

DISENTANGLING THE ROLE OF CONTEXT AND COMMUNITY IN TEACHER PROFESSIONAL DEVELOPMENT UPTAKE

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The study presented here utilized a cross case comparison of three different professional development programs to examine the contextual factors associated with uptake related to what teachers learned related to content, pedagogy and the resources used in their professional development (PD) workshops. From a theoretical perspective this study draws on a situative perspective to guide our analyses on how uptake across different PD projects impacted teacher learning. Findings indicate that teachers' perceptions of learning may be associated with explicit goals and intentions of the PD program, their perceptions of community and the relevance of the content, pedagogy and resources provided to their everyday work in mathematics classrooms. Differences were found to be related to where they fell on the adaptive-specified continuum.

Keywords: Research Methods, Professional Development, Teacher Knowledge, Teaching Tools And Resources

One central challenge for the field of teacher professional development (PD) is how to design interventions that target teacher knowledge, while also maintaining a focus on instructional practice and student learning (Jacobs, Koellner, Seago, Garnier & Wang, 2020). A number of researchers have worked to address this challenge and there is now a strong research base delineating critical design features of effective PD (e.g., Borko, Jacobs & Koellner, 2010). The consensus in the current PD discourse about features of effective PD include a focus on mathematics content, student learning of content, active learning opportunities for teachers, coherence, duration, and collective participation (Sztajn, Borko, & Smith, 2017). Although some PD programs that adhere to design recommendations by the literature have produced encouraging results (e.g. Franke, Carpenter, Levi & Fennema, 2001), others have proven much less successful (e.g. Jacob, Hill & Corey, 2017). We believe that context, as well as the nature of the PD on the adaptive-specified continuum, might be key to helping us understand and uncover impact aspects related to how teachers perceive their learning of content and pedagogy as well as their use of resources.

At present, very little is known about the degree to which context impacts teachers' learning from PD. The one area that researchers have focused on and have found some evidence of how context plays a role in teacher learning is social and political contexts of schools and their impact on the implementation and effectiveness of mathematics of PD.

The study reported here goes beyond social and political aspects that impact PD and includes multiple contextual factors related to what teachers take up and implement after participating in a particular PD. The study uses comparative case study analysis to examine three different and distinct professional development programs that are geographically situated across the US, focused on different mathematical content, and different PD structures. We aim to disentangle the role that context plays in uptake of PD content, pedagogy and resources of these three ambitious PD projects by analyzing teachers' perceived uptake in these areas.

Theoretical Frameworks

Situative theorists define learning as changes in participation in socially organized activity (Greeno, Collins, & Resnick, 1996). They consider the acquisition and use of knowledge as aspects of an individual's participation in social practices. With respect to professional learning, situative theorists

focus on the importance of creating opportunities for teachers to work together on improving their practice and locating these learning opportunities in the everyday practice of teaching (Ball & Cohen, 1999). All three PDs were designed around this premise. A situative perspective suggests that groups of teachers who take part in different PD workshops using different materials, with different facilitators, and are situated within different educational contexts (e.g., different geographical locations within the United States) might have very different learning opportunities and experiences impacted by the role of context.

PD Model Continuum: Adaptive Through Specified

PD models fall on a continuum from adaptive to specified (Borko, Koellner, Jacobs & Seago, 2011). On one end of the continuum are *adaptive* models, in which the learning goals and resources are derived from the local context and shared artefacts are generally from the classrooms of the participating teachers. In these models, the artefact is selected and sequenced by the facilitator and/or the participating teachers, and the related activities are based on general guidelines that take into account the perceived needs and interests of the group. On the other end of the continuum, specified models of PD typically incorporate published materials that specify in advance teacher learning goals. In video-based specified PD, the video clips are typically pre-selected and come from other teachers' classrooms.

The nature of what teachers take up and use across the continuum has the potential to shed light on factors that are associated with the teacher learning related to content and pedagogy. This study examines three professional developments that fall on different parts of the continuum. The goal is not to determine which types of PD are “best” because each has its affordances and challenges, but rather to better understand the variance of teacher uptake and use within and across these PD experiences. Understanding and deeply analyzing and unpacking variance among and between types of PD offers the potential to identify the factors that impact uptake and use from PD. This paper examines how teachers' self-reported uptake differs across PDs located at different points on the adaptive-specified continuum. Specifically, one is highly adaptive, one is highly specified, and one lands in the middle. We believe conducting a cross case comparison will aid in helping us understand the factors associated with uptake related to content, pedagogy and resources.

Overview of TaDD Project

This three-year impact study, Taking a Deep Dive (TaDD) is collecting qualitative data from three large U.S. National Science Foundation PD projects in order to use case studies and cross case analysis to further inform what teachers take up and use in different PDs in different contexts and why some teachers appear to take up and use more than others and why some PDs have better results than others. This paper uses a comparative case analysis and focuses on the portion of the TaDD study that investigates self-reported learning related to pedagogy, content and resources taken up and used from the following three NSF PD projects one to two years after the project and funding ended. In the next section, we briefly describe the three different PD projects.

Learning and Teaching Geometry (LTG)

The first NSF project, LTG, an efficacy study of the learning and teaching geometry professional development materials: Examining impact and context-based adaptations, sought to improve teacher's own knowledge and instructional strategies in transformations-based geometry. This PD consists of 54 hours of highly specified video-based PD that is grounded in modules of dynamic transformations-based geometry which is aligned with the Common Core State Standards in mathematics (CCSSM). Through video analysis, teachers work together to solve problems and further their knowledge in mathematics teaching in the domain of geometry. The PD allows teachers to better support students in their attempt to gain a deeper understanding of transformations-based

geometry through activities like rate of change on a graph, scaling activities, and similarity tools. The material strongly connects to other critical domains including similarity, proportional reasoning, slope, and linear functions. LTG is a specified PD as the content and pedagogical goals of the PD are clearly articulated for each workshop in the packaged materials.

Lesson Study (LS)

The second NSF project, Collaborative research: TRUmath and Lesson Study: Supporting fundamental and sustainable improvement in high school mathematics teaching (LS), aimed to engage in design research to develop and implement a replicable model for a coherent, department-wide approach to professional learning focused on creating classroom environments that produce students that can be powerful mathematical thinkers. In the PD, teachers work to create lesson plans that are focused and coherent and allow for a deeper and richer understanding of mathematics and the ability to make connections and implement curriculum more effectively. In this project, teachers were taught the *TruMath* framework. This is an observation instrument that can be used to analyze classroom interaction across different dimensions. Teacher teams engaged in LS as a way to work on specific shifts in teaching practice that aligned with the TRU dimensions. LS is an adaptive form of PD that utilized the TRU framework but allowed for teachers' ideas to guide the workshops.

Visual Access to Mathematics (VAM)

The third NSF project, Visual access to mathematics: Professional development for teachers of English learners (VAM), aimed to build skills in mathematical problem solving and communication through the use of visual representations. This PD consisted of face-to-face PD as well as online workshops where teachers implemented problems from the PD and shared their student work to discuss access for English Learner's (EL's) and all students. The project investigated the instructional strategies and supports that teachers of EL's need to provide access to mathematical learning while advancing academic language development. The approach was grounded in the use of visual representations, such as diagrams and geometric drawings, for mathematical problem-solving with integrated language support strategies. The intended goals of VAM were to help teachers to properly select appropriate visual representations for the use of different rational number task types and communication tools to show and explain mathematical thinking. VAM fell in the middle of the adaptive-specified framework as the face-to-face workshops had specified and intentional goals and the online professional learning meetings were guided by the teachers and used artefacts of practice, mainly lesson plans, to guide their discussions.

Methodology

Sixty-six participants from the three NSF projects took a 32-question survey (LTG had 28 participants, VAM had 25 and Lesson Study had 13). This survey included questions that asked participants to reflect back on their PD experience and characterize their past and/or current use of the PD content, pedagogy and materials. The survey included seven Likert scale questions, where participants responded to statements on a scale of 1-10, as well as eighteen follow up questions that allowed the participants to explain and provide more details about their numeric response. To analyze the data, we used descriptive statistics and ANOVAs to understand the differences and similarities between uptake by project (LTG, VAM, Lesson Study) with ANOVAs followed by pairwise comparisons. Given the small sample sizes in this study, we report significance levels at the $p < .10$ level as well as the typical $p < .05$ level.

Qualitative responses were coded to move deeper into the data and unpack the quantitative results. Three project researchers coded the qualitative responses to better understand teachers' perceptions of uptake after participating in professional development. The seven Likert scale questions were used as the baseline and the coded eighteen qualitative questions were used to analyze participants

perception and vision of uptake from their learning experiences in PD. Finally, we compared the differences among and between programs and present case studies of each project.

Results

We examined one-way differences by project by finding averages of the seven Likert scale questions on the survey. Likert survey questions ranged from 1 (not at all) to 10 (a lot). In comparing the three projects, VAM participants had consistently higher average ratings than LTG and Lesson Study. We found 6 areas that were significant at $p < .05$ and one at $p < .10$. While all three projects reported a high degree of established community within their respective PD experiences, VAM participants reported a stronger ($p < .10$) sense of community than Lesson Study participants. Furthermore, VAM participants reported greater ($p < .10$) use of materials and resources than Lesson Study. Other significant differences include VAM participants reporting higher levels of district support than both Lesson Study and LTG ($p < .05$). Reports of content and pedagogy use, as well as how well the facilitator met the goals of the participants, were significantly higher ($p < .05$) for VAM than LTG.

Table 1: Average teacher survey descriptions of PD uptake and use, by group: means and standard deviations (N=66)

Likert Scale Survey Question: Codes for Likert Scale Survey Questions ranged from 1 (not at all) to 10 (a lot)	LTG (n=28)	VAM (n=25)	LS (n=13)	<i>p</i> -value
To what degree, was the community established in your PD? ¹	8.46 (2.12)	9.24 (1.01)	8.00 (1.41)	$p < .10$
How much did your district support your attendance and implementation of the PD in your classroom? ^{2,3}	5.21 (3.34)	7.44 (2.62)	4.77 (3.32)	$p < .05$
How much of the content from your project do you use in your classroom? ³	5.29 (3.10)	7.24 (2.28)	5.54 (2.67)	$p < .05$
How much of the pedagogy from your project do you use in your classroom? ³	5.54 (3.12)	7.56 (1.92)	6.62 (2.90)	$p < .05$
How much of the resources/materials from your project do you use in your classroom? ¹	4.57 (3.34)	6.16 (2.76)	3.69 (2.72)	$p < .05$
To what degree was the facilitator focused on the intended goals of the PD from your own perspective? ³	7.57 (2.67)	9.16 (1.38)	7.69 (2.53)	$p < .05$
To what degree was the facilitator meeting the needs of the participating teachers? ⁴	6.54 (2.72)	8.84 (1.34)	6.46 (2.33)	$p < .001$

Of the three studies, teachers in the VAM project had higher self-report data on several dimensions related to the uptake of content, pedagogy and resources. In order to better understand specific

1 VAM > Lesson Study, $p < .10$.

2 VAM > Lesson Study, $p < .05$.

3 VAM > LTG, $p < .05$.

4 VAM > Lesson Study and LTG, $p < .01$.

uptake, we analyzed the qualitative data using a coding manual consisting of 33 codes that span content, pedagogy and resources in general, as well as specific areas such as representations, technology, principal and coach support, facilitator impact and theoretical alignment. Three project staff initially coded three surveys from each project and compared their results, discussed discrepancies and resolved differences by refining and agreeing upon codes.

VAM

Almost all of the VAM participants were able to identify representations from the PD that they used to teach relevant content including ratio, proportion, percent, dilation, and scaling. Additionally, approximately 50% of participants mentioned specific pedagogical strategies such as the Three Read Strategy that they learned in the PD. Participants were also able to describe how they used resources such as specific tasks, applets, and computer-based activities from the PD in their classroom practice. Only two participants didn't respond or identify any specific uptake from the PD. The majority (92%) of the participants responded with an abundance of uptake. One participant explained, "I use the number line as often as I can. I try to help students see that it can be used with multiple patterns as an underlying skill for the double number line." Some participants took up general strategies that could be used across mathematics lessons and others in other content areas. For instance, one person explained,

"Generally, I've found that using visuals to access mathematics and the conceptual understanding in math has greatly benefited my students. The teaching strategies around using visuals to support understanding is something I use regularly."

In regard to principal and district support, the majority of VAM participants reported high levels of support. Others reported support related to release time. In general, no one reported anything negative related to support. Participants also reported that principals were generally supportive. In terms of community, VAM participants reflected on the collaborative nature of both the on-line and in-person sessions. One participant noted,

"I felt part of the community at the PD, my voice was heard and mattered. The small zoom sessions were also helpful and supportive. Getting to know and ask questions to a smaller cohort was less intimidating and educational. The moderators were so supportive and helpful and always followed through with any issues that needed follow-up or extra clarification."

Participants also felt they benefited from working on problems together as learners, "As we explored activities and experienced them as learners ourselves, we really opened up to one another and got to know one another."

LTG

Participants reported lower levels of uptake for LTG than VAM. About 50% of participants responded "none" or "nothing" in terms of content they currently use in their classroom. Several noted that this was because they were not currently teaching geometry. The participants who did report content uptake mentioned specific transformation-based content from the PD. For example, one participant noted, "Rotations, translations and dilations are helpful for students to see and visualize different possibilities for real world problems they are interested in solving." In terms of pedagogy, LTG teachers talked about using dynamic strategies that were closely related to the transformation-based geometry content, including the use of manipulatives and representations. Other teachers mentioned more general pedagogical strategies that were modelled by the facilitator of the PD, such as strategies for facilitating discussions, incorporating vocabulary and helping students develop explanations. As one participant noted, "I learned how to let students have a discussion to sort out their own ideas and practice defending their answers. In terms of resources, 75% of participants described how they currently used specific resources, such as patty paper or tasks and activities from the binder they were given at the PD. However, 25% of participants reported

that they did not use any resources from the PD. As described by this participant, this may be due to the content or grade level the teacher is currently teaching: “I do not use any of the paper materials that we were given in the binder because it does not apply to 6th grade or is very introductory for 7th grade.” In terms of district and principal support, teachers generally responded neutrally, and many stated that the district was not involved and sometimes not aware of the PD. Principal support varied greatly between school sites. Several reported that the principal was very supportive whereas other teachers reported lack of support. In terms of community, most teachers noted that they felt part of the community and enjoyed working on problems and discussing strategies together. For example, one participant noted that there were, “lots of discussion and opportunities to share. All opinions and strategies and thoughts were valued.” Another added, “We worked during PD hours together and discussed our shared teaching experiences at other times. The PD leaders made sure everyone felt engaged and included.”

LS

The LS project also had much lower responses than VAM when looking at the quantitative findings for each category. LS participants did not perceive that they took up any content. Not one of the respondents referred to specific mathematics content in their responses. Most responded that they didn't have anything to report or that it was not applicable. On the other hand, when responding to pedagogical uptake, many responded positively and focused on different aspects of pedagogy that they took up and new instructional strategies that they were continuing to try to use. Three participants mentioned the TRU framework that was used to analyze lessons related to effective instruction throughout their PD. Other than two respondents that said the pedagogy was not applicable, the positive respondents shared different strategies they took away from the PD. One participant commented,

“I engage in much more formative assessment with students and I constantly try to elicit more student thinking to determine how students are thinking through problems and then tailoring my instruction to meet students' needs for understanding in real-time. I also think that I am much more focused on the central mathematics and big ideas of a unit or a lesson. This has allowed me to tweak my lessons, so I can make better decisions about which content is ancillary, extension or extraneous.”

The other three responses were focused on assessment and questioning. Other LS teachers focused on questioning. For instance, one teacher reported that she has changed, “questioning strategies during a lesson to cultivate student's critical thinking.” It is not clear why four out of 13 teachers in the LS program had very targeted pedagogical uptake related to assessment, questioning, and meeting students' needs whereas the rest of the participants found little to respond to related to content, pedagogy and resources. One participant did note, “Developing a focus for the work that applied to all teachers concerns proved to be difficult.” In terms of resources, none of the LS teachers reported acquiring or using any resources from the PD. Three reported using some strategies with other teachers in planning lessons. In regard to principal and district support teachers reported a range of feelings from negative to positive but as a whole appeared to fall somewhat in the middle. One teacher might sum this up the best when explaining, “Somewhat? The district didn't play an active role in either supporting us or hindering us.” In terms of community, most reported they felt part of the community and several highlighted the importance of the community builders that were done at the beginning and end of each session. However, one reported mixed feelings about their colleagues and community, “There were moments of brilliance during these sessions. Unfortunately, the department, in general, always leaves a bad taste in my mouth because we have a lot of dead weight in our department. It makes everything more difficult”

Discussion and Implications

Teachers' perceptions of uptake differed across the three sites. It appeared that where a PD falls on the continuum may have impacted self-report data. VAM, which falls in the middle of the continuum, had the highest self-report data among teachers. The more specified the goals, the clearer teachers were able to indicate whether the PD was useful to the types of mathematics classes they were currently teaching. On the other hand, if the PD was more adaptive and the nature of the goals and intentions were evolving, teachers appeared to indicate quite different aspects of the PD that were relevant to their planning and teaching. If a PD was both adaptive and specified at times, more teachers had positive and similar experiences associated with uptake.

For instance, the VAM PD was specified enough to allow participants to recall and identify specific resources or pedagogical tools (such as double number lines or the Three Reads Strategy) that they could use in their classrooms. It was also adaptive enough that participants had time to think about how to modify the tools and resources that they learned about during the PD. On the other hand, the adaptive nature of LS might have made it difficult for participants to report how they were using the skills they learned because some of the goals and intentions of the program were not articulated during the PD. The goals were evolving simultaneously during the PD as teachers were engaging in developing one lesson plan per cycle for one specific classroom. In addition, teachers may have had a harder time generalizing the relevance from a particular lesson study cycle to their specific classrooms and contexts. The adaptive nature of the LS PD has many more complexities than the other two. For example, the goals and intentions are continually evolving and therefore teachers may take up very different aspects of the PD that are relevant to their teaching. This is unique to adaptive PD because it has the potential to meet teachers where they are at. On the other hand, the specified nature of LTG might have impacted self-report in that if teachers were not teaching transformations-based geometry, they may not have been able to explicitly identify content, pedagogy or resources when they were teaching other content, even if there were underlying connections that could have been made. Many of the LTG teachers were able to identify tasks and tools when asked but at the same time may or may not have found the narrowly focused and specified content relevant to their current teaching. However, the teachers who were currently teaching geometry reported positive levels of uptake because they highly motivated to use and then teach the LTG content with their students.

The nature of the PDs and the ways in which participants felt as if they were members of the community may also influence uptake. The LS PD was the only one of the three where teachers visited each other's classrooms. The impact of visiting classrooms on community needs to be explored as we hypothesize that this may make teachers more vulnerable and may influence their perceptions of their learning. On the other hand, VAM was the only PD that had both an online and in-person community as part of the professional development. This role of this on teacher learning also needs to be explored further. We argue that this self-report data does not indicate whether classroom practice or student learning was impacted. More research is needed on the impact of context on classroom uptake. Case study classroom videotape data and interviews will provide us more information on the classroom uptake of participants in these three studies and will help us investigate the ways in which the three different types of PD have different affordances and constraints on teacher uptake.

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