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Teacher Logs: A Tool for Gaining a Comprehensive Understanding of Classroom Practices

Abstract

Examining repeated classroom encounters over time provides a comprehensive picture of activities. Studies of instructional practices in classrooms have traditionally relied on two methods: classroom observations, which are expensive, and surveys, which are limited in scope and accuracy. Teacher logs provide a "real-time" method for collecting data on classroom practices by giving teachers a tool to document and reflect about specific lessons and the impact they may have had on their students. Logs can collect data for review by teachers, their colleagues, administrators, and researchers. These self-reported data, collected online repeatedly over a specified period of time, present a series of snapshots that capture ongoing classroom practices and lesson strategies. In this article, we describe the use of teacher logs to understand classroom practices by highlighting the kinds of activities teachers emphasized and their perceptions of effectiveness. In a National Science Foundation-funded evaluation of a high school reform program, we used online teacher logs to understand the education delivery in Science, Technology, Engineering, and Mathematics (STEM) subjects in redesigned North Carolina high schools. We find that teacher logs are an appropriate, efficient, and useful tool for documenting practice. Teachers can use log data to reflect on practice, determine areas of strength and challenge, and set goals for personal improvement. Administrators can use logs to support teachers in examining practice and setting goals.

Keywords: instruction, classroom practice, student engagement, pedagogy, problem-based learning, STEM, logs

Introduction

The study of instructional practices in classrooms has traditionally relied on two methods: classroom observations, which are expensive, and surveys, which are limited in scope and accuracy. Teacher logs provide a "real-time" method for collecting data on classroom practices by giving teachers a tool to document and reflect about different lessons and the impact they may have had on their students. Logs can be developed to collect data for review by teachers, their colleagues, administrators, and researchers. These self-reported data, collected online repeatedly over a specified period of time, present a series of snapshots that capture ongoing classroom practices and lesson strategies. This type of data collection can help teachers reflect on their implementation of new practices and programs at school. Here, we focus on teachers in schools that have undergone Science, Technology, Engineering, and Mathematics (STEM) reform.

Many practitioners and evaluators agree that dynamic, interactive instructional practices are a key component of Science, Technology, Engineering, and Mathematics (STEM) education. Approaches such as creativity strategies, problem-based learning, and learning through design are particularly effective for reinforcing STEM-based material (Clark & Ernst, 2007). If instruction motivates students, then students are likely to value their educational endeavors and perhaps even seek similar educational experiences in the future (Durik & Harackiewicz, 2007). Ultimately, the instruction students receive should inspire and motivate them to pursue STEM careers. To connect content to students' interests, STEM teachers are encouraged to embed content in real-life practical problems (Community for Advancing Discovery Research in Education, 2012). As the National Science and Technology Council's Committee on STEM Education points out, the President's Council of Advisors on Science and Technology (PCAST) concluded that STEM teachers should have "enough content knowledge to link STEM to compelling real-world issues, model the process of scientific investigation, effectively address student misconceptions, and help their students learn to reason and solve problems like mathematicians, scientists and engineers" (Committee on STEM Education, 2013, p. 18).

North Carolina New Schools (NCNS) along with the New Tech Network (NTN) supported the development of STEM high schools with guidance and professional development. The authors worked with NCNS to study a set of schools that had received support from NCNS. NCNS's vision for STEM emphasized making connections in the fields of math and science; meaningfully integrating technology; and helping students cultivate creativity and develop problem solving, communication, and collaboration skills. NCNS provided professional development to teachers to help them create classrooms with these characteristics. Some schools working with NCNS also received professional development from NTN. This National Science

Foundation-funded study examines how much these professional development experiences influence the daily classroom practices of the participating teachers. We developed online teacher logs to obtain evidence as to whether teachers routinely used instructional practices aligned with the NCNS and NTN goals and professional development.

Teacher Logs

When Ball, Camburn, Correnti, Phelps, and Wallace (1999) conducted a pilot study of the usefulness of teacher logs as a web-based tool, they asked teachers to make note of a number of variables that fell into four main categories: (a) the nature of student work, (b) the specific activities in which students engaged, (c) the teacher's actions, and (d) the topics and content covered. The authors found that by documenting classroom practices, such as how students were grouped, what materials they used, which types of activities were used to engage students, what the teachers were doing, and how the content was presented, they could form general insights as to the typical practices employed in the classroom. In studying the use of logs to determine the quality of instruction, Rowan and colleagues (Rowan, Jacob, & Correnti, 2009; Rowan & Correnti, 2009) identified four dimensions of teacher-student interplay that were important to assessing the quality of an educational setting. Dimensions they studied included:

- Social relationships among students and between students and teacher,
- Coherence and cognitive demand of content,
- Pedagogical practices of the teacher, and
- Order and organization of the classroom.

The original research with online logs (Ball, Camburn, Correnti, Phelps, & Wallace, 1999; Rowan & Correnti, 2009; Rowan, Jacob, & Correnti, 2009) was validated in elementary school mathematics and reading classes. These studies provided the framework in which RTI developed teacher logs to study selected STEM high schools in North Carolina. Ball's work was particularly applicable to RTI's study as it focused on obtaining a more complete picture of what teachers do when teaching math (e.g., what materials they use, how they approach instruction) and analyzed the impact of interventions on instruction.

RTI's study examined the characteristics of classroom instruction in the STEM schools and the extent to which it reflected NCNS goals. We wanted to determine the priorities teachers set for instruction, the variety of activities in which students were engaged, the way students used technology in the classroom, and how frequently lessons incorporated various attributes. Teacher logs provided a vehicle for continuously monitoring the pedagogical techniques teachers utilized to engage students in problem solving and collaborative practices.

Method

Site-Based Implementation

Because multiple site visits would have been cost-prohibitive and possibly disruptive to the school day, we designed teacher logs based on research (cited above) which indicated that these logs are an effective way to collect reliable data on the frequency with which teachers use different types of instructional activities when multiple observations are not an option. Teachers were asked to log about one specific class period (e.g., geometry first period, earth science fourth period) throughout the study in order to provide an ongoing series of snapshots of that class and the experience of its students. To minimize the burden on teachers, the log had only five open-ended questions, three of which were only asked on the first administration. The remaining questions required teachers to rate the lesson attributes on scales from 1 (low) to 5 (high). Specific descriptors on the scales varied based on the questions asked (e.g., "never" to "often," "not important" to "moderately important") but always indicated that 1 was the lowest rating and 5 was the highest rating.

We designed four sections similar to the dimensions recommended in the earlier research: (a) general information and classroom context (teacher and student demographics, teacher preparation and licensure, classroom materials available), (b) lesson description (content and topics, student tasks), (c) instruction (materials and student engagement strategies), and (d) implementation (teacher reflection on lesson success/progress). Pilot testing of the log instrument showed that test subjects took between 10 and 12 minutes to complete a log. Because we would not expect general information and classroom context to change much over the course of the term, questions pertaining to general information and classroom context were asked only on the first log. Sections on the lesson description, instruction, and implementation were included in every log because they could vary within each lesson.

We used the logs in two academic years. Each year, we selected four teachers from each school to complete a predetermined number of logs. The typical configuration included two math and two science teachers; but, when possible, we included health, agriculture, and engineering teachers. These options were limited in the small schools participating in this study. Because the research suggested that the usefulness of the log data tapered off somewhere between 10 and 20 logs (Rowan and Correnti, 2009), we set the threshold at 14 in the first year and 12 in the second year.

In the first year, we collected logs from 10 schools, and in the second year, we limited data collection activities to three schools. The Year 1 response rate varied by school, and some teachers in some schools did not participate. In Year 2, RTI collected logs from 12 teachers at three schools. We also added face-to-face training and reduced the logging period to one semester, which increased response rates. For one third of the logs, we set target dates for completion to coincide with our site visits, and teachers chose when to complete the remainder. In year 2, we requested a total of 144 logs and received 122.[1]

[1] In school 1, all four teachers completed the required 12 logs. In school 2, one teacher quit logging after one entry and another teacher logged eight times. In school 3, one teacher logged five times, while the rest completed the required 12 logs.

This article focuses on Year 2 because it had more complete response rates. The schools included in this year tend to serve students who were underrepresented in college and in STEM fields. Table 1 shows the characteristics of these schools.

Two of the schools are in rural areas, and one is in a town. By design, these small schools serve fewer than 400 students. In all of them, at least half of the students are members of ethnic groups underrepresented in college and in STEM fields, and at least half are eligible for free- or reduced-price lunch. One of the schools (school 2) has faced challenges attracting and retaining highly qualified teachers, and 67 % of its teachers were novices (i.e., had fewer than four years of experience). Only about two thirds of school 2's teachers were fully licensed. The turnover rate for school 2 was 50 %, while turnover rates for schools 1 and 2 were 7% and 14%, respectively. In comparison, state-level data show that 20% of all North Carolina teachers were novices, 93% were fully licensed, and the teacher turnover rate was 16% (North Carolina Department of Public Instruction, 2014).

Technical Implementation

RTI provided teachers with a training manual, a link to the online survey site, and a unique login identifier. We sent weekly emails throughout the study to remind teachers to log and record the activities for a specific lesson. Teachers could contact a designated RTI staff member if they had questions about the log. They were asked to avoid reporting on a class that experienced atypical interruptions or shortened periods due to external influences such as school assemblies, fire drills, or special programs. By compressing the 12 required logs into an eight-week period, teachers had less chance to forget and were able to get into the habit of completing logs. Each school subsequently received a case study report, with log data aggregated to the school in order to provide a picture of instructional practices across the chosen classes, rather than a picture of individual teacher practices.

Because teacher logs are repeated surveys, we used an internally developed web-based survey tool for teacher logging. The survey tool required "emptying" after each use, so the data were transferred to a spreadsheet where they were collected and maintained throughout the course of the logging. Teachers could choose to complete the logs in a paper and pencil format. They received printed copies, which they could mail or fax. Teachers almost always chose the web-based version.

Results

A review of the log data collected from the 12 teachers who participated in the year 2 data collection revealed several interesting findings. For ease of reporting, the 12 participating teachers are designated as Teachers A-D (school 1), Teachers E-H (school 2), and Teachers I-L (school 3).[2]

[2] Teacher E logged once. Because all teachers completed the first section only once, her responses to questions in this section are included in analyses, but other portions of the single log she completed are not.

Teacher Priorities in Lesson Planning

In the first section of the logs, teachers responded to a list of lesson attributes, rating the importance of each attribute on a scale of 1 (low) to 5 (high) in developing lessons and student activities (Table 2). We compiled the list from national documents (National Research Council, 2012; National Council of Teacher of Mathematics, 2014) that recommend classroom practices designed to engage and interest students. This question was intended to reveal the teachers' beliefs and pedagogical practices and was asked only once, during the initial logging session. Teachers rated the importance of each element in a set of attributes, which included "ensure active participation by all," "encourage students to generate ideas," and "make real-world connections."

Low teacher turnover, years of experience, and shared professional development experiences seem to influence consistency of beliefs across STEM teachers within a school. Table 2 shows each teacher's responses to questions about priorities in lesson planning, along with years of experience and subject taught. Overall, school 1 had a low turnover rate and a relatively low percentage of novice teachers. School 1 was in its eighth year of operation, and all four STEM teachers joined the faculty when the school opened. Table 1 shows that 25 percent of teachers at school 1 are novice teachers, so the STEM teachers are a little more experienced than the school average. Three had more than 10 years of teaching experience. Teachers in school 1 showed more consistency in rating the importance of lesson elements than teachers in other schools in the study. All teachers had participated in the specific professional development[3] provided to the school, and collectively, they indicated that one of the greatest influences on their pedagogical approaches and teaching practice was the shared professional development they received from NTN or NCNS. Perhaps these years of shared

[3] Results about teacher professional development are available from the authors.

Table 1: Characteristics of Schools in Academic Year 2012-13

School	Urbanicity	Total students	Percent under-represented minority	Percent eligible for free or reduced-price lunch	Percent fully-licensed teachers	Percent novice teachers	Turnover rate
1	Town	128	55.5	61.7	100	25	7
2	Rural	217	76.0	57.1	67	67	50
3	Rural	148	61.5	63.5	100	50	14

Sources: National Center for Education Statistics (2014). Common Core of Data Public School Universe, 2012-2013. Washington, D:C: U.S. Department of Education.
North Carolina Department of Public Instruction (2014). North Carolina School Report Cards: 2012-13

teaching experiences influenced the consistency of their pedagogical beliefs.

In contrast, in school 2, which had the highest turnover rate and highest percentage of novice teachers overall, three STEM teachers had fewer than three years of experience. One teacher had 32 years of experience. According to NCNS, “since the founding principal retired in at the end of the 2010-2011 school year, the school has experienced tremendous and constant turnover” (personal communication, NCNS staff, April 1, 2014). Three of the STEM staff had not received the same level of professional development. Teacher E was the only STEM teacher who attended the NCNS Summer Institute in June 2013, so the current STEM faculty had not shared a professional development experience. Teacher E completed only one log, so we cannot determine her classroom practices, but Table 2 shows that the three-day institute did not prompt her to see importance in a number of the desired lesson attributes. Teacher H rated all 13 elements a 5, while the three newer teachers rated the elements with 2s, 3s, and 4s, giving only seven 5s collectively. Of the 13 attributes, only “respect students’ contributions” and “embed problem solving” were rated 4 or 5 (high importance) by all of the teachers in this school.

In school 3, two of the teachers had fewer than six years of teaching experience, while the other two were veterans with more than 10 years of experience. This school did not continue to receive direct NCNS services in 2013-14, and only teacher I attended the NCNS Summer Institute in June 2013. Teacher J reported that support in previous years had guided the development of her instructional practice. The current principal (in her second year) was a former science teacher at the school and had been there since its inception. In school 3, teachers ranked about half of the elements as important (with a score of 4 or 5).

Interestingly, the three math teachers with the least teaching experience (E, G, and J) gave most of the middle-level and low-importance ratings. They gave 20 of the 25 “3s” as well as the only “2s.” In neither school 2 nor school 3 did all of the teachers have a shared professional development experience with the NCNS or the NTN.

Student activities during the lesson. Teachers responded to questions in the remaining sections of the logs each time they completed a log. The next section focused on describing that day’s lesson, and a key question asked teachers what students did during the day’s lesson. Pedagogical options included items involving various levels of student engagement. Less-challenging activities included: listen to a presentation by the teacher, perform tasks requiring ideas or methods already introduced to the student, and assess a problem and choose a method to use from those already introduced to the student. Choices involving more critical thinking and problem solving included: perform tasks requiring ideas or methods not already introduced to the student, assess a problem and devise a creative solution, explain an answer or a solution method for a particular problem, and prove that a solution is/isn’t valid or that a method works/doesn’t work for all similar cases.

Logs indicated that teachers employed a variety of cognitive and pedagogical options for student engagement over time. Table 3 illustrates the range of cognitive processes—the means by which one acquires knowledge and develops understanding—recorded by the 11 teachers who completed multiple logs. Many teachers used all of the cognitive approaches listed over the course of the logging period. However, students in teacher B’s class engaged in very

Table 2: Importance Ratings (1-5) of Lesson Attributes by Teachers (5 = Very Important)

	School 1				School 2				School 3			
Teacher →	A	B	C	D	E	F	G	H	I	J	K	L
Years teaching →	8	18	22	15	1	0	2	32	16	5	1	17
Subject*→	S	S	M	M	M	E	M	S	M	M	E	S
Lesson attributes												
Ensure active participation by all	5	5	4	4	3	5	3	5	5	5	5	5
Respect students’ contributions/opinions	5	5	5	5	4	5	5	5	5	5	5	5
Embed opportunities for discourse	5	5	4	4	2	3	3	5	4	5	4	4
Encourage students to generate ideas.	5	5	5	5	3	5	3	5	4	4	5	4
Include challenging concepts	5	5	5	5	3	5	2	5	4	4	5	3
Encourage collaboration	5	5	5	5	4	4	3	5	5	5	5	5
Make real-world connections	5	5	4	5	3	4	3	5	4	3	4	4
Develop scaffolded questions	5	5	4	5	2	5	3	5	5	4	5	3
Allow for revisions	5	4	4	5	3	4	3	5	4	3	5	3
Focus on “big” ideas	5	5	4	5	3	5	2	5	3	3	4	4
Develop students’ confidence	4	5	4	5	3	4	4	5	4	4	4	4
Excite my students	4	5	4	4	3	4	3	5	4	3	4	4
Embed problem solving	5	5	5	4	4	4	4	5	5	4	5	3

*Note: S=science, M=mathematics, E=engineering few of these activities over 12 class periods. Having conducted site visits, we know from teacher B that, during this period, students were working on a specific project, and these listed activities may not have fit the project work. Specifically, her students were constructing and decorating a booth for a health fair, where they would display what they had learned about nutritional benefits of various diets. Much of the work during the logging period was focused on building the booth and preparing the information packets for visitors, so opportunities for cognitive engagement were low.

The activities in the table are listed in ascending level of rigor. It is striking that some teachers rarely reported that students were expected to "listen to a presentation by a teacher." Perhaps teachers believed that their own presentations were a less socially desirable response to this item and chose to log about days that did not focus on their presentations. Or, perhaps the term "presentation" seemed more formal than leading a discussion about the course concepts or delivering a short lecture. In any case, we will use caution in interpreting these results. None of these patterns would have been detected with only a single observation or one-time survey.

A second key question asked how the students would go about the assigned task; in other words, what pedagogical strategies were being employed. So, while Table 3 shows *what* students were expected to do (types of cognitive engagement), Table 4 illustrates *how* they went about the assigned tasks (variety of pedagogical options). Although teachers' responses varied widely, the first two approaches, "answer recall questions orally" and "work on textbook, worksheet, or board work exercises," together garnered a high number of responses although Teacher B did not report doing them at all. "Work on problems that have multiple answers or solution methods" and "engage in meaningful discourse of ideas, problems, solutions, or methods in pairs or small groups" also showed high response rates. Note that few teachers reported the "use of manipulatives"—visual and tactile tools—or "write extended explanations about science activities." Only two teachers ever chose the "none of the above" option, indicating that this list of activities is comprehensive. Teacher B, who selected this response in 25 percent of the lessons, seemed to be using different practices from other teachers.

Use of Technology

The next section of the logs focused on instruction and contained a question about the use of technology in the logged lessons. The question was intended to go beyond a "yes-no" inquiry about whether technology was used at all in a lesson and sought to determine the purposes for which the technology was used in each class. Choices included low-level activities such as "used for calculation" to higher forms of student engagement such as "manipulating variables in models and simulations."

Technology remains an underutilized tool in supporting lesson development, even in these redesigned STEM schools. Teachers in each school reported that students used technology for calculation purposes more than twice as often as they used it to manipulate variables in models. The first three items, "to develop conceptual understanding," "to learn or practice a skill," and "for calculation purposes," require only lower-level thinking skills with fairly passive student participation , while items such as "manipulate variables" and "collect data," are more student-led and require critical thinking and active decision-making. Table 5 shows a significant drop in the use of technology for more student-led activities.

Few teachers reported using models and simulations as problem-solving tools. Models are animations of phenomena that can be manipulated repeatedly by varying the input variables. The result of the manipulation simulates what would happen in real life and contributes to conceptual learning. The math and science concepts that can be studied using models and simulations extend the use of technology in the classroom far beyond that of a high-end calculator or online worksheet. Few teachers reported using technology to collect data - even though laptops, calculators, and cell phones can now collect data ranging from heart rate to humidity, which students could have analyzed.

As with the use of the word "presentation" discussed earlier, there is some

Table 3: Percent of Logged Lessons (n=122) in Which Teachers Reported Use of Various Cognitive Engagement Activities

	School 1				School 2			School 3			
Teacher →	A	B	C	D	F	G	H	I	J	K	L
Cognitive Engagement Activities											
Listen to a presentation by the teacher	58	0	42	58	33	100	8	25	33	58	40
Perform tasks requiring ideas or methods already introduced	92	0	58	67	83	75	92	92	75	50	100
Assess a problem and choose a method to use from those already introduced	67	0	42	42	67	75	33	58	75	0	0
Perform tasks requiring ideas or methods not already introduced	33	25	50	50	33	50	67	16	42	50	20
Assess a problem and devise a creative solution	42	8	8	33	67	63	25	16	33	16	0
Explain an answer or a solution method for a particular problem	83	25	42	50	50	88	58	67	92	50	20
Prove that a solution is/isn't valid or that a method works/doesn't work for similar cases	58	0	0	16	16	38	25	0	44	0	20

Note: Teacher G logged 8 lessons and Teacher L logged 5 lessons. Responses from Teacher E, who logged only 1 lesson, are not included in this analysis.

Table 4: Percent of Logged Lessons (n=122) in Which Teachers Reported Use of Various Pedagogical Strategies

	School 1				School 2			School 3			
Teacher →	A	B	C	D	F	G	H	I	J	K	L
Pedagogical Strategies											
Answer recall questions orally	58	0	33	8	92	63	75	75	50	8	0
Work on textbook, worksheet, or board work exercises for practice or review	58	0	67	75	33	63	92	50	92	16	20
Work on problem(s) that have multiple answers or solution methods, or involve multiple steps	67	0	50	33	67	100	42	75	92	25	40
Engage in meaningful discourse of ideas, problems, solutions, or methods in pairs or small groups	67	16	58	67	92	75	100	75	67	83	100
Use manipulatives, games, or technology activities to improve recall or skill	67	8	0	0	25	25	58	0	33	8	20
Use manipulatives, games, or computer activities to explore concepts via models and simulations	50	25	0	0	16	0	58	25	16	16	0
Write extended explanations about science activities—such as experimental design, data collection, and findings—or about mathematical ideas, solutions, and methods	50	25	0	25	33	38	16	16	0	0	0
Work on an investigation, problem, or project over an extended period of time	42	50	33	42	50	25	0	8	33	58	20
None of the above	0	25	0	16	0	0	0	0	0	0	0

Note: Teacher G logged 8 lessons and Teacher L logged 5 lessons. Responses from Teacher E, who logged only 1 lesson, are not included in this analysis.

concern about the teachers' interpretation of the term "develop conceptual understanding." This was intended as a higher-level use of technology, which was not witnessed in the classroom observations conducted in this study. Perhaps teachers thought that using technology to learn or practice a skill was how one develops conceptual understanding.

Teachers' assessments of lessons. The final section of the log asked teachers to reflect upon the progress made in that day's lesson. As noted above, the first time teachers completed a log, they responded to a question about the importance of various lesson attributes. In every subsequent log, teachers indicated the extent to which each attribute was a part of that day's lesson on a scale of 1 to 5. At no time did RTI expect that all attributes would be evident in all lessons, but rather that over time different attributes would play varying roles in the lessons as a whole. A look back at Table 2 shows that in the first log, most teachers rated most of the attributes as highly important. By repeating the question in each subsequent log, RTI hoped to compare the pedagogical beliefs expressed in the initial log to the actual classroom practice (Table 6), noting the match between the intended curriculum and the enacted curriculum.

Teachers' assessments of their taught lessons indicate that they did not simply give a desired response – they acknowledged the difference between the ideal (beliefs in Table 2) and the real (occurrence in Table 6). With repeated logs, we found differences in the way teachers responded to the inclusion of these attributes in their lessons. While many desirable lesson attributes earned 4s and 5s in Table 2, teachers were more selective in their responses and ratings when reflecting on their lessons (Table 6). As logging continued, teachers seemed to respond thoughtfully to this question, and 1s, 2s, 3s, and 4s began to appear in the data, while the number of 5s seemed to drop. However, we note that teacher H reported including almost every attribute in every lesson, and that teacher G did not incorporate any of them in most of her logged lessons. Results from teachers listing almost all 5s or 0s suggest that these teachers may have rushed through the log.

Another way to study the data is to look at the occurrence, across a teacher's 12 lessons, of each lesson attribute listed in Table 2. By looking at how often each attribute was perceived by the teachers to be evident in the 12 logged lessons, we get a sense of which ones the students experienced more often. Whereas Table 6 shows the number of 5s teachers awarded themselves in each lesson, Table 7 shows the number of lessons in which each attribute was rated a 5. Looking at the data this way supports the earlier suggestion that teachers G and H are outliers whose data do not reveal much about their classroom practice.

Table 7 presents the same lesson attributes as Table 2, but depicts them arranged by frequency of occurrence. This allows an analyst to look for a variety of trends. For example, Table 7 shows that some of the attributes rated as occurring most often in all logged lessons are those with greater behavioral relevance, but less academic relevance. Those lesson attributes rated highest and most often included respect for student ideas, collaboration, and opportunity for discourse. Academic attributes that were rated lower and occurred less frequently included making real-world connections and embedding problem-solving activities. On their first logs, teachers did not rank either behavioral or academic attributes as more important. Repeated logs

Table 5: Percent of Logged Lessons (n=122) in Which Technology Was Used to Achieve a Specific Purpose

	School 1				School 2			School 3			
Teacher →	**A**	**B**	**C**	**D**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Purpose of Using Technology											
To develop conceptual understanding	92	25	42	25	50	63	83	33	25	58	40
To learn or practice a skill	92	8	58	33	16	83	75	25	33	42	0
For calculation purposes	67	16	50	58	8	100	33	83	0	58	0
To conduct research (e.g. Internet)	67	42	33	8	75	0	16	0	0	8	0
To manipulate variables in models and simulations to study outcomes	67	0	0	16	0	13	42	25	8	8	0
As a presentation tool	16	8	8	8	16	0	0	0	58	16	40
For word processing or as a communications tool (e.g., e-mail, Internet, Web)	33	58	16	0	8	13	8	0	0	0	20
As an analytic tool (e.g., spreadsheets or data analysis)	33	16	0	8	0	0	0	0	8	8	0
To collect data (e.g., probeware, applications, sensors)	16	0	0	8	8	0	16	8	0	0	0

Note: Teacher G logged 8 lessons and Teacher L logged 5 lessons. Responses from Teacher E, who logged only 1 lesson, are not included in this analysis.

show that in practice, they focused more on behavioral attributes.

Discussion

RTI used teacher logs to examine whether instructional practices in STEM classes were aligned with the goals the professional development teachers received through the NCNS or NTN models. We found that teachers did employ a variety of cognitive and pedagogical options for student engagement over time, but that technology remains an under-utilized tool in supporting lesson development. Most teachers were able to link their many classroom activities to the program's goals.

We are encouraged by the useful role that logs played in gathering data on classroom instructional practices and student engagement. In this study, the logs revealed, through self-reported data, that the professional development provided by NCNS was not always implemented consistently across the classrooms. These differences seem to be related to teacher turnover and lack of institutionalized professional development. Low teacher turnover, years of experience, and shared professional development experiences may influence consistency of beliefs across teachers within a school.

The variety of data gathered via the logs suggests that they provide a fuller picture of instructional activity than one gets from infrequent observations and end-of-year surveys. Unlike end-of-the-year surveys, that capture recollections of general practices over the course of a year, logs target specific practices on a specific days in a specific class. This data collection tool gave us the ability to determine the importance of specific lesson attributes, the frequency and variety of different student engagement strategies used by teachers, the purposes of technology integration in lessons, and the match between what attributes teachers value in lessons and what they are actually able to embed in their lessons.

By repeatedly collecting this data over the term, we saw variation in teacher practices and observed that one teacher's reported activities differed from most of her colleagues. We were able to see the variety of ways in which students used technology in their classes. A one-time survey could have had teachers rank classroom activities or the use of technology with options like "never," "rarely," "sometimes," "often," and "always." This approach would not have yielded as much specific information about instructional practices.

Table 6: Number of Attributes (n=13) Rated "5" by Teacher by Lesson (5=Attribute Achieved)

	School 1				School 2				School 3			
Teacher →	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Lesson Number												
Lesson 1	13	8	9	9	0	7	3	13	0	2	7	9
Lesson 2	13	9	10	6		6	0	13	8	7	5	3
Lesson 3	12	3	6	8		5	0	13	5	0	11	4
Lesson 4	7	10	8	13		7	0	13	10	8	6	4
Lesson 5	4	5	10	9		8	0	12	4	0	13	6
Lesson 6	2	11	4	2		11	0	13	8	0	7	
Lesson 7	6	12	4	5		12	0	13	3	4	5	
Lesson 8	7	8	5	4		11	0	12	3	5	3	
Lesson 9	7	10	1	7		11		13	12	1	1	
Lesson 10	4	4	0	5		4		13	6	9	6	
Lesson 11	10	3	0	6		0		13	7	9	9	
Lesson 12	5	4	1	4		9		11	2	5	7	

Note: Teacher G logged 8 lessons and Teacher L logged 5 lessons. Responses from Teacher E, who logged only 1 lesson, are not included in this analysis.

Table 7: Number of Lessons in Which Teachers Indicated that They Included Specific Attributes (maximum =12)

Teacher →	A	B	C	D	F	G*	H	I	J	K	L*	Total
School →		School 1				School 2			School 3			
Attributes												
Respect students' contributions/opinions	7	10	8	10	11	0	12	10	8	10	1	87
Embed opportunities for discourse	7	10	6	10	5	0	12	10	7	10	2	79
Encourage collaboration	5	8	7	10	10	1	12	7	5	6	5	76
Encourage students to generate ideas	10	11	3	4	11	0	10	8	5	8	1	71
Include challenging concepts	5	8	3	2	7	0	12	8	6	10	3	64
Make real-world connections	7	11	4	3	5	1	12	4	2	8	2	59
Ensure active participation by all	7	2	6	7	7	0	12	2	8	6	1	58
Develop scaffolded questions	9	6	3	3	6	2	12	3	3	3	2	52
Allow for revisions	6	3	7	11	6	0	9	4	4	1	1	52
Focus on "big" ideas	9	10	2	5	5	0	12	5	0	3	1	52
Embed problem solving	7	3	5	4	8	0	11	3	1	7	3	52
Excite my students	5	6	3	2	4	0	11	2	1	7	2	43
Develop students' confidence	6	2	0	6	5	0	12	2	0	2	2	37

Note: Teacher G logged 8 lessons and Teacher L logged 5 lessons. Responses from Teacher E, who logged only 1 lesson, are not included in this analysis.

The logs capture a variety of practices within STEM classrooms and can, perhaps, speak to implementation of desired practices and/or the influence (or lack thereof) of specific professional development efforts in these classes. Perhaps the greatest caveat associated with teacher logs is that, like surveys, they represent self-reported data. Teachers may or may not take them seriously, they may "see" their lessons differently than an outsider might; and, regardless of the developer's attention to ease-of-use, teachers may still view logs as an inconvenience and interruption in an already full day.

Examining teaching practices under reforms targeted toward disadvantaged students is crucial. The schools employing the logs were not particularly advantaged schools serving students with demonstrated interested and proficiency in STEM. About half of the students were in demographic groups underrepresented in STEM and in college. Additionally, we found that the least experienced teachers responded to questions about the importance of lesson attributes somewhat differently from more experienced teachers. Using this kind of teacher log can show whether new teachers are still learning about why certain attributes are important, and whether they need additional communication or professional development about these topics.

Because the STEM schools in RTI's study were designed to be small, the mathematics and sciences departments comprised only three or four teachers, and we obtained logs from most of them. The teachers using the logs and other teachers in the school had similar levels of experience. In the school with the highest turnover and highest percentage of novice teachers, most of the teachers completing the logs were novices. Even though the characteristics of teachers responding to the logs resemble those of all teachers in the school, we would not generalize these results to the school as the practices of these teachers may not represent those of teachers in other subjects. Rowan and Correnti (2009) caution against generalizing results from a few teachers to the entire school because a few teachers may not represent schoolwide practices. They suggest that data from 15-20 teachers are needed to yield school-level reliabilities.

Responses to logs also gave us insights into the quality of responses, which we would not have had with a one-time survey. Relatively high response rates and the variation in teacher responses give us confidence that almost all teachers did take the logs seriously and did not simply give the most desirable answer. Teachers understood that their responses would be confidential. Only aggregate results were shared with the school, and analytic reports listing individual teacher responses are de-identified and do not include the school name. If teachers had completed logs as part of a self-assessment, they might have felt less comfortable reporting challenges, as they would have had an incentive to give the most desirable answer. Because they knew that the logs were going to be used to capture instructional practices at the school, they may have felt more comfortable completing them.

To facilitate teachers' participation, we tried to make the logs easy for teachers to complete. Almost all of the questions were multiple choice, relying on teachers' recollections of a given class period. Teachers were not burdened by having to look up additional information. Thus, logs should only have taken about 10 minutes to complete. Having teachers complete logs over a specified time period and setting target dates for doing logs seemed to help teachers maintain a focus on this activity. Schools, districts, or researchers using logs might want to set specific goals for this activity, rather than having open-ended reporting. Face-to-face training and identifying a contact person who could help teachers with questions or challenges helped teachers become more comfortable with the logs. Schools, districts, or researchers using logs might consider adopting these strategies. They could also offer teachers the option of completing a paper survey instead of an on-line survey if that method seems better suited to them. In this study, teachers could complete paper surveys, but almost no one chose to do it that way.

Teachers and administrators in the study suggested that the logs were a promising professional development tool that teachers could use on a regular basis to check the variability of instructional strategies they employed. They also commented on the potential for logs to be used within a school department as a collaborative tool within professional learning communities. The logs provided teachers a common language around which to discuss improving classroom practices. Teachers can use log data to reflect on practice, determine areas of strength and challenge, and set goals for personal improvement. Administrators can use logs for many of the same purposes—to support teachers in examining practice and setting goals.

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