Supporting Mathematics Instruction with an Expert Coaching Model

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This article presents findings from a study in which the author served as an expert coach and provided ongoing support to four elementary school teachers related to employing standards-based pedagogies in their mathematics classrooms. In addition to assisting teachers, the author examined which supports they sought and the impact of them on mathematics instruction. Data were collected through participant interviews, classroom observations, and anecdotal notes. Inductive qualitative analysis indicated that teachers who sought more in-class support and co-teaching opportunities showed more enactments of standards-based pedagogies than teachers who asked for resources and support outside of their mathematics classroom. Implications for models of teacher support related to mathematics instruction are provided.

Introduction

Most professionals agree that teachers require worthwhile professional learning experiences in order to effectively implement reform-based pedagogies that embody current reforms in mathematics education (Bobis, 2010; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Higgins & Parsons, 2010). Numerous empirical and theoretical recommendations have been made about effective teacher learning (cf. Desimone, Porter, Garet, Yoon, & Birman, 2002; Heck, Banilower, Weiss, & Rosenberg, 2008; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2009). Effective professional development designers focus on issues related to student learning (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007), giving teachers ownership of their learning (Loucks-Horsley et al., 2009), addressing specific content and pedagogies (Desimone et al., 2002); providing opportunities for teachers to reflect and learn from their own practice (Loucks-Horsley et al., 2009), allowing teachers to collaborate with their colleagues and others (Putnam & Borko, 2000; DuFour, Eaker, & DuFour, 2005), and embedding activities in a comprehensive, ongoing project (Heck et al., 2008). Best practice approaches call for learner-centered approaches to professional development (Polly & Hannafin, 2010; National Partnership for Excellence and Accountability in Teaching [NPEAT], 2000).

While these theoretical and empirically based recommendations for professional development have promise, professional development research includes mixed results, especially in the area of mathematics. In a large-scale professional development study with middle grades mathematics teachers, researchers found that the professional development positively influenced teachers' use of learner-centered practices in some cases, but with little evidence of influence on student learning outcomes (Garet et al., 2010). In the seminal *Cognitively Guided Instruction* project, teachers spent the first year demonstrating no change in their instruction or beliefs, but in the second year of professional development started to drastically shift their teaching (Carpenter, Fennema, & Franke, 1996). Researchers in the Rational Number Project (Cramer, Post, & del Mas, 2002) found that professional development only changed teachers' practice when it was paired with classroom-based support during and immediately after lessons. In summary, professional development that is content specific and develops teachers' content knowledge in conjunction with teachers' skills related to teaching with standards-based pedagogies can positively influence teachers' instruction (Carpenter et al., 2006; Cohen, 2004).

Supporting Mathematics Teachers through Coaching

One type of professional development that has been empirically associated with gains in teacher performance and student achievement is site-based (or job-embedded) professional learning experiences (Joyce & Showers, 2002; Killion & Harrison, 2006). This approach focuses work between teachers and content experts, which could include instructional coaches, specialists, facilitators, administrators, or lead teachers who provide support with planning, teaching, assessment, and other duties related to instructional activities (Campbell & Malkus, 2010). In literacy, instructional coaches have had a positive influence on teachers' use of reform-based pedagogies and student achievement (Mraz, Algozzine, & Kissell, 2009; Sailors & Shanklin, 2010). In mathematics, little research has been conducted to examine the influence of coaches on student achievement (Campbell & Malkus, 2010; Campbell & Malkus, in press). With the growing demand for the use of coaching models in mathematics classroom, the need for research evidence to support the efficacy of this approach is necessary.

Part of the need for research relates to the interaction between coaches and teachers in schools. Halai (1998) found that teachers were more likely to adapt instructional practices recommended by coaches when the relationship was built on mutual trust, rather than the coach taking on an evaluative or supervisory role. Males, Otten & Herbel-Eisenmann (2010) found that mathematics teachers in a critical lesson study group benefited from the experience when conversations focused on student learning and data, and the experience resulted in conflict when the conversations focused on anecdotal or personal experiences. This work extends the work of others (Doyle & Ponder, 1978; Guskey, 1985, Fullan, 1992, Fennema et al., 1996) who found that teachers' beliefs change when they see how interventions benefit their students' learning.

This study focuses on examining teachers' use of two reform-based mathematics pedagogies: cognitively-demanding mathematical tasks and questions about students' mathematical understanding. Cognitively-demanding mathematical tasks provide opportunities for students to engage in and explore complex mathematical situations that involve doing mathematics, or allowing students to make mathematical connections between mathematical concepts and procedures (Henningsen & Stein, 1997; Smith & Stein, 1998; Stein, Grover, & Henningsen, 1996). As Henningsen and Stein (1997, p. 525) note

> The nature of tasks can potentially influence and structure the way students think and can serve to limit or to broaden their views of the subject matter with which they are engaged.

In their study, Smith and Stein's framework of cognitively demanding mathematical tasks was used to analyse the tasks posed during classroom observations. The researchers distinguished between four types of mathematical tasks. Table 1 provides descriptions and examples of the four different types of tasks.

Table 1
Types of tasks

Types of Tasks and Description
Memorization – Students recall a simple calculation or definition
Procedures without Connections – Use of algorithm with no representation
Procedures with Connections – Use of algorithm with connection to multiple representations or other mathematical concepts
Doing Mathematics – Non-routine tasks that require the learner to devise a strategy and justify their approach

Teachers' questions posed during mathematics instruction have also been found to be critical in understanding students' mathematical thinking and supporting students' understanding of mathematical concepts (Hufferd-Ackles, Fuson, & Sherin, 2004). Table 2 describes the various levels of questions that were used to analyze data during this study. This framework was developed after synthesizing frameworks from previous research (Hufferd-Ackles et al., 2004) and refined after a prior study (Polly & Hannafin, 2011).

Table 2
Levels of questions

Levels of Questions
0 – does not ask questions when the opportunity arises
1 – asks questions that elicit only a mathematical answer or definition
2 – asks questions and follow-up questions about students' processes or steps towards finding a solution
3 – asks questions about students' rationale for choosing certain steps or students' mathematical thinking

Theoretical Framework: Zone of Proximal Development

Vygotsky's (1978) constuct of a zone of proximal development [ZPD] provides an empirically based framework for examining teacher support. Tharp and Gallimore (1989) explicated ZPD in the context of teaching and referred to the idea of teaching as assisted performance, where more knowledgeable others (i.e., coaches, specialists, or faciliators) support teachers in learning about the craft of designing, implementing and reflecting on their instruction. Tharp and Gallimore described four stages of ZPD for learners. During Stage I, within the ZPD assistance is provided by more capable others through modelling, coaching and other methods of scaffolding performance, while during Stage II learners become increasingly self-supported and able to carry out the task without assistance. Stage III focuses on internalization where assistance from more capable others can paradoxically hinder performance. Stage IV involves the recursive process back through the ZPD, during which learners have to frequently modify their actions based on the environmental surroundings and context (Tharp & Gallimore, 1989).

Research indicates that specific activities, such as co-teaching or providing in class support have a greater impact than less intensive activities, such as attending planning meetings or providing resources (Killion & Harrison, 2006). In recent years in the United States of America [USA], mathematics coaches have been referred to as coaches, facilitators, or specialists (U.S. Department of Education, 2008). Recent research shows that these school personnel can positively impact teachers' practices (Campbell & Malkus, 2010; Haver, 2008) and student learning outcomes (Campbell, 2008; Campbell & Malkus, in press). In this article, the terms coach, facilitator and specialist are used synonymously to refer to a professional who supports classroom teachers with their mathematics teaching.

Methods

The purpose of this study was to examine the types of support that elementary school teachers seek from more knowledgeable others and the influence of various types of support on their teaching while attempting to implement standards-based pedagogies. Two research questions guided this naturalistic, qualitative study (Bogden & Biklen, 2003):

1. What types of support did teachers seek out while attempting to implement standards-based mathematics instruction in their classroom?
2. What was the influence of mathematics support on mathematics instruction?

Participants and Setting

All participants had a bachelor's degree and were licensed to teach Kindergarten to 6th grade. Pam and Lynda taught in inclusion mathematics classrooms with a combination of general education and special needs children, and occasionally had support from a special education teacher. Ruth and Sarah taught general education students. All four teachers worked at an urban elementary school in south-eastern USA. The school was located a mile away from a major university. Sixty-five percent of the students were minority (51% African American and 14% Latino) and 76% qualified for free or reduced lunch.

Teachers were participants in grade-level learning communities, which met weekly for 90 minutes. During meetings teachers shared instructional plans and discussed logistical issues, such as field trips and special events. At the time of the study, the school used a basal mathematics curriculum, but had sample copies of a standards-based mathematics curriculum that they were interested in teaching.

Procedure

While numerous models of professional development are found in the literature such as collaborative or content-specific coaching, the model used and examined in this study was grounded on principles of learner-centered professional development (Polly & Hannafin, 2010; NPEAT, 2000) as well as Tharp and Gallimore's (1989) explication of the ZPD. All of the support provided was influenced by teachers' requests for assistance related to their mathematics instruction. By giving teachers ownership of their learning, there was an increased likelihood that teachers would feel empowered to have ownership of this support, and be more receptive to ideas related to modifying their instructional practices. The goal of this effort was to examine how to best support teachers' instructional practice, and better understand how those supports influence teachers' practice; a teacher-requested model of coaching supported this goal.

Recruitment

At the beginning of the study the author recruited participants who were teaching 3rd and 5th grade. These grades were chosen since state testing is emphasized in these grade levels, and teachers in these grade levels had previously requested support in mathematics from their administration. The author recruited participants by telling them about the characteristics of standards-based instruction (e.g., allowing students to explore worthwhile mathematical tasks, asking rich questions to gauge students' mathematical understanding, etc.), and then gauged their interest in teaching mathematics in this manner. The author offered support for their mathematics instruction however they desired, including providing curricular resources, co-planning lessons, providing in-class support and feedback, co-teaching a lesson, or teaching a demonstration lesson. All four teachers who reported interest in using standards-based pedagogies were selected.

Data collection

Field notes from classroom observations were the primary data source in this study. Secondary data sources included conversations with participants and researcher memos, which were recorded after any interaction with participants.

The number of classroom observations ranged from 21 to 30, based on the requests of participants. During lessons, the author sat with a group of students and took field notes. In other instances, the author was invited to teach a model lesson or co-teach with the classroom teacher. In these cases, field notes were taken during breaks in the lesson or immediately afterwards. Field notes were recorded about the types of tasks posed, and the types of questions asked. The end-of-year interview lasted approximately 20 minutes and was transcribed verbatim.

Data Analysis

Data from field notes were entered into a spreadsheet and analysed using inductive analysis (Bogden & Biklen, 2003). Once the author had identified the types of support that teachers sought, data were revisited to confirm these types of support, in addition to examining what factors in the data might have led to teachers' specific requests (Question 1).

Using Vygotsky's ZPD framework, data from classroom observations were examined (Question 2) with an explicit focus on the types of mathematical tasks and questions posed (see Table 3). Tasks were analysed using Smith and Stein's (1998) framework for mathematical tasks. Teachers' questions were analysed using a scale derived from prior studies (Polly & Hannafin, 2011; Hufferd-Ackles, et al., 2004). The author analysed instructional practices (i.e., tasks and questions) three times; each time tasks and questions were categorized into the various levels, and data from field notes were analysed to ensure that tasks and questions were correctly categorized.

In order to examine teachers' instruction across the school year, data were analysed and presented for six observations: the first two observations, the middle two observations, and the final two observations. Data regarding instructional practices are presented in terms of percentages to illustrate potential shift during the study. Further qualitative descriptions are also provided to describe teachers' instructional practices.

Table 3
Analysis of classroom observations

Tasks	
Type and Description	Example
Memorization [M] Students recall a simple calculation or definition	What is the product of 8 and 6?
Procedures without Connections [PWoC]	Find the product of 22 and 13.
Use of algorithm with no representation	

Tasks	
Type and Description	Example
Procedures with Connections [PWC]	Find the product of 22 and 13. Find your answer in more than
Use of algorithm with connection to multiple representations or other mathematical concepts	one way.
Doing Mathematics [DM] Non-routine tasks that require the learner to devise a strategy and justify their approach	There are 22 students in the class. During a canned food drive, each student brings in 10 cans on Monday and then 3 more cans on Friday. If the class' goal is to donate 250 cans of food do they have enough?
Questions	
0 – does not ask questions when the opportunity arises	Questions are not asked
1 – asks questions that elicit only a mathematical answer or definition	"What did you get for an answer to 22 times 13?"
2 – asks questions and follow-up questions about students' processes or steps towards finding a solution	"Tell us how you found the answer."
3 – asks questions about students' rationale for choosing certain steps or students' mathematical thinking	"Why did you decide to multiply 22 by 10 and then 22 by 3?"

Results

Types of Support Sought

During the study, participants sought various types of support from the author (see Table 4). These types of support included feedback on lessons, support during instruction, co-planning assistance, and providing curricular resources.

Feedback on lessons. After the first observation, each participant asked what I was focusing my attention on during observations. I showed both frameworks for analysing tasks and questions and then provided examples of high-level tasks and questions. All four participants sought feedback for every lesson for the rest of the year.

Table 4
Types of Support Requested

Teacher	Grade	Years in current grade/overall teaching	Number of observations	Support Requested
Pam	3rd	1/1	25	Planning, resources, ideas for classroom management in her inclusion classroom
Ruth	3rd	1/1	30	Planning, resources, in class support posing word problems , co-teaching
Sarah	5th	1/5	21	Resources, clarification of content and what the standards mean
Lynda	5th	6/6	28	Ideas for hands-on activities, higher-level thinking skills, co-teaching

Participants requested different types of feedback. Pam, in her first year of teaching, always asked for feedback about how she should deal with classroom management problems. Rarely did she want feedback about her mathematics teaching. Sarah, who was new to 5th grade, also asked for a lot of feedback about management rather than her teaching. Primarily, teachers requested more feedback about tasks. When asked about receiving feedback, Ruth explained, "We have a choice about the curriculum and the activities. I want to make sure that I am challenging my students appropriately."

In some cases, teachers were reflective about the tasks that they posed. During a lesson on ordering fractions, Lynda had posed the task:

> You have $1\frac{3}{8}$ pieces of pie, your mom has $1\frac{1}{2}$ pieces of pie, and your sister has $1\frac{1}{8}$ pieces. Who has the most pie? Who has the least amount of pie?
>
> How do you know?

Lynda's entire class successfully completed the task. After the lesson Lynda said,

> I think the last problem was too easy. They had just been successful with 2 tasks with three different denominators, and after I gave this one I realized that it was easier than the two that they had just gotten right.

Support during instruction. During classroom observations participants asked for assistance in a variety of ways. Each time I visited Ruth's class, she asked me to pose a few mathematical tasks and questions to her students based on the concepts they were learning. As the year continued, Ruth became more independent and asked for my assistance less frequently. Occasionally Lynda asked me to look at specific students' work and discuss students' error patterns. Lynda and Ruth asked me to situate myself near specific students to lend a hand during a lesson if they had problems. Sarah did not request in-class support and preferred receiving resources rather than having me in her classroom during her mathematics teaching.

The content also influenced the amount of in-class support that participants requested. All four participants requested extensive support while they were teaching fractions. Even Sarah, who did not typically ask for in-class support, requested me to teach a model lesson about fractions. She commented, "I've tried to teach this concept for three days and most of my class still doesn't understand. I figured that you could handle this one." However, during the model lesson, Sarah worked on other activities.

When I asked about their reason for the in-class support, Ruth said,

> Fractions are difficult for me and I want feedback from you to make sure that I'm teaching it correctly. Also, I am unsure if I'm teaching in a way that makes the most sense to them.

Co-planning. Ruth and her grade level mentor planned together during the entire school year. Pam, who taught third grade with Ruth, did not receive much mentorship and independently planned lessons primarily from her basal curricula. In November, Pam sought my guidance about planning, and after talking with Ruth; a planning group was formed among some of the third grade teachers at the school. Each week between 4 and 9 teachers shared resources and ideas. In order to provide teachers with ownership, I attended meetings and contributed ideas when asked. For each meeting, I had chosen some lessons from the standards-based curricula that the school had copies of, and gave them to teachers as an option to use. By February, every teacher that attended the planning group was using either units or lessons from the standards-based curricula.

The fifth grade teachers, Sarah and Lynda sought assistance pacing out the lengths of units and long-term planning, rather than specific lessons. The district provided teachers with a broad pacing guide for topics to cover every quarter, but both teachers were unsure how long to spend on specific concepts. Further, Lynda had asked me to examine student data and make decisions based on her students' progress each month. Lynda said,

> The confusion was trying to determine whether students were ready to move on or not. By looking at some of their work, I feel more comfortable making the decision to move on if I have data that my students understand the concept.

Providing curricular resources. The teachers had access to sample units of a standards-based curriculum that the district was considering to adopt. Typically a week before starting a new concept, all four participants asked if I knew specific lessons from the curriculum that would be easy to implement. In the 3rd grade planning group with Pam and Ruth, both teachers taught several lessons later in the year. Sarah and Lynda were more reluctant to use the curricula; Sarah tried a few lessons after I had spent time reviewing the activities and had taught a model lesson. Lynda saw little alignment between the curricula and the fifth grade state test, and was not interested in using it.

Influence on Teachers' Mathematics Instruction

Observations illustrated two features related to how supporting teacher-participants influenced their instruction. The types of mathematical tasks and the questions posed during teachers' mathematics instruction are described below.

Mathematical tasks. Overall, the quality of tasks that teachers posed improved throughout the year (Table 5). Specifically, teachers enacted more tasks that allowed students to generate multiple representations and explore mathematical connections within a task. For example, Pam and Ruth both enacted the following task from the standards-based curricula,

> You have 5 brownies and you want to share them equally among 4 people. How many brownies does each person receive?

Ruth kept the task integrity high by allowing students to explore with manipulatives. Meanwhile, Pam enacted this task as a procedure with connections task, as she walked her students through the process of splitting the leftover brownie into four equal pieces.

Table 5
Types of Tasks Posed

	First Two Observations %				Middle Two Observations %				Last Two Observations %			
	M	PWoC	PWC	DM	M	PWoC	PWC	DM	M	PWoC	PWC	DM
Pam	100	0	0	0	20	40	30	10	10	40	40	10
Ruth	100	0	0	0	30	50	20	0	0	10	90	0
Sarah	100	0	0	0	80	20	0	0	20	75	5	0
Lynda	25	75	0	0	20	15	60	5	20	5	75	0

Key: M=Memorization; PWoC=Procedures without connections; PWC=Procedures with connections; DM=Doing mathematics

Teachers' enactments of more rich tasks were influenced by several factors. Pam, a 3rd grade teacher, started using more high-level tasks when she started co-planning with other 3rd grade teachers. Ruth, the other 3rd grade teacher, participated in the planning group, and sought several co-teaching opportunities with the author. However, she relied on more Memorization and Procedures without Connections tasks despite extensive co-planning and co-teaching support. She reported, "These are the types of tasks included on the end of grade tests so that has to be my focus. I don't have a choice."

Lynda, meanwhile, implemented a variety of Procedures without Connections and Procedures with Connections tasks during the school year. She shared her lesson plans with Sarah. However, Lynda's tasks that were Procedures with Connections were enacted as Procedures without Connections tasks in Sarah's classroom. Sarah frequently gave students algorithms and explicit steps for her students to follow. While co-planning with teachers improved the quality of the planned tasks, at times during implementation teachers provided too much structure, thus reducing the quality of enacted tasks.

Questions that teachers posed. All four teachers asked more higher-level questions as the year progressed (see Table 6). Specifically, teachers posed more and higher-level questions towards the end of a lesson as students were sharing their work on mathematical tasks.

Table 6
Types of Questions Posed

	First Two Observations (%)			Middle Two Observations (%)			Final Two Observations (%)			
	0	1	2	0	1	2	0	1	2	3
Pam	42.0	58.0	0	11.1	88.9	0	5.5	45.0	49.5	0
Ruth	11.0	83.5	5.5	16.6	33.3	50.0	5.5	31.0	63.5	0
Sarah	10.0	90.0	0	10.0	75.0	15.0	5.0	85.0	10.0	0
Lynda	10.0	45.0	45.0	10.0	10.0	80.0	6.0	13.0	73.0	6.0

During the first month of observations, only Lynda (5th grade) asked students to share their mathematical thinking and strategies; the rest simply questioned for answers. During the year, Lynda asked me to pose questions during class discussions. As I posed questions in her class about her students' mathematical thinking, she mimicked me and posed questions about students' strategies during class-wide discussions and independent work time. For example, while teaching about the connection between fractions and decimals, Lynda's students were shading representations of fractions on a decimal grid and naming the fraction. She asked students what they noticed about the decimal grids for $\frac{4}{5}$ and 0.8. When they commented that the same area was shaded, Lynda asked her class, "Why do you think that is the case?" Without a response from students, rather than giving an answer, Lynda then asked, "How can you represent each of those?" Over the course of the year, Lynda asked more how and why questions during her lessons. After an observation, Lynda commented,

> I love my students' responses when I pose these 'why' kinds of questions. Unfortunately, we have so much content to get through that we don't have a lot of time to discuss the mathematics as much as I want.

Ruth began to ask higher-level questions, as well, after I had modelled how to facilitate a discussion by posing questions. In a lesson that we co-taught, I asked students to sort a set of 3-dimensional shapes anyway they wanted to, and then have their neighbour guess the rule for the sort. One student sorted the shapes into a pile of a prisms and non-prisms. During the class discussion, Ruth asked about this students' rule:

Ruth: Let's look at Angelica's sort. What do you notice?

Ben: All of the shapes in this pile are stackable. You can put other shapes on top of them or underneath them.

Ruth: Okay. Other thoughts?

Austin: The stackable pile includes only prisms.

Ruth: How do you know they are all prisms?

Austin: It has two opposite faces that are identical and every face is flat.

Ruth: (as she picks up a hexagonal prism) Is this a prism? Why or why not?

Ben: Yes. Every face is flat and it has two congruent faces.

Through questioning, Ruth helped her students explore characteristics of prisms. Pam and Sarah rarely questioned students for information other than answers to tasks or descriptions of how students found answers to tasks that they had posed. When asked at the end of the year, Pam reported, "For me this year was about managing the classroom and teaching the standards. I hope that I can ask better questions next year."

Discussion

Several findings from this study warrant further discussion. As education leaders continue to seek ways to support teachers' use of standards-based pedagogies, expert coaching has promise to support teachers. Consistent with prior work (Banilower, Boyd, Pasley, & Weiss, 2006; Campbell & Markus, 2010), teachers desired support with curricular resources and areas explicitly connected to their daily practice. Three of the teachers sought feedback that they were enacting rich tasks. These desires were consistent with prior studies about teachers trying to use standards-based pedagogies (Polly, 2006; Polly & Hannafin, 2011; Tarr, Reys, Reys, Chávez, Shih, & Osterlind, 2008). Also, consistent with prior research (Peterson, 1990; Prawat, 1992), teachers who were more resistant to change (Pam and Lynda) sought less in-class support and preferred to limit their interactions with me to planning and receiving curricular resources.

Ruth and Sarah both sought more intensive supports during their mathematics teaching. As expected from prior work (Polly & Hannafin, 2011; Heck et al., 2008), both teachers demonstrated significant gains in the levels of tasks and questions that they posed during the study. Ruth and Sarah's primary request for support was to get reaffirmation and feedback about their instruction during lessons. Similar to earlier studies, the dialogue that occurred between the author and teachers about their instruction and their students' learning was beneficial (Glazer & Hannafin, 2006).

Pam's use of standards-based pedagogies improved when she collaboratively planned with myself, and her colleagues. Similar to other projects where collaboration led to increased enactment of standards-based pedagogies (Desimone et al., 2002; Heck et al., 2008; Polly, 2011) Pam grew as a result of her time co-planning with others.

This study was framed around Vygotsky's (1978) concept of zone of proximal development, and the neo-Vygotskian view of teaching as assisted performance (Tharp & Gallimore, 1989). Vygotsky posited that learners need scaffolding and support until they are able to accomplish tasks independently. This holds true for teachers. As seen in this study, teachers spent most of the year in Stage I, requiring modelling and extensive coaching to support their mathematics instruction. Towards the end of the year, observations from Sarah's classroom showed a shift to Stage II; she independently planned and enacted standards-based pedagogies without support before or during a lesson. Ruth also had slight shifts towards Stage II, as she became more independent during instruction; however, Ruth still requested extensive support during planning.

Implications for Research and Practice

In only one year of support, teachers started to pose higher-level tasks and questions. Future studies should collect and analyse data over multiple years, in order to provide a more comprehensive picture of teacher change through the various stages of ZPD. Further, future research should examine the best ways to efficiently move teachers through the various stages of ZPD. If studies continue to indicate that intensive supports, such as co-planning and co-teaching lead to higher enactments of standards-based pedagogies, subsequent studies should examine the issues with scaling up the model or having one coach work intensively with more teachers. One limitation of the study was teachers' willingness to participate, and their interest in using these reform-based pedagogies in their classroom. Future studies should include a more diverse range of participants, including those teachers who are not interested or willing to immediately begin adopting these reform-based pedagogies.

This study indicates that expert coaching has promise to support mathematics instruction through activities such as co-planning, providing feedback on lessons, and co-teaching. The largest adoption of instructional practices occurred with teachers who requested and received extensive classroom-based support. Instructional coaches should be put in roles where they are able to support teachers during lessons through co-teaching and providing feedback after observations.

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