Treatment Video Coding Scheme

This scheme was used to code treatment teacher videos. The codes target several additional features (beyond the core instructional practices deemed integral to the use of our materials) that were hypothesized to be instrumental to promoting learning. Coding was at the lesson level.

MAKING SENSE OF PROCEDURES

This code is intended to capture the extent that the teacher's explanations and/or questions are intended to push students toward making sense of procedures and strategies in the WEP portion of the lesson and refers to deliberate actions that the teacher takes. Some WEPs are explicitly designed with questions and dialogue focused on making sense of procedures, while others are not. Some of what the teacher may focus on – in the form of questions and/or explanations – that signal her interest in students' sense-making of procedures are the following:

• The WHY that supports individual steps in a procedure (e.g., WHY you plug in x = 0 into a linear equation when finding the y-intercept)

• The WHY that explains the solution generated by a procedure (e.g., when the ordered pair (x, y) is a solution to a system of linear equations, this means that (x, y) is the point of intersection of two lines and/or results in a true statement when plugged into both equations)

• The purpose/mathematical goal of a procedure (e.g. using quadratic formula allows us to find the roots of a parabola)

• The mathematical properties underlying a procedure (e.g., how FOIL is really the distributive property, how y = 2 is a horizontal line because all of its point have the form (x, 2); that shaded points in graphs of inequalities indicate values that make the inequality true)

• The WHY indicating the reasons for that a procedure holds (e.g. when you multiply exponents with a common base, you can add the exponents because multiplication works as repeated addition)

Also, note that this code is intended to capture teachers' efforts to make sense of procedures in the *whole class portions* of the class, *not* in partner or group work.

1- Little or no focus	Low – incidental focus	Medium – moderate focus	High – major and sustained focus
Includes little or no indication that the teacher is interested in having students make sense of procedures. If there are sense-making questions or explanations in the WEP, the teacher does not go beyond a rare brief comment.	While making sense of procedures, in the form of teacher questions and explanations, occurs *occasionally* or *incidentally*, it is not sustained or an explicit focus of the instruction. The teacher asks questions or provides explanations focused on sense-making – either those in the WEP or supplements. Even if there are multiple instances of such questions and explanations, these are relatively infrequent, short in duration, and done in passing.	Making sense of procedures clearly happens in explicit ways. This focus is neither incidental – occurring occasionally or in passing – nor is it a sustained major focus of the lesson. Rather, sense-making occurs for one sustained time or for several times, including questions and explanations that are part of the WEP but perhaps supplements as well.	Making sense of procedures is a prominent, explicit, and *major focus* of the WEP portion of the class. The teacher not only utilizes questions and explanations included in the WEP in pursuit of this focus *but also supplements with additional explanations and questions pushing students to make sense of procedures.*

This code is intended to capture the extent to which teachers present procedures and strategies such that students had the opportunity to develop procedural flexibility, particularly focusing on multiple strategies and working with students to consider which strategies to use on certain problems, and this code focuses on the actions that the teacher takes in support of procedural flexibility. Note that most WEPs contain some built-in support for procedural flexibility, since multiple strategies are always presented. And some WEPs are explicitly focused on procedural flexibility, particularly "Which is better?" WEPs. Also, note that this code is intended to capture teachers' efforts to support procedural flexibility in the *whole class portions* of the class, *not* in partner or group work.

In supporting procedural flexibility, the teacher may:

• Discuss multiple strategies for approaching the same problem, perhaps with a focus on when a particular strategy may be especially beneficial or efficient to use

 • Attend to applicability conditions of a procedure (e.g. by noting when it can or can't be used or what problem conditions led to the choice of a given procedure)

 • Attend to the key conditions of steps within a procedure to be able to understand its usefulness/efficiency in specific situations as opposed to other situations

 •Use a heuristic or identify a problem type for evaluating when a procedure is useful or efficient (e.g., when we see problems that look like <problem feature> it means this strategy might be a good idea)

1 - Little or no focus	Low – incidental focus	Medium – moderate focus	High – major and sustained focus
Includes little or no indication that the teacher is interested in having students develop procedural flexibility. The teacher does not go beyond a rare brief comment related to flexibility in these strategies.	Procedural flexibility is an incidental or occasional focus. This may occur when the WEP is explicitly focused on flexibility but the teacher does not dive into or dwell on flexibility. It may also occur when the WEP is not focused on flexibility but the teacher occasionally asks questions or makes short explanations related to flexibility. Even if there are multiple instances of such questions and explanations, these are relatively infrequent, short in duration, and done in passing.	A focus on procedural flexibility clearly happens in explicit ways during the WEP implementation. This focus is neither incidental – occurring occasionally or in passing – nor is it a sustained major focus of the lesson. Rather, emphasis on flexibility occurs for one sustained time or in several times, including questions and explanations that are part of the WEP but perhaps supplements as well.	Procedural flexibility is a prominent, explicit, and *major focus* of the WEP portion of the class. The teacher not only utilizes questions and explanations included in the WEP in pursuit of this focus but *also supplements with additional explanations and questions pushing students to be flexible.*

TEACHER QUESTIONING

This code is intended to capture the extent that the teacher (via questioning) creates an opportunity for students to engage in deep and sustained mathematical thinking. (These types of opportunities for deep thinking are presumed to occur as a result of the types of questions that teachers ask.) The coding levels refer to the kinds of teacher questions that are most salient or instrumental in the mathematical work of the lesson. Questions asked that do not play a role in the mathematical work of the class are not considered (e.g., logistical questions). We also note that we consider as questions only those statements from the teacher that are asked with the interest of being answered – meaning that rhetorical questions (e.g., "Alright?") or questions asked without any pause or attention to the possibility that students might answer (e.g., "Any questions?" without a pause for anyone to answer) are not counted as questions. We consider the following framework for questions.

Type 1 questions are yes/no questions or, more generally, questions that can be (and may indeed be) answered with a single word or number.

Type 2 questions can generally be answered within a sentence and typically have a clear right or wrong answer.

Type 3 questions are open-ended questions, often require longer answers, and generally do not have a pre-established or right/wrong answer.

Also, note that this code is intended to capture teacher questioning in the *whole class portions* of the class, *not* in partner or group work.

1 – Little or no questioning	2 – Mostly Type 1 questions	3 – Critical mass of Type 2 questions	4 – Critical mass of Type 3 questions
A teacher is not asking students questions but instead is generally doing the talking herself. When questions included as part of the WEP are asked, they are asked rhetorically such that there is no clear expectation that students will answer and/or the teacher answers the questions herself.	Lesson is dominated by Type 1 questions. The teacher poses questions that students are intended to answer, but the answers provided or required are generally short (e.g., yes/no, or numbers). There may be some higher-level questions, such as those included as part of the WEP. But on the whole, the majority of the lesson revolves around the teacher's use of Type 1 questions.	Lesson is dominated by Type 2 questions – where students are expected to provide answers that are longer than a word but where generally there is a right and a wrong answer. Some Type 3 questions may be used – particularly those included as part of the WEP. But the use of Type 2 questions is a substantial component of the lesson, including the teacher supplementing the provided questions with additional questions of Type 2.	The lesson contains a significant number of Type 3 questions, where students are asked to elaborate, to speak for more than one sentence, and to make interpretations or judgments. There may be lower level questions used by the teacher, but the presence of (and time spent asking and answering) Type 3 questions is a substantial part of the lesson. This usually requires teachers asking supplemental Type 3 questions not in the WEP materials.

STUDENT RESPONSES

This code is intended to capture the extent that the classroom environment created by the teacher is one where students feel comfortable expressing themselves and *that a variety of students do so* – that students are inspired to contribute in response to mathematical questions from the teacher. Because of poor student audio, it is generally not possible to hear what students are saying. So in this code, it may often be necessary to infer the nature of students' responses based on how teachers respond to the students. Also note that we are only interested in students' responses to mathematical questions. The code focuses on the characterization of students' responses to teachers' questions during the lesson, including how many students are responding to questions, the length of each student's turn while talking, and the content of students' contributions (when it is possible to hear them). Also, note that this code is intended to capture student responses in the *whole class portions* of the class, *not* in partner or group work.

1 - Little or no individual responses	2 – Regular short individual responses	3 - Mix of short and long individual responses	4 – Substantial and elaborated responses from many students
Almost entirely focused on teacher talk. Students' responses are limited to 'choral' (group) responses to teachers' questions or occasional individual (e.g., called upon by name or hands raised) responses to Type 1 (yes/no) question. The total number of students in the class who are participating by offering individual (called by name) responses is small.	Students respond to the teacher's questions regularly throughout the WEP portion of the lesson. But the nature of students' responses is mostly in the form of single words or short sentences. A variety of students in the class are offering individual responses – e.g., many students in the class are called upon to participate.	Students respond to the teacher's questions regularly throughout the lesson. The nature of students' responses is a mix of short (one word or a short sentence) and long – where a long response is when a single student holds the floor for about 15 seconds or more. The lesson may include a few instances where one or more students offer longer responses, yet only a small number (one or two) students offer these longer responses. Yet a relatively large number of students are called upon to participate generally (attend to whether this last sentence should be kept in code)	Lesson is characterized by several students taking relatively long speaking turns in response to teachers' questions. Students are regularly responding to teachers' questions during the lesson, and there may be some other forms of responses (e.g., short or one-word responses). But in general, a noteworthy feature of the lesson is that students are talking in long turns and the teacher is asking questions and listening a lot to students' contributions.

The interaction code is intended to assess the degree to which the teacher creates a classroom environment where students begin engaging in mathematical talk with each other and not only with the teacher. By virtue of the ways that she responds to students' utterances, the teacher not only asks good questions (captured in the teacher questioning code) and the students not only feel comfortable responding (captured in the student responses code), but the teacher also encourages students to listen to, interact with, and respond to each other. Among the strategies that the teacher could use to push students in this direction are deflecting a question directed at the teacher and posing it back to a student, asking a student to rephrase what another student has said, and asking a student whether she disagrees with another student and why. Because we usually cannot hear students' utterances, this code does not consider whether the teacher's encouragement efforts in this direction are fruitful. Also, note that this code is intended to capture student interaction in the *whole class portions* of the class, *not* in partner or group work.

1 – Little or no teacher attempts to encourage interaction	2 – Low - Occasional and/or infrequent teacher attempts to encourage interaction	3 – Medium - Moderate teacher attempts to encourage interaction	4 – High- Major and sustained teacher attempts to encourage interaction
The teacher does not attempt (in her use of questioning) to encourage student interaction or her limited attempts are not successful.	The teacher's attempts to stimulate student interaction through her questions occur infrequently and may include tactics such as asking multiple students the same question.	Teacher attempts to stimulate student interaction through tactics such as rephrasing student contributions in order to direct them to other students, or asking other students to rephrase a student's work, clearly happens in explicit ways. This focus is neither incidental – occurring occasionally or in passing – nor is it a sustained major focus of the lesson.	Teacher attempts to stimulate student interaction through tactics such as rephrasing student contributions in order to direct them to other students, or asking other students to rephrase a student's work is a prominent, explicit, and *major focus*