

UNDERSTANDING HOW CONTEXT IMPACTS TEACHER LEARNING: THREE PDs & THREE SITES

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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 located in different geographical contexts impacted teacher learning. Findings indicate that teachers' perceptions of learning may be associated with explicit goals and intentions of the PD program and the relevance to their everyday work in mathematics classrooms. Differences were found to be related to where they fell on the adaptive-specified continuum.

INTRODUCTION

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 might be key to helping us understand and uncover impact aspects related to teachers' prior experiences, PD design, selected content, teacher's professional vision, and geographical differences.

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 PD (Cobb, McClain deSilva Lamberg, T. & Dean, 2003; Coburn & Russell, 2008).

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 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 PD designs. We aim to disentangle the role that these contextual features play in these three PD projects by analysing teachers' perceived uptake on content, pedagogy and resources.

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, specified models of PD typically incorporate published materials that specify in advance teacher learning goals and provide resources and guides to implement the PD. 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 analysing 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 Through 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 analyse 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, VAM, Visual access to mathematics: Professional development for teachers of English learners, aimed to build skills in mathematical problem solving and communication through the use of visual representations. This PD consists 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 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 took the full survey (LTG had 28 participants, VAM had 25 and Lesson Study had 13). A 32-question teacher survey was administered to all participating teachers in the three NSF projects. 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 both Likert scale questions, where participants responded to statements on a scale of 1-10, as well as follow up questions that allowed the participants to explain and provide more details about their numeric response. To analyse 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 quantitative results. We coded qualitative responses to better understand teachers' perceptions of uptake after participating in professional development. We used Likert scale questions to serve as the baseline and coded related qualitative questions where participants articulated their perception and vision of uptake from 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.

In summary, 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 this, we analysed the qualitative data. In our analysis we used open ended coding for content, pedagogy and resources combined as they are inter-related, and similarities appeared in all three areas.

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.

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.

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 analyse 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. In terms of resources, none of the LS teachers reported acquiring or using any resources from the PD. Three reported using some new 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.”

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 more 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 more teachers had positive and similar experiences associated with uptake.

This paper contributes to our understanding of how the nature of PD design as well as context impacts what teachers take up and their perception of their experiences. 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. 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 end of the continuum, the specified nature of LTG might have impacted self-report in that if teachers were not teaching transformations-based geometry, they typically did not identify content, pedagogy or resources when they were teaching other content, even though there are 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. Seventy-seven percent of LTG teachers noted uptake in pedagogy from survey data which peaked our interest as Jacobs et al., (2020) recently found significant longitudinal changes in instructional practice with the same LTG teachers compared to a control group.

Thus this self-report data does not indicate whether classroom practice or student learning was impacted but it provides a basis related to PD design and context to further study nuances of uptake to examine instructional practice. More research is needed in this area. Case-study teacher classroom videotape data will provide us more information on the instructional 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 and instructional practices.

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