Designing Professional Learning to Support the Implementation of Instructional Materials: Case Studies From an Integrity Perspective

John Russell, Math for America, jrussell@mathforamerica.org

Abstract: The design of professional learning to support the implementation of instructional materials with fidelity is prefaced on the point of view researchers take of the choices teachers make, consciously and unconsciously, in making adaptations for their classroom. Drawing on evidence from two cases where teachers made adaptations to high quality instructional materials during the Analyzing Instruction in Mathematics through the Teaching for Robust Understanding (AIM-TRU) model for professional learning, we analyze the interplay between the teacher, instructional materials, and other participants as they took an integrity perspective to the curriculum, based on understanding the conceptual framework that underlies its design. In doing so, we show how professional learning effects implementation of materials positively when specific design choices are made.

Keywords: Design, Scale, Mathematics Professional Development

Major issue and significance of the work

Early work on the fidelity of implementation (FOI) of instructional materials took the measure of success to be how clearly teachers followed the intended pathways in order to realize the goals of reform (Schneider & Kracjik 2002, Coburn 2005), or more often, scholarship demonstrated the gap between the intended and enacted curriculum (Brown & Campione, 1996). In this framing, moments when teachers made conscious or unconscious efforts to make changes in reform-based materials are centered on how they bypassed the goals of reform (Putnam 1992; Price & Ball 1997), positioning the curriculum and not the teachers as agents of reform-oriented change in the classroom. With this mindset, the end goal of teacher learning supplementing instructional materials was to understand the intentions of the designers of the curriculum so that teachers would adhere closely to the curricula (Mowbray, Holter, Teague, & Bybee, 2003).

Later, as researchers studied the teachers' perspective on the curriculum in their own right (LeMahieu, 2011; Sherin & Drake, 2009), the idea of "pedagogical design capacity" was introduced to explain teachers' capacity to translate resources (e.g., instructional materials) and craft them to serve their own goals (Brown, 2009). Pedagogical design capacity perceives adaptations to curriculum as teachers translate materials into their local context as common place and a source for examination, keeping teachers' knowledge, goals, and values into account. In an example of this work, McNeill, Marco-Bujosa, Gonzalez-Howard and Loper (2018) measured teachers' enactments of instructional materials through two constructs: fidelity to procedure and fidelity to goal. Fidelity to procedure examines teachers' adherence to the order and procedures of the tasks, while fidelity to goal examined their adherence to the goals of the materials. Interestingly, they found cases where teachers would score highly with fidelity to goal even if they had a lower score for fidelity to procedure, as they made choices to adapt the curriculum for a context that the original designers of the material may not have considered.

Fidelity to goal is one example of the argument that many current researchers take when reframing fidelity of implementation through an integrity perspective (LeMahieu, 2011; Penuel, Phillips, & Harris, 2014). The integrity perspective takes the presumption that teacher adaptations always take place and that the primary focus of analysis for adaptations should be on their substance, or whether those adaptations are congruent with the goals and principles designers had in mind (Borko & Klingner, 2013).

The reframing of fidelity work around an integrity perspective also repositions the role of professional learning in supporting that fidelity work. Instead of giving teachers the information they need to "follow the script" provided by the instructional materials, professional learning through the integrity perspective positions teachers as the agents through which the goals of the curriculum are met through their thoughtful enactment of the materials in the classroom (McNeil et al, 2018).

Most importantly, this perspective is bidirectional; as the materials are adapted for use in the classroom, those adaptations become a source for investigation (Kazemi & Hubbard, 2008). This coevolutionary design for professional learning, where the classroom and professional development contexts react to each other, is underutilized as a construct for increasing the integrity of implementation of instructional materials.

In current work the Analyzing Instruction in Mathematics through the Teaching for Robust Understanding framework (AIM-TRU) research-practice partnership is engaged in, we use an adaptive professional learning model to support the enactment of a set of high-quality instructional materials in the

classroom. As teachers investigate each others classrooms, the adaptations that teachers make become apparent to each other. In the two case studies that we will explicate here, one can see how the AIM-TRU model for professional learning has provided a reflective space where teachers have looked at the adaptations made, thought about the framework that the professional learning supports, and made decisions for future enactments. To this end, we hope to start to answer the following research question: *What are ways in which adaptive professional learning changes the implementation of instructional materials from an integrity perspective?* This paper will explain the synthesis of the AIM-TRU model for professional learning, then draw upon case studies that demonstrate how this style of learning uniquely addresses many issues raised in current research on fidelity.

Theory of action – the AIM-TRU model for professional learning

In accepting the 2013 AERA Distinguished Researcher award, Schoenfeld (2014) states clearly that there are two related problems that require a framework to productively answer:

- What makes for mathematically powerful classrooms?
- How can we support teachers in creating them?

The second question could not be answered without first answering the first. In order to build a suitable framework to simply describe what makes certain classrooms more mathematically powerful, Schoenfeld's team distilled certain core ideas found over multiple years watching classrooms. This work resulted in the development of the Teaching for Robust Understanding (TRU) framework, which has five dimensions that are "necessary and sufficient for the analysis of effective classroom instruction" (Schoenfeld, 2013; p. 607). These dimensions are (a) The Mathematics; (b) Cognitive Demand; (c) Equitable Access to Content; (d) Agency, Ownership, and Identity; and (e) Formative Assessment (see Figure 1).

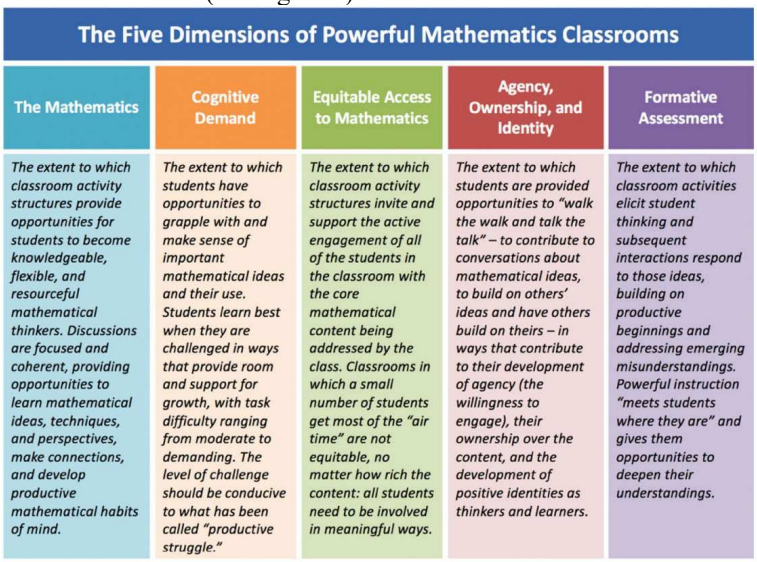

Figure 1. The TRU Mathematics Framework (reprinted with permission from Schoenfeld, 2019).

In engaging with these dimensions, Schoenfeld (2017) stresses a few points. Firstly, the TRU framework shifts the perspective in the classroom from what the teacher is doing to how instruction is perceived through the student's eyes. Secondly, the framework's goal is to problematize instruction; at its core, it asks whether what is being done in the classroom increases "the ways in which the students have meaningful opportunities to make sense of the content" (pg. 494).

If it is known what makes for powerful classrooms, then, in order to answer Schoenfeld's second question, materials aligned with the TRU framework should begin to support teachers in creating rich learning environments. The first set of materials developed by the Mathematics Assessment Project (MAP) aligned with TRU were 100 "Formative Assessment Lessons" designed to support the kinds of rich instruction proposed by the five dimensions of TRU as well as the Common Core State Standards. These lessons, which span middle and high school, are designed so they can be inserted within the curriculum that teachers are currently using to help teachers formatively assess students by having them engage in carefully constructed tasks that are grounded in research on what students find difficult (Schoenfeld, 2014).

However, instructional materials are not enough. Teachers also need a supportive system of professional learning that problematizes the implementation of these materials and gives space for a close analysis of practice

in how the materials are used by students to develop powerful mathematical ideas (Little, 2002; Roth et al, 2017). To that end, the AIM-TRU model for professional learning was developed, using what is known about good professional development (Garet, Porter, Desimone, Birman, & Yoon, 2001), what has been learned about extending those principles to a video-based model grounded in participants' classrooms (Borko, Koellner, Jacobs, & Seago, 2011, Roth et al, 2017) and perhaps most importantly, using the TRU framework as a conceptual framework that teachers could use as an analytic lens for how implementation occurs. Through multiple iterations (Russell, Murray, DiNapoli, & Driskill, 2020), the AIM-TRU model for professional learning was developed and adapted (the current version can be found in Figure 2).

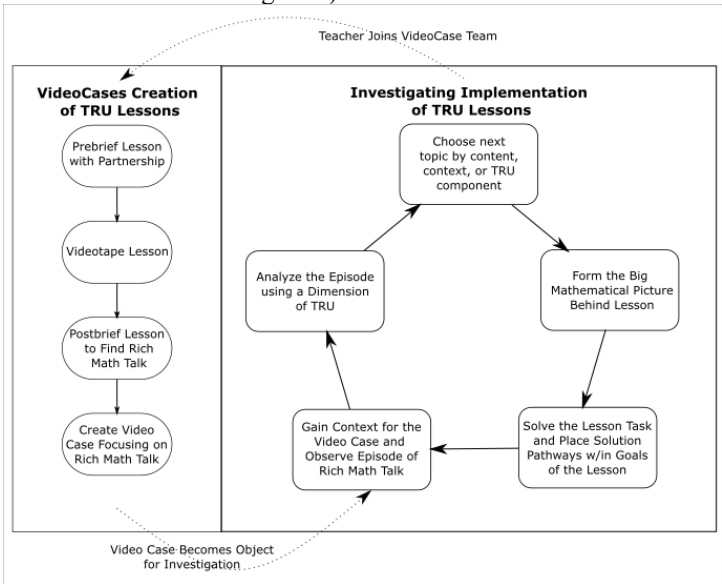

Figure 2. The complete AIM-TRU model for professional learning, involving the creation of video cases (left) as well as their subsequent investigation by a group of teachers (right).

In short, a typical cycle within one workshop of the AIM-TRU model for professional learning centers on investigating the implementation of one of the "Formative Assessment Lessons" built using the TRU Framework in a participants' classroom. The cycle involves teachers positioning the lesson within the larger mathematical context that students learn, then solving the task in order to think about the solution pathways that students use. Then, teachers watch a video case illuminating a moment of rich mathematical talk from the implementation of the lesson, which is then analyzed through one of the dimensions of the TRU framework in order to understand the lesson from the students' point of view, and what teachers can do to push students within that dimension of the framework. At the end of the workshop or in between sessions, the next video case starts to be built when a teacher joins the video case team in order to prepare a video case for the next session.

Methodology

We employed a multiple-case study approach (Yin, 2003) to address our research question, analyzing data from two topics that were discussed within a larger study of a group of teachers as they engaged in the AIM-TRU model for professional learning through monthly meetings over the course of a school year. Specifically, we started with videos of the sessions and grouped moments across each session where teachers discussed the adaptations made in the implementation of instructional materials into units of meaning. These units of meaning were the subject of a second reading, with a goal of choosing potential cases based on those that offered the best opportunity to learn (Stake, 2000). Once potential cases were chosen, follow-up interviews focused on the teachers who implemented the lesson and the adaptation they made. These interviews and the memos of the author (who took the role of participant-observer across each session) provided further triangulation around each individual case. These cases are presented below, centering on the adaptation that the teacher chose, followed by the groups' reactions and how the teacher felt in follow-up interviews. After each case is presented there is a closer analysis using the integrity perspective to see the interplay of the professional learning context with the adaptations teachers took in enactment.

Study participants

A total of 19 teachers across 18 schools in a large urban district in the US Northeast were participants in the AIM-TRU model for professional learning over the course of this study. We present case studies regarding two adaptation choices that teachers made. In particular, the cases center on the teachers who videotaped their classrooms to show the implementation of a lesson, as well as the interplay between the adaptations they made and the reactions that the group of teachers had when they collectively investigated how the lesson was enacted in the classroom.

All of the teachers were public school teachers who have taught a minimum of five and a maximum of twenty-seven years. Ten teachers taught high school, eight taught middle school, and one taught 5th grade. All teachers' names in the findings and discussion are pseudonyms.

Findings

In each of these case studies, we look at an adaptation that at least one teacher made when implementing a lesson. Each case study starts by explaining the issue as it showed up in the enactment of the lesson, reactions to the adaptation from the group, and then how the teacher reflected upon these reactions in follow-up interviews.

Case study 1 – calculator use in the classroom

When and how calculators are used in the classroom is itself a point of contention among mathematics teachers from elementary through postsecondary education (NCTM, 2015; Pang, 2016), and the topic came up in the enactment of a middle school lesson on applying the properties of exponents (the entire video case with the lesson, math problem and video transcript can be found at https://tle.soe.umich.edu/MFA/ as the first "Applying Properties of Exponents" case). This lesson lightly discourages calculator use by students, as the designers explain that it removes student discussion around the mathematical structure of the expressions, which is a focus for this formative assessment lesson. Lisa, the teacher who implemented the lesson in some way adapted the lesson by not disallowing students to take out a calculator during the lesson (as Simon, another teacher, stated in talking about this adaptation, "it always feel like we have our calculators, like I always have my phone on me").

In the video of the lesson, students are working through the card sort activity at the center of the lesson, where they try to match expressions and explain their thinking while creating each match. In reviewing the video of the lesson, Lisa noticed a table that was ripe for discussion. At this table, a boy working with two girls was using a calculator to evaluate the expressions in order to match them, while the two girls were trying (successfully and unsuccessfully) to apply the properties of exponents to simplify the expressions.

In introducing the video to the group, Lisa explained that she did not give any instructions regarding the use of calculators, so a few students took them out naturally. Teachers then watched the video, which showed moments of tension where all three students stopped discussions while the boy would enter expressions into the calculator to make sure that they were equivalent. After watching the video and as a part of the professional development model, the teachers wrote their thoughts on the following discussion question (targeting the TRU dimension of Formative Assessment) before engaging in small group and whole group discussions - "What do student's explanations tell us about what they were thinking and what they understood?"

The calculator's role in the video was in many ways a focus for what it did and did not tell teachers about student explanations, as the following exchange demonstrates:

NANCY - Sure. So we said that the boy does not believe in the laws of exponents or identities, just because of his reliance on the calculator… the girls wanted to use the identities, but how do we deal with the, the addition and subtraction [of exponents], which came up when we were working on it, and the phrase "why do you do everything the hard way" [which the girls said to the boy with the calculator] was interesting...

LISA - The two girls were thinking of the identities as like a shortcut or a more efficient way of getting to the answer whereas he thought it was much easier to just evaluate and get these really, really big numbers because it just made sense…

JOSH - No, I liked the way you said he doesn't believe in the laws of exponents beyond just being easier. It wasn't clear to me whether he thought the laws were valid. The only way you know for sure is if you put it into the calculator.

In reflecting upon the lesson with the group, Lisa is asked what she would do differently, and she admits to grappling openly with access to the calculators by stating

LISA - I, I don't know. I think I wouldn't let them use the calculator. But then again, I don't know because some of them I feel like need that to make sense of the exponent. I'm curious to see what everyone else thinks.

This collective call is important; in subsequent discussion, participants are split, and in fact, two other teachers end up using the same formative assessment lesson in the next couple of months. Nancy is convinced that these lessons work best without access to calculators, and does not provide them to students, while Luis imagines that the lesson would work best by adapting some of the cards to have variables instead of numbers as bases, discouraging calculator use but allowing them with his students for other matches (these make up the Case 2 and Case 3 video cases on our website). Through the following two sessions, participants notice that, for this lesson, lacking access to calculators in Nancy's classroom forced students to come up with explanations for each other using whiteboards and arguments that the calculators had obfuscated in Lisa's implementation. On the other hand, in the words of Lisa when they investigated Luis' implementation of the lesson:

LISA - ...the use of the calculator to check the answers reminded me of my student video where they really relied on the calculator to check those answers. And we said that their explanation was very answer focused and they can't seem to fully justify why the whole thing is equal to six to the fourth. There is a missing piece to their work and we want it to be there, but it's not.

The group moved on to other issues (including the one addressed in the following case), but Lisa kept thinking about calculator use in her classroom, and especially as regards lessons such as the one she presented to the group. The follow-up interviews a few months later showed that Lisa was still thinking about it, but that Luis was convinced to at least try out the lesson without calculators this time.

AUTHOR - What do you think you would do with the calculators?

LISA - I have a feeling I would end up allowing them… if they took them out, I would allow it to happen. But maybe at the beginning, I'd discourage them, like, "Don't use the calculators. Try not to."

LUIS - I think to better answer your question, since I am going to do it again, is, I'm just going to -- I'm going to say no calculator on this one and I'll come back with an answer.

Looking at this case from an integrity perspective

The use of calculators in Lisa's classroom was not strongly aligned with the stated intention of the lesson to allow students to explore and discuss the mathematical structure within the activity. Indeed, in looking at the calculator use from multiple dimensions of TRU, it could be argued that it reduced the ability for the student to see structure (The Mathematics), work through a problem (Cognitive Demand), and inform them and the teacher what they did and did not know as they successfully found the answer using the calculator (Formative Assessment).

As teachers looked at video of this enactment, they were able to come to the same conclusion, and moreover, this affected the later enactment of the lesson by Nancy and Luis. These enactments, moreover, did the extra work of providing extra data for the group that they could use to deepen their own understanding of the intentions of the designers of the lessons. As the teachers came to better understand the lesson through the TRU framework, they became better able to understand the integrity of the lesson and to enact it with higher fidelity.

Importantly, this is what we would call a casual adaptation, building off of the literature that much of the discrepancy between how curriculum is designed and how it is enacted come not only from active choices teachers make when enacting the curriculum, but also passive ones that occur, often without the teacher realizing it (Remillard, 2005). The researchers imagine that much of the casual adaptations that teachers make when implementing curricula are not picked up by traditional models for professional development, because they do not work to have a shared experience using video that is grounded in the actual enactment of the lesson (Sherin, 2004).

Case study 2 – procedurizing turn taking

One of the common structures within the formative assessment lessons was turn-taking in pairs, where one student would make a match, explain their thinking, answer any questions from their partner, and then switch. In thinking about the TRU dimension of equitable access to content, this turn-taking is incredibly important - it allows students to engage in mathematical talk as an explainer as well as an interrogator of the decisions that are being made. However, even when teachers were doing the tasks themselves, turn-taking often went by the wayside as matches were made based only on who saw them first with subsequent explanations focused only on the answer and not on the mental representations of the problem that went into finding the answer.

While it could be argued that teachers were making a casual adaptation in not strictly following the turn-taking, teachers kept coming back to the idea that, in a class of thirty students, even if they wanted to follow the instructions of the lesson, it would be incredibly tough to make sure that every pair of students was taking turns. As one teacher said:

SIMON - How do you enforce that in a room of 34 kids? Yeah. Like, that's why I didn't follow it because I knew there was no chance I could actually, like I can tell the kids to do that. And then just like this room [of teachers working through the math], they would ignore it.

The theme of turn-taking became a recurrent one, as teachers also began to notice that, especially in group conversations, there was often inequity of voice among the students, and that it was hurting the ability for students to grapple openly with the problems they were being presented.

At this point, as a participant-observer in the professional development cycle, I suggested thinking of a routine that would codify the turn-taking. In discussing the roles that we wanted students to take, we realized that this could take the form of a piece of paper folded lengthwise on the table (a table tent), where one side gave prompts for a student explaining their thinking, and the other side gave prompts for a student to ask clarifying questions based on what they heard. Once students were finished with a match, they could turn the table tent around, switch roles, and resume with the next student's match.

One teacher, Miriam, was particularly excited about not only trying this out, but catching it on video for the other teachers of the group (this is the "Interpreting Multiplication and Division" case listed on the website). We continued making small iterations to the table tent (for instance, we color coded each side of the tent so that a teacher could tell at a glance what role each student was taking) and chose a lesson to use it on. As we watched the video later on, we noticed that one group was heavily using the table tent, and that it was supporting the roles that we thought the lesson intended. As others watched this part of the video, they noticed it as well.

LISA - So we kind of just summed it up that the students actually made use of the table tents and I didn't catch that student three was the one who initially said, "Can you say more about that?" and that kind of set the tone for the rest of the group. Also, each student needed to know – I think it was student three that was quiet, she still took an active role. They were all really listening to each other, which we thought was great, listening, explaining and critiquing each other.

Miriam herself spoke for her group of teachers who were analyzing the video in saying:

MIRIAM- Sure. So we noticed that in the beginning, students were — they began their discussion by really heavily utilizing the prompts in the table tents, but then they kind of naturally evolved into just a conversation about the math, which was really cool… And then, Luis noticed at the very end, they kind of cycled back to using the table tents to start the next turn or next round of discussion.

In the follow-up interview around this adaptation, Miriam made note of the intention she had for this, and why she felt like it was a necessary adaptation to consider as teachers analyzed the video.

MIRIAM - You know what was interesting was hearing folks reflect on how at first, it seemed like an adaptation was a tool that kids needed to steer them in the right direction. But eventually, the conversation starts to flow naturally. And there seemed to be some debate about that, whether or not it was actually natural. Do you remember that?

AUTHOR - Yes

MIRIAM - That back and forth. So that was just fascinating to me. And just thinking about how this kind of discourse-- how natural is it for kids to be like probing each other in that way about mathematics. I think it's something that has to be learned and maybe will become natural.

Looking at this case from an integrity perspective

Most conscious adaptations that teachers make are from the perspective of enacting the lesson within the context of their classroom, hopefully using the integrity perspective to keep the goals of the lesson in mind. For instance, other researchers recently pointed out the case of a teacher who maintained the goals of the lesson well enough to make adaptations to a science curriculum for her native Spanish speaking students that preserved the integrity of

the lesson (McNeill et al, 2018). In that case, as well as in this one, the adaptation aligned with the intent that the designers had with their lessons. While fidelity was not strictly kept, making an adaptation that aligned with the integrity of the lesson was necessary in order for successful teaching to occur.

In Miriam's case, the adaptation is also unique because it came not from a single classroom but from the need of the collective group of teachers to preserve the integrity of the TRU framework even more so than what a specific lesson specified that they should do in enactment. Teachers were making casual and conscious adaptations to the lessons as a whole that did not give all students equal access to the mathematics, in large part because the lessons themselves did not give teachers the structure necessary for equitable access to occur.

The use of the table tents as a codified talk routine addressed this perceived need by allowing students to have equal opportunities to make and explain their matches (attending to the dimension of Equitable Access to Content), but it also gave them the support they needed to push others thinking and clarify their ideas (attending to the dimensions of Cognitive Demand and Formative Assessment). Miriam and others noticed the success of the adaptation in what they identified as a need for 'unnatural talk' in the classroom, which parallels work other researchers have done on the need for argumentation and explanation schema in the mathematics classroom (Yackel and Cobb, 1996).

Discussion

In each of the cases detailed above, a conscious or casual adaptation to a lesson was made in their enactment in the classroom, and a community of teachers engaging in the AIM-TRU model for professional learning were able to reflect upon the adaptation and interpret whether it supported or obscured the curriculum from an integrity perspective. In Lisa's case, a casual adaptation was made apparent and discussed, where most saw the adaptation as undermining the TRU framework. In addition, for many teachers, it caused them to reflect on the role that a tool has in their classroom, and even for those who continued using the adaptation, they did so, interestingly, while acknowledging the problems that the adaptation raises. In Miriam's case, a conscious adaptation was made with the goals of the lesson in mind. This adaptation allowed Miriam to build equitable access in her classroom, and so more closely match the integrity of the lesson, even if fidelity was not kept. Other teachers defined the adaptation as being supported by the TRU framework, and it continued conversations on supporting argumentation equitably in their classrooms.

In answering the research question, the cases also build upon nascent ideas in the literature that most current models of professional development are not designed in order to increase the integrity of implementation of instructional materials (Roth et al, 2017). As such, we build upon the broader discussion around current scholarship on professional development design by suggesting the following design constraints in addition to what is typically known about good professional development.

As a first constraint, the models should be designed coherently using a conceptual framework that allows the integrity perspective, and ideally, that this conceptual framework is the same one that grounds the instructional materials. We find it impossible to divorce the success our teachers have in implementing instructional materials (Russell et al, 2020) with the TRU framework that the materials and model for professional learning are grounded in.

In addition, the model should be based on coevolutionary design; it is incredibly important for teachers to have the ability to use their own classrooms as a source for learning. This design constraint is particularly important regards the implementation of instructional materials, as it positions teachers as reflective agents in the enactment of instructional materials, responsible for translating the materials into the context of their classroom, and able to reflect on the adaptations they made in doing so.

References

Borko, H., & Klingner, J. (2013). Supporting Teachers in Schools to Improve Their Instructional Practice. *Yearbook of the National Society for the Study of Education, 112*(2), 274-297.

Borko, H., Koellner, K., Jacobs, J., & Seago, N. (2011). Using video representations of teaching in practice-based professional development programs. *ZDM, 43*(1), 175-187.

Brown, M. W. (2009). The teacher-tool relationship: Theorizing the design and use of curriculum materials. In J. Remillard, B. Herbel-Sisenham, & G. Lloyd (Eds.), *Mathematics teachers at work: Connecting curriculum materials and classroom instruction* (pp. 17-37). New York: Routledge.

Brown, A. L., & Campione, J. (1996). Psychological theory and the design of innovative learning environments: On procedures, prinicples and systems. In L. Schauble & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 289-325). Hillsdale, NJ: Erlbaum.

Coburn, C. E. (2005). Shaping teacher sensemaking: School leaders and the enactment of reading policy. *Educational Policy, 19*, 476-509

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American educational research journal, 38*(4), 915-945.

Kazemi, E., & Hubbard, A. (2008). New directions for the design and study of professional development: Attending to the coevolution of teachers' participation across contexts. *Journal of teacher education, 59*(5), 428-441.

LeMahieu, P. (2011). What we need is more integrity (and less fidelity) of implementation. Carnegie Commons. Retrieved October 10, 2019, from https://www.carnegiefoundation.org/blog/ what-we-need-in-education-is-more-integrity-and-less-fidelity-of-implementation/

Little, J. W. (2002). Locating learning in teachers' communities of practice: Opening up problems of analysis in records of everyday work. *Teaching and teacher education, 18*(8), 917-946.

McNeill, K. L., Marco-Bujosa, L. M., González-Howard, M., & Loper, S. (2018). Teachers' enactments of curriculum: Fidelity to Procedure versus Fidelity to Goal for scientific argumentation. *International Journal of Science Education, 40*(12), 1455-1475.

Mowbray, C. T., Holter, M. C., Teague, G. B., & Bybee, D. (2003). Fidelity criteria: Development, measurement, and validation. *American journal of evaluation, 24*(3), 315-340.

NCTM (2015). Calculator use in elementary grades: A position of the National Council of Teachers of Mathematics. Retrieved October 12, 2019, from https://www.nctm.org/uploadedFiles /Standards_and_Positions/Position_Statements/Calculator%20Use%20in%20Elementary%20Grades% 20July%202015.pdf

Pang, W. (2016). The common high-school tool that's banned in college. The Atlantic. Retrieved October 12, 2019 from https://www.theatlantic.com/education/archive/2016/12/the-conundrum-of- calculators-in-the-classroom/493961/

Penuel, W. R., Phillips, R. S., & Harris, C. J. (2014). Analysing teachers' curriculum implementation from integrity and actor-oriented perspectives. *Journal of Curriculum studies, 46*(6), 751-777.

Price, J. N., & Loewenberg Ball, D. (1997). 'There's always another agenda': marshalling resources for mathematics reform. *Journal of Curriculum Studies, 29*(6), 637-666.

Putnam, R. T. (1992). Teaching the "hows" of mathematics for everyday life: A case study of a fifth-grade teacher. *Elementary School Journal, 93*(2), 163-177.

Roth, J. K.., Bintz, J., Wickler, N. I. Z., Hvidsten, C., Taylor, J., Beardsley, P. M., Caine, A., & Wilson, C. D. (2017). Design principles for effective video-based professional development. *International Journal of STEM Education, 4*(1), 31.

Russell, J., Murray, E., Dinapoli, J., & Driskill, M. (2020). *Documenting professional learning focused on implementing high-quality instructional materials in mathematics - the AIM-TRU learning cycle*. Manuscript in preparation.

Schneider, R. M., & Krajcik, J. (2002). Supporting science teacher learning: The role of educative curriculum materials. *Journal of science teacher education, 13*(3), 221-245.

Schoenfeld, A. H. (2013). Classroom observations in theory and practice. *ZDM, 45*, 607–621.

Schoenfeld, A. H. (2014). What makes for powerful classrooms, and how can we support teachers in creating them? A story of research and practice, productively intertwined. *Educational researcher, 43*(8), 404-412.

Schoenfeld, A. H. (2017). Uses of video in understanding and improving mathematical thinking and teaching. *Journal of Mathematics Teacher Education, 20*(5), 415-432.

Schoenfeld, A. H. (2019). Reframing teacher knowledge: a research and development agenda. *ZDM*, 1-18.

Sherin, M. G., & Drake, C. (2009). Curriculum strategy framework: Investigating patterns in teachers' use of a reform-based elementary mathematics curriculum. *Journal of Curriculum Studies, 41*(4), 467-500.

Stake, R. E. (2000). Case studies. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 435-453). Thousand Oaks, CA: Sage.

Yackel, E., & Cobb, P. (1996). Sociomathematical norms, argumentation, and autonomy in mathematics. *Journal for research in mathematics education*, *27*(4), 458-477.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed., Vol. 5). Thousand Oaks, CA: Sage.