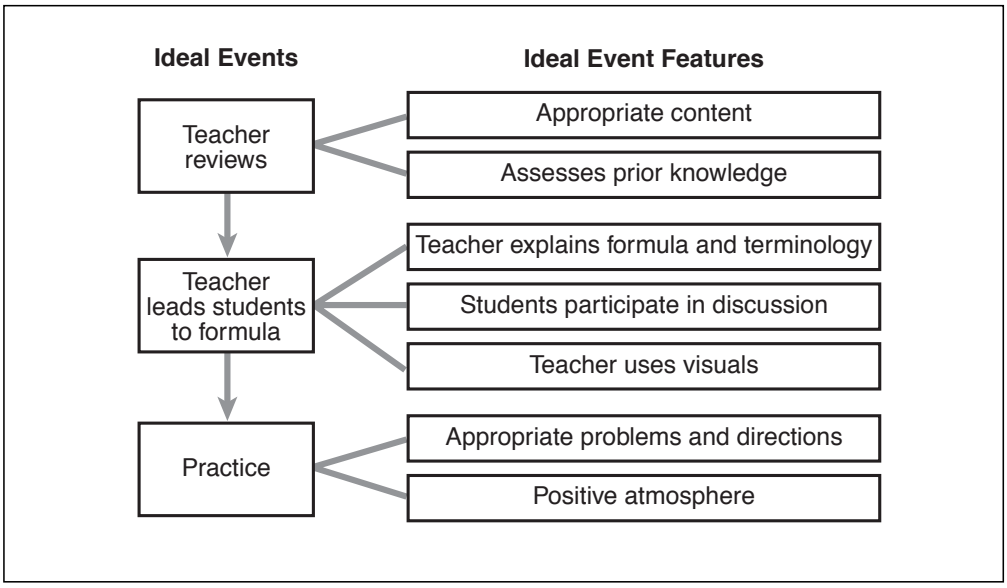

Figure 3. American teachers' ideal script for the American lesson.

Like the American teachers who viewed the Japanese lesson, the American teachers who viewed the U.S. lesson commented frequently about the *review* in Segment 1. These comments generally focused on the instructor's presentation of the review material and the extent to which he assessed students' prior knowledge before introducing new material. Most teachers agreed that the review content presented in the beginning of this American lesson was appropriate and clearly linked to the new content and that the students were adequately involved.

After the brief review, the next segment consisted of the *instructor presenting the formula and guiding practice*. During this segment, the American participants frequently made positive references to the instructor's explanation of the formula for area of a rectangle and related terminology, such as square units. They also focused on the students' verbal involvement, remarking on such details as the quality of the questions posed to students and their engagement in answering. The American teachers were split as to whether students were involved enough or whether the instructor should have engaged them more. There was more agreement about the positive effects of the instructor's use of visuals.

The third segment of the American lesson is conceptually similar to the second; again, the *instructor presented a formula and guided practice*. Many of the idea units brought up during Segments 1 and 2 by the U.S. participants were quite similar, but the tone was often less positive in the third segment. For instance, in Segment 3, the American teachers were more divided in their impressions of how well the instructor explained the formula for area of a triangle and the necessary terms. Related complaints centered on the perceived lack of involvement by students in discussing the formula. In addition, some teachers criticized the prac-

tice problems that the instructor worked through with the class, although other teachers were more positive. A number of participants took note of the classroom atmosphere during this segment, with about half of their idea units on this topic coded as strengths. As in Segment 2, many American teachers commented that they were pleased to see the instructor using visuals.

The final segment of the U.S. lesson was a *practice* segment, during which students began to work on their homework assignment. The American participants often spoke about the nature of these problems as well as the directions provided by the instructor. A large percentage of these comments were negative, with participants maintaining, for example, that the instructor was too rigid in his requirement that students write out every step of the solution process. The American teachers also looked for the instructor to observe and help students as they worked independently on the homework problems, but many felt that the classroom atmosphere was not sufficiently positive.

The U.S. lesson cycled through two events, learning formulas and practicing, several times—first when students learned how to compute the area of a rectangle and again when they learned how to obtain the area of a triangle. These two events comprise a recitation-practice pattern with which the American participants, by and large, expressed comfort at an ideological level. The fact that the instructor went through this cycle twice in one class was rarely described as problematic. Our hypothesized ideal script for the American teachers for this lesson therefore contains these events but for the sake of brevity lists only one cycle.

Japanese Teachers' Evaluations of the American Lesson

The topics most commonly mentioned by the Japanese teachers as they evaluated the American lesson are presented in Table 7, along with the percentage of comments that were coded as strengths. No ideal script was hypothesized for the Japanese teachers for this lesson.

In the first segment in the American lesson, the instructor asked students what they studied yesterday. The Japanese teachers hardly made any comments in reference to this *review*, in stark contrast to the American teachers, who felt that it was quite well done. (Seven idea units were suggested by the Japanese teachers during Segment 1, compared to 21 idea units suggested by the American teachers.) This brief period of time may not have been very meaningful to or well understood by the Japanese teachers.

In the next segment of the American lesson, the *instructor presented the formula for the area of a rectangle and guided students through several practice problems*. The Japanese participants had mixed impressions of the instructor's explanations. They were in agreement, however, in their objections to the type of problems that students worked on. For example, several said that the problems were not motivating enough for the students and recommended activities such as finding the area of actual objects. They also shared the opinion that students should have been more involved in this segment of the lesson, specifically by using both the blackboard

Table 7
Mean Percentage of Japanese Teachers' Frequently Mentioned Idea Units and Strengths Within Each Segment of the American Lesson

Segment	Events/features	Japanese teachers—U.S. lesson % Idea units	% Strengths
1	Review concept of perimeter (not applicable)		
2	Area of a rectangle—explanation, formula and practice problems		
	Explanation of formula and terminology	36 (26)	55
	Nature of problems presented	10 (17)	0
	Students' use of objects	19 (23)	6
	Fast pace	23 (21)	0
3	Area of a triangle—explanation, formula and practice problems		
	Explanation of formula and terminology	33 (22)	24
	Discussion of formula	25 (21)	14
	Fast pace	18 (16)	0
4	Students began homework assignment		
	Nature of practice problems	31 (41)	32
	Pace and timing	60 (36)	34

Note. Standard deviations are shown in parentheses.

and manipulatives. Furthermore, the Japanese teachers complained frequently about the fast pace.

The third segment of the U.S. lesson consisted of the *instructor presenting the formula for the area of a triangle and guiding students through practice problems*. As in Segment 2, the Japanese participants often discussed the instructor's explanation of the formula and the associated terminology, but this time their comments were more negative. The Japanese teachers frequently noted that there was not enough class discussion of the formula and that in general the pace of this segment was too fast.

During Segment 4, many Japanese teachers expressed surprise that the students were told to start on their homework assignment as *practice*. Although a few teachers said that working on homework during class time was an interesting idea that they might experiment with, most were more critical. Many teachers also commented on the pace and timing of the lesson in general, asserting, for example, that having time left over at the end of the lesson for homework was a sure sign that the teacher had not allowed enough time for the students to think at the beginning of the lesson.

The clearest impression one gets from studying the Japanese teachers' evaluations of the American lesson is that they would not use this style of teaching. Indeed, we hypothesized that their ideal version of the lesson would not overlap at all with the actual unfolding of the events in the lesson. Instead, in many of their comments, the Japanese teachers implied that they would have preferred to see the same events

as those found in the Japanese teachers' ideal script for the Japanese lesson (see Figure 2). That is, they would have posed an open-ended problem to the children, allowed them to work on the problem, had them present their ideas, and then guided them to generate the formula.

DISCUSSION

We posit that the American participants in this study have two very different ideal scripts for the Japanese and American lessons. The American teachers who evaluated the Japanese lesson seemed to have in mind an instructional scheme that includes a thorough review, an open-ended problem that children work on using manipulatives and in groups, a period of time for sharing and generating the appropriate formula, and, finally, time for practice. By contrast, the American teachers who watched the U.S. lesson seemed to critique it according to an instructional scheme that includes reviewing and then cycles consisting of teacher-led development of the formula followed by practice time. One interpretation of the American teachers' evaluations is that they reflect underlying scripts that are consistent with and supportive of both nontraditional and traditional elementary school mathematics instruction.

This interpretation invites the question: Are American teachers largely comfortable with *any* type of mathematics instruction? We hope that this study prompts further investigation of this topic, but we suggest that our data indicate some degree of consistency in American teachers' evaluations of videotaped lessons. In the ideal scripts that we hypothesized for both the Japanese and U.S. lesson, reviewing was seen as the event that should occur at the beginning of the lesson and practice was seen as the event that should occur at the end of the lesson. The major difference between these scripts involved the development of the new mathematical concept or formula. In the Japanese lesson, the American teachers supported having the formula develop through three steps: the teacher poses an open-ended problem, the students work on it, and the students then present their ideas and generate the formula. By contrast, in the U.S. lesson, the American teachers supported having the formula emerge through the instructor's gradual assistance of his students in discovering it.

Why might American teachers be so comfortable with very different approaches to introducing a new mathematics concept? Prior research has found a disconnection between what instructors in the United States know about mathematics teaching and how they actually teach. Stigler and his colleagues (1999) found that the American mathematics teachers they videotaped employed very traditional instructional practices and rarely incorporated reform techniques. However, these same teachers reported that they were quite familiar with the reform literature. On the basis of the data in this paper, it appears that American teachers have, at least at an ideological level, blended a number of reform notions into their conception of effective mathematics teaching. Perhaps knowledge of an alternative approach to teaching, and the ideological shift that supports this revised method, has predated

its actual use in American classrooms. That is, these evaluations may reflect a belief in the beneficial aspects of certain reforms, even if teachers do not yet implement such reforms in their own classrooms.

Unlike the American teachers, the Japanese teachers in this study had only one ideal lesson script that they wanted to see carried out in both of the lessons they critiqued. In general, they felt strongly that the lesson should contain a well-planned problem or set of problems to introduce a new concept, time for the students to work on and discuss the problem(s), and an opportunity for students to generate the formula themselves with minimal teacher direction. Reviewing and practicing are not central in this lesson script. Instead, the emphasis is on providing plenty of time for conceptual development, which is seen to occur in four ideal events: the teacher poses the problem, the students work through it, they share ideas with guidance from the teacher, and they arrive at the intended conclusion. This model of effective conceptual development appears to be at the forefront of Japanese teachers' minds when they evaluate an introductory mathematics lesson. The fact that the U.S. lesson followed a very different model, which included more time for practicing than for exploring the underlying concept, seemed both to surprise and to frustrate the Japanese teachers.

These teachers' ideal script for the Japanese lesson is in fact closely tied to "typical" Japanese mathematics instruction (Stigler et al., 1999; Stigler & Perry, 1990), and is also strongly supported by the Japanese literature on effective teaching (e.g. Becker & Shimada, 1997). Our Japanese participants seemed to have well-developed and exacting criteria for lessons that attempt to follow such a model. They related clear, consistent opinions about what good teaching involves and could often explain why one method would be preferable to another.

Several explanations are possible to account for the fact that the Japanese teachers had only one, relatively detailed ideal script. Japanese teachers typically have a good deal of experience watching and critiquing other Japanese lessons and having their own lessons critiqued (Sato, 1993). Japan has a well-established in-service development protocol that requires teachers to participate in this sort of exercise. Furthermore, the Japanese educational system is highly centralized, and teacher practices and the accompanying beliefs of Japanese teachers are likely to be more widely shared. Specifically, in Japan there may be a more detailed and unified theory about how to teach an introductory mathematics lesson (see Becker & Shimada, 1997).

IMPLICATIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

The results from our study suggest that American teachers may have more culturally sanctioned options for teaching an elementary school mathematics lesson than Japanese teachers do. One implication of these findings is that the instructional scripts of American teachers could be more easily changed, particularly in the direction that U.S. reformers would like to see. Note that some efforts

to make fundamental changes in both teachers' beliefs and mathematics instruction in the United States have had modest success (e.g., Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996). By contrast, Japanese teachers might be more knowledgeable about the specific instructional pattern that is dominant in their mathematics classrooms and might have more fully developed schema about effective practices. Participating in "lesson study" with other teachers would be likely to strengthen and reinforce their views (Stigler & Hiebert, 1999).

The data presented in this article should be considered as baseline information that other researchers might draw on to ask related questions and generate hypotheses. Some limitations of our method and sample should be taken into consideration. For instance, we showed teachers only one of two lessons and therefore can make no conclusions about how generalizable or stable their evaluations would be across lessons. Also, these lessons are introductions to an elementary mathematics topic. Other types of lessons, such as practice or review, might yield very different results, as could lessons in different subject areas. Furthermore, the participants in this study represent a convenience sample. Ideally, video-viewing methodology, similar to that presented here, would be implemented using a considerably larger, random sample of teachers. Such a sample would allow a thorough exploration of important within-country factors, such as experience and mathematical knowledge.

In future research using the methodology developed in this paper, showing teachers two different videotaped lessons and having them compare and contrast the lessons might prove interesting. This type of comparison would allow researchers to examine teachers' evaluations of the *most* ideal script for a mathematics lesson, as well as why one script might be more effective than another. Another suggestion is to investigate within-country differences, such as the differences between more and less reform-minded teachers. Finally, a more thorough probing of teachers' comments—including asking them why they believe that particular events are strengths or weaknesses, or how they think that such events could be improved—would help elicit more ideas that could aid in the interpretation of teachers' ideal lesson scripts.

The methodology described in this paper has the potential to uncover teachers' underlying notions about what constitutes effective instruction. Examining and critiquing fellow teachers helps to bring clear, specific, and detailed opinions to the surface, which can then be examined by teachers, researchers, and policymakers. Ultimately, this type of exercise may produce more reflective teachers, more informed researchers, and more effective practice in the classroom.

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