PUTTING SOCIO-CULTURAL THEORIES TO WORK IN SUPPORTING MATHEMATICS TEACHERS' PROFESSIONAL DEVELOPMENT[1]

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We discuss the contributions of socio-cultural theories to research and design of interventions directed at the professional development of mathematics teachers. We explain how these theories have been put to work in the field. We also bring to attention specific issues arising in the field for which development and adaptation of socio-cultural theory might be a useful resource.

INTRODUCTION

In this paper, we explore the contribution of socio-cultural theories in enhancing research and design of interventions directed at the professional development of mathematics teachers. We suggest that fields such as educational research contribute to the work of theorizing in two important ways: one, by capitalizing on existing theoretical frameworks, and in this way putting theories to work (Cobb, 2007), and two, by bringing to attention specific pragmatic problems arising in the field for which useful theoretical guidance yet has to be developed. We ground our discussion (a) in the literature on development of mathematics teachers, (b) in our research on supporting the development of professional teaching communities (e.g., Cobb et al., 2007), and (c) in the second author's explorations directed at establishing a productive collaboration with mathematics teachers in an underprivileged school district in southern Mexico.

Our primary research goal when working with mathematics teachers is to investigate ways and means of supporting them in developing instructional practices that have been identified as beneficial for student learning of mathematics with understanding (e.g., Carpenter & Lehrer, 1999). Instructional practices of this kind are complex, demanding, uncertain, and not reducible to predictable routines (Ball & Cohen, 1999; Clark, 1988; Lampert, 2001; McClain, 2002; Schifter, 1995; Smith, 1996), and differ significantly from those commonly observed in classrooms (e.g., Hiebert et al., 2005). Supporting teachers in developing these instructional practices is an equally complex endeavor (Borko, 2004; Loucks-Horsley, Hewson, Love, & Stiles, 1998; Tirosh & Graeber, 2003). It involves building on teachers' current instructional practices and, at the same time, being effective in pursuing key learning goals for teachers as part of a professional development agenda.

To encompass this complexity in a systematic and cumulative way, we have found it useful to conceive of the work in teacher professional development as a design science, "the collective mission of which involves developing, testing, and revising conjectured designs for supporting envisioned learning processes" (Cobb, 2007, p. 3). In our research, we design learning

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environments to provide the context for inquiry, and conduct ongoing and retrospective analyses to inform the further improvement of our designs (Edelson, 2002; Gravemeijer, 1994). Inherent to this work is the formulation and/or adaptation of theoretical frameworks that inform the development of designs. It is in the context of this practice that we examine the contributions of socio-cultural theories to research in professional development of mathematics teachers.

DESIGN RESEARCH AND ADAPTING THEORIES FOR A PRAGMATIC PURPOSE

It might be tempting to portray the relatively newly adopted socio-cultural theories as an improvement over the cognitively oriented perspectives that dominated the field of teacher professional development previously. Such portrayal would be deceptive, given that in the complex efforts involved in supporting teacher learning different perspectives are employed to understand different phenomena and to answer different questions. In the endeavor of developing, testing, and revising professional development designs, theoretical perspectives are construed as tools, rather than as competing ideological commitments.

We find it useful to think about three different levels of design and analysis on which theoretical guidance is needed in our research (cf. Tzur, Simon, Heinz, & Kinzel, 2001). First, on a broad level, designing requires detailed understanding of productive goals for teacher professional development. In other words, it is necessary to understand what are some of the key aspects of mathematics instruction, which is effective in supporting students' learning of mathematics. Second, on a fine-grained level, we need to be able to analyze and interpret an individual teacher's approach to instruction, in ways that would help us comprehend the extent to which this approach could serve as a basis for this teacher's further improvement. As we argued elsewhere (Visnovska, 2007), adaptations of cognitive and emergent theoretical perspectives provide valuable guidance on these two levels of design and analysis (e.g., Carpenter & Fennema, 1992; Simon & Tzur, 1999; Simon, Tzur, Heinz, Kinzel, & Smith, 2000).

The remaining level of design concerns the planning of specific activities in response to how a group of teachers participates in professional development sessions. This meso-level is necessary, since having clarity about the broad goals of an intervention might be insufficient to inform the design of specific activities, given the distance between teachers' current instructional practices and the envisioned endpoints. Similarly, detailed understanding of individuals' instruction does not, in its own right, provide sufficient basis for evaluating alternative ways in which to proceed with an entire group of teachers. The planning of professional development interventions requires interpreting the groups' ongoing practices in ways that enable envisioning how could the activity evolve locally in directions compatible with the global goals. Specifically, it is necessary to envision a trajectory for the learning of the teacher group that (a) originates with issues accessible to the group at present time and (b) can support the evolution of those issues into others that are significant in terms of the overarching professional development goals.

The literature review we conducted suggests that studies drawing on situated theories of activity (Lave, 1991; Lave & Wenger, 1991; Rogoff, 1995, 1997; Wenger, 1998) have been especially well positioned to develop valuable tools for supporting teacher learning on this meso-level of design. Importantly, these studies suggested productive ways to account for patterns and shifts in the practices of whole groups, rather than of individual teachers. In the reminder of this paper, we first

discuss some of the issues inherent in teacher professional development in which the adoption of a situated perspective provided useful guidance. Next, we describe a problem in our current work that we anticipate can be addressed by drawing on socio-cultural theories.

IMPACT OF SOCIO-CULTURAL VIEWS ON CONCEPTUALIZATIONS OF PROFESSIONAL DEVELOPMENT

Situated nature

Efforts to support mathematics teachers' development of complex instructional practices that could lead to significant student learning brought to the fore the importance of social aspects of teaching that, to a great extent, shaped teachers' learning experiences. Situated theories enabled researchers to account for cases where the same designs resulted in differential learning opportunities for groups of teachers with similar initial knowledge and beliefs of effective mathematics instruction, by bringing to the picture the different contexts in which these teachers' learning occurred (e.g., Franke, Carpenter, & Battey, in press). At the same time, framing teachers' learning as situated required that researchers explicate how professional development support could result in more than merely shifts in teachers' participation in professional development activities. This concern was initially addressed in conceptualizations of the means intended for supporting teacher learning in professional development settings. Ball and Cohen (1999) explored the idea of *centering teachers' learning in their instructional practices* as an overarching principle for professional development design and analysis. They clarified that

> Centering professional education in [teachers' instructional] practice is not a statement about either a physical locale or some stereotypical professional work. Rather, it is a statement about a terrain of action and analysis that is defined first by identifying the central activities of teaching practice and, second, by selecting or creating materials that usefully depict that work and could be selected, represented or otherwise modified to create opportunities for novice and experienced practitioners to learn (p. 13).

The idea of centering teachers' professional development learning in instructional practices broadly addressed the need to coordinate teachers' learning across the two settings. Ball and Cohen (1999) argued that to learn anything relevant to professional performance, teachers "need experience with the tasks and ways of thinking that are fundamental to the (instructional) practice" (p. 12). This view built on characterizations of teaching as a reflective practice, changes in which can be supported through the process of focused inquiry (Dewey, 1910, 1938; Schön, 1983, 1987). Among the central activities of teaching mathematics that were utilized as foci for professional development inquiry were, for instance, explicating the mathematical potential of instructional tasks while considering learners' perspectives (McClain, 2003), or understanding students' mathematical reasoning from their written work (Kazemi & Franke, 2004). The inquiries designed around these activities of teaching required teachers to discuss their conjectures about how students might reason in situations under investigation. The purpose of these inquiries was to support teachers' development of specific ways of reasoning about mathematics instruction, in which drawing on their students' reasoning would become an inherent part of instructional practice.

Collective

Given the nature of envisioned inquiries into instructional practices, teachers' participation was considered most productive when individuals could capitalize on each other's expertise. Central to this idea, as Putnam and Borko (2000) clarify, is an assumption that as each participant brings

unique pedagogical and disciplinary understandings to a professional collaboration, group members "can draw upon and incorporate each other's expertise to create rich conversations and new insights into teaching and learning" (p. 8). It is for this reason that professional development activities were designed in a form of *collective* inquiries into instructional practices. However, envisioned collaboration among teachers could not be adequately cultivated without the development of more substantial professional discourse and teachers' engagement in communities of practice (Ball & Cohen, 1999; McLaughlin & Talbert, 1993; Putnam & Borko, 2000).

While specific criteria for what constitutes a community of mathematics teachers, or a professional teaching community, were not always made explicit, the findings of a number of investigations indicated that strong social networks can be a crucial resource as the teachers attempt to develop new and complex instructional practices (Cobb & McClain, 2001; Franke & Kazemi, 2001b; Gamoran, Secada, & Marrett, 2000; Kazemi & Franke, 2004; Lachance & Confrey, 2003; Lehrer & Schauble, 1998; Little, 2002; Stein, Silver, & Smith, 1998). Building on empirical research, Carpenter and colleagues (2004) assert that mathematics teachers' participation in professional teaching communities can "provide a climate for engaging in inquiry, sharing knowledge of student thinking, sharing norms for what counts as effective instruction and student achievement, and building social supports for managing uncertainty" (p. 8; cf. Cobb, 1999; Gamoran et al., 2003; McLaughlin & Talbert, 1993; Quiroz, 2001). Beyond supporting teachers' development while research collaborations took place, professional teaching communities reportedly served as productive sites for *ongoing* teacher learning and collaboration, thus nurturing and sustaining generative growth (Franke & Kazemi, 2001a, 2001b). While a systematic design effort of university collaborators was often critical for the initial emergence of professional teaching communities (Putnam & Borko, 2000), several communities persisted and continued learning many years after the researchers withdrew from the site (e.g., Cobb & McClain, 2001; Franke & Kazemi, 2001a).

Institutional setting

Institutional context of teachers' work was brought to the foreground in discussions of both development and sustainability of professional teaching communities. Professional development and research experiences continued to create examples of professional development designs that, although highly effective in one setting, did not prove viable in supporting learning of a professional teaching community in another setting (e.g., Franke et al., in press; Franke, Kazemi, Carpenter, Battey, & Deneroff, 2002). There was little doubt that teachers' work and learning experiences are "profoundly influenced by the institutional constraints that they attempt to satisfy, the formal and informal sources of assistance on which they draw, and the materials and resources that they use in their classroom practice" (Cobb, McClain, Lamberg, & Dean, 2003, p. 13; see also Ball & Cohen, 1996; Brown, Stein, & Forman, 1996; Feiman-Nemser & Remillard, 1996; Nelson, 1999; Senger, 1999; Stein & Brown, 1997). Indeed, researchers' awareness that different institutional settings present different challenges for teacher professional development manifested also in cognitively-oriented studies in both (a) the great attention that these researchers paid to choosing research sites and (b) their introduction of significant changes to the structure of teachers' working environment, for instance in the form of extensive in-class support (e.g., Fennema et al., 1996). The choices and adjustments of institutional settings, while pragmatically valuable, were often conceptualized as dealing with factors that were external to the processes of teachers'

learning. Current reform implementation and sustainability research (e.g., Carpenter et al., 2004; Coburn, 2003; Elmore, 2004) suggests that designing specific institutional contexts would provide critical resources for supporting teachers' learning. However, many teachers work in districts where profound interventions at an institutional level are not an open possibility. It became clear that to be useful, an interpretive framework for documenting the learning of a professional teaching community and the participating teachers would have to account for the institutional contexts in which the teachers worked. Only then could it guide researchers' and professional developers' efforts to effectively support teachers' learning in a variety of institutional settings, drawing attention to aspects of designs that are key in supporting teacher learning.

ADAPTATION

To illustrate what we mean by adapting theories for purposes of design research on professional development of mathematics teachers, we consider Cobb, Dean, and colleague's (Cobb et al., 2003; Dean, 2004, 2005, 2006) analytical framework, which is an adaptation of Wenger's work on communities of practice, developed in response to the described practical need. The framework conceptualizes mathematics instruction as an activity that is distributed (Dörfler, 1993; Pea, 1993) across different people and their actions and situates teachers' instructional practices within the institutional settings of their work.

When characterizing school environments in which students learn mathematics and teachers work, Cobb and colleagues focused on the *functions of teaching* and how they are accomplished in schools and school districts. This focus enabled them to bring to our attention how a number of persons in various designated positions within the school and district are involved in accomplishing these functions, thus shaping students' mathematical learning and influencing teachers' work. Specifically, these functions include

> *Organizing for mathematics teaching and learning* by, for example, delineating instructional goals and by selecting and adapting instructional activities and other resources, and
>
> *Making mathematics learning and teaching visible* by, for example, interpreting test scores or posing tasks designed to generate a record of students' mathematical reasoning (Cobb et al., 2003, p. 14)

The resulting view of the institutional setting in which mathematics instruction takes place is that of groups of people attempting to achieve at times complementary, and at other times competing agendas as they organize for mathematics teaching and learning and make it visible. Using their framework to analyze two institutional settings in which they supported development of professional teaching communities of middle school mathematics teachers, Cobb et al. identified three distinct groups of people whose enterprises were concerned with teaching and learning of mathematics. These were a district-wide mathematics leadership group, a school leadership group, and a group comprised of mathematics teachers. All three groups attempted to shape both mathematics instruction and students' learning in both districts. To understand the co-existence and potential alignment of the agendas, the researchers analyzed three types of interconnections among the groups: (a) *boundary encounters* in which members of different groups engaged in activities together, (b) the role of *brokers* who were at least peripheral members of two or more groups, and (c) the role of *boundary objects* that have been incorporated into the practices of two or more groups (cf. Star & Griesemer, 1989; Wenger, 1998). The identified differences allowed the researchers to account for different instructional practices of mathematics teachers in the two

districts, as well as for some of the differences in these groups' participation in professional development setting (for details see Cobb & McClain, 2006; Cobb et al., 2003).

Building from the analysis of the institutional setting, Dean's (2005; 2006) work focused on developing analytical tools to document the developments of a professional teaching community along with the means by which these developments were supported. Grounding her work in empirical analyses of the first two years of collaboration at one of the sites, Dean's analysis provided critical insights into the process of the evolution of a professional teaching community. As used by Dean and colleagues, the term *professional teaching community* is not merely a description of a group of mathematics teachers who collaborate with each other in some way. Specifying the distinction between a group and a community was important given that not every group composed of mathematics teachers would provide them with the climate, the need, and the resources for engaging in inquiry into instructional practices centered in students' mathematical reasoning, or for supporting each other in managing uncertainties inherent in complex, reform-oriented mathematics instruction. Some groups, nevertheless, have been documented to do so (Carpenter et al., 2004). Based on review of the literature on professional communities and professional teaching communities (Bellah, Madsen, Sullivan, Swidler, & Tipton, 1985; Gamoran et al., 2003; Grossman, Wineburg, & Woolworth, 2001; Lave & Wenger, 1991; Newmann & Associates, 1996; Rogoff, 1995; Secada & Adajian, 1997; Wenger, 1998), Dean and colleagues (Cobb et al., 2003; Dean, 2004, 2005) articulated what they came to see as the salient characteristics of a professional teaching community of mathematics teachers working in high-stakes accountability environment in the United States:

> *A shared purpose or enterprise* such as ensuring that students come to understand central mathematical ideas while simultaneously performing more than adequately on high stakes assessments of mathematics achievement,
>
> *A shared repertoire of ways of reasoning with tools and artifacts* that is specific to the community and the shared purpose including normative ways of reasoning with instructional materials and other resources when planning for instruction or using tasks and other resources to make students' mathematical reasoning visible,
>
> *Norms of mutual engagement* encompassing both general norms of participation as well as norms that are specific to mathematics teaching such as the standards to which the members of the community hold each other accountable when they justify pedagogical decisions and judgments.

This characterization of a community provides designers of professional development with a more specific orientation to the substance of the professional collaborations, emergence of which they attempt to support. Importantly, collaborating groups with these characteristics were documented to lead to sustained generative growth of participating teachers (e.g., Franke & Kazemi, 2001a). The characterization can also help us understand some of the reasons why teachers' membership in groups that, for instance, regularly meet to socialize during lunch time might not adequately support the teachers in improving their students' learning of mathematics with understanding.

Following from this characterization of a professional teaching community, an analytical framework that Dean and colleagues proposed for analyzing its developments and how these were supported focused on documenting shifts in several types of norms of mutual engagement as they got established within the group. Detailed description of this framework goes beyond the focus of our present discussion. It will suffice to note that the framework attends in detail to patterns of

teachers' general participation, and their reasoning about pedagogy and mathematics – that is, issues that were identified as relevant to development of professional teaching communities before (e.g., Bransford, Brown, & Cocking, 2000; Grossman et al., 2001; Ma, 1999; Shulman, 1986). Among major contributions of Dean and colleague's work is an explicit attention to the evolution of the teachers' collective understanding of their institutional setting. The researchers illustrate explanatory power and practical significance of seeing "(t)he teachers' changing views of the institutional context and how it supported or constrained their instructional practices (as) an important aspect of their learning" (p. 25). In particular, the analytical framework both highlighted the necessity to support teachers in de-privatizing their instructional practices and guided choices of possible means of support. Explicit discussions of institutional context opened up an avenue to teachers' classroom instructional practices that teachers cautiously guarded when the discussions related to their pedagogical reasoning.

Usefulness

Let us conclude this section by highlighting major contributions of the discussed adaptation of the theoretical framework. For Dean and colleagues, making sense of how functions of mathematics teaching got accomplished within the institutional setting of teachers' work proved to be a critical resource for understanding teachers' actions in their classrooms, as well as in the professional development sessions *as reasonable from their perspective*. While such understanding was also deemed necessary by researchers adopting a cognitive perspective (e.g., Simon & Tzur, 1999), the described framework expanded our understanding of reasonableness of teachers' actions beyond their cognitive faculties, bringing to the picture the constraints that the teachers attempted to satisfy.

This was most important with respect to the *meso-level* of design research because, in our experience, the teachers' initial engagement in mathematical discussions did not provide sufficient insights into their cognitive skills. Partially, this was because the teachers engaged in a different "game" than the researchers when they proposed solutions to the mathematical tasks at the beginning of the collaboration. In their mathematical solutions, teachers attempted to satisfy test performance expectations (e.g., correctness of used graphing conventions) established in their schools, rather than our expectations to genuinely explore mathematical relationships when solving the tasks. Therefore, inferring teachers' cognitive skills in mathematics from their participation in order to use them as a basis for further design would be in such cases problematic.

Importantly, the explicit realization that the teachers' actions and points of view could be construed as reasonable when taking in consideration the institutional constraints that they attempted to satisfy suggested an alternative course of action in further design. It provided the researchers with resources to both challenge the teachers' ideas of what learning mathematics with understanding should be about and start bringing to teachers' attention how their instructional practices are shaped by the institutional context of their schools and the district. As Dean (2005) reported, teachers' increased awareness of the institutionally situated nature of their job manifested both in the teachers' desire to make changes in their instructional practices and in their perception of the institutional setting as something they could influence. The teachers started to actively plan for obtaining control over essential resources needed to teach mathematics with a focus on student reasoning by supporting the school leaders' understanding of what such teaching and learning mathematics encompassed.

OPEN QUESTION: NEGOTIATING COLLABORATION AT A NEW SITE

To this point, we aimed to illustrate what we mean by putting theories to work when studying how to effectively support professional development of mathematics teachers. We would now like to exemplify the second type of contribution to the work of theorizing, that of highlighting specific pragmatic problems for which useful theoretical guidance yet has to be developed.

Supporting the emergence of a professional teaching community that could be characterized by a shared purpose, repertoire of ways of reasoning with tools, and substantial norms of mutual engagement is not a trivial matter. According to Dean's analysis, it was not until after approximately 19 months of collaboration (during which the group met in 13 full-day sessions) that the group she analyzed emerged as a professional teaching community. It is important to realize that while Dean and colleagues' findings provide unparalleled guidance to both conducting ongoing analyses and making pragmatic decisions of how to proceed while working with teachers, they - too - are situated in a specific cultural context, taking some of broader aspects of working with mathematics teachers for granted. The researchers were aware of this fact, acknowledging that their findings might be most relevant to professional developers working with groups of mathematics teachers in institutional environments with significant accountability pressures to which administration responds by attempting to monitor teachers (Dean, 2005).

High-stakes accountability pressures in the United States position teachers within ongoing efforts at improvement of mathematics instruction, or, at very least, of their students' performance on state-mandated tests. Over the last decade, teachers' participation in professional development activities became a routine part of teachers' jobs in many school districts in the US. While the teachers often remain skeptical with respect to the usefulness of these activities and their relevance to the job of teaching mathematics in classrooms, institutional conditions shaped by national-level policies created perceptions of a need for teacher professional development and, to a great extent, legitimated the efforts of professional development providers in teachers' eyes.

This would not necessarily be true in other countries where the institutional contexts where teachers work are culturally and politically shaped in different directions. To illustrate the significance of some of these differences, consider the case of a school district in southern Mexico, where the second author has been exploring the possibility of collaborating with a group of elementary school teachers, while building on experiences from designs that were successful in supporting mathematics teachers in the US.

The school district is located in an area of Mexico characterized by low student performance in mathematics. It is not uncommon to find sixth grade classrooms where more than 50% of the students do not recognize the inscription $\frac{1}{2}$ as meaning "half". We initially conjectured that teachers would be interested in participating in professional development aimed at supporting them to improve their teaching of fractions. However, teachers showed little interest in attending, despite the fact that the sessions took place during their working hours, they got release time to attend, and innovative resources for teaching fractions were introduced. The lack of teachers' commitment was noticeable by people coming late to the sessions, leaving early, or not returning after attending one session. It is worth clarifying that other groups that tried to implement professional development in the region noticed similar teacher attitudes.

The teacher behavior becomes less surprising when we consider the institutional context in which they work. Professional training efforts in the district are typically limited to short, once-a-year workshops prescribed by the National Ministry of Education. Teacher accountability is based more on bureaucratic performance (e.g., turning in paperwork complete and on time) than on instructional practices and student outcomes. Appointment, deployment, and promotion of teachers is controlled by a central office and negotiated with corrupt union leaders (Hallak & Poisson, 2007). State mandated tests started to be implemented in 2006, but not in a high stakes fashion. In this institutional context, it seems reasonable to find teachers not being readily interested in professional development that aims at rather dramatic changes in their instruction. The question then arises of what could be the basis of a collaboration with these teachers that could lead towards improvements in students' mathematical understanding.

The case of the Mexican teachers alerted us to the fact that what we considered starting points for an effective collaboration could be, in some contexts, insufficient. Cultivation of shared goals, common norms, and tools for a group collaboration provided a satisfactory orientation for productive work with a group of teachers who already accepted - in some ways - a need for being a part of a professional development community. These goals, however, seem far at the horizon for the group of Mexican teachers who do not readily perceive a need for professional development in order to be successful in doing their jobs.

This discrepancy fueled our interest in understanding the characteristics of effective relationships between teachers and researcher groups working together in professional development settings. A characteristic that we suggest is common to cases of effective teacher professional development intervention is that of establishing a genuine collaboration between teachers and professional developers (e.g., Lamberg, 2005). When two groups come together, they are likely to have different expectations, goals, interests in, and rationales for participating in common work sessions. To achieve a collaboration both groups need to enter a negotiation that can allow for mutual alignment of goals, purposes, and expectations; a collaboration that would involve both the teacher group and the researchers seeing their counterparts as valuable, unique contributors to an endeavor that everyone recognizes as relevant and worthwhile. Establishing such collaboration might not be trivial since these negotiations take place in circumstances that involve considerable, institutionally situated power differences. Even teachers in the institutional contexts that we understand better at this point might, for example, see professional development meetings as a compliance activity, expecting these to have little or no consequences for their instructional practices, yet being an unavoidable part of their job. We contend that such expectations, if not problematized, might become a significant obstacle for teachers' productive engagement in establishing a professional teaching community.

In fact, a number of issues that are related to collaboration and mutual trust might contribute to low effectiveness of professional development sessions if left unattended. Our goal in this section is to highlight this issue as a theoretical as well as pragmatic problem. We suggest that professional development designers would benefit from a theory-based understanding of the key aspects important in the process of initial negotiation of effective collaboration. Because of the nature of this issue, socio-cultural theories seem to be the most likely resource.

As an initial step, we drew inspiration for grasping the relationship between mathematics teachers and researchers who come to work together from intercultural studies, in particular those that built on the idea of contact zone (Pratt, 1992, 1999). A particularly inspirational work is that of Somerville & Perkins (2003), who analyzed a research collaboration and partnership between non-indigenous university researchers and an aboriginal organization in New South Wales, Australia. These two groups came together to "research relationship to place using archeological and oral history methods to produce educational materials for the organisation's cultural and educational ecotourist enterprise" (p. 254). Without going into details of the theoretical framework developed by these researchers, it is reasonable to assume that if research on professional development of mathematics teachers should benefit from intercultural theories, it is by the framework adaptation and further development, rather than their straightforward application. It was our goal to illustrate that such adaptation and further theoretical development would have a significant pragmatic impact.

FINAL REMARKS

Socio-cultural theories have proven to be a valuable resource in enhancing research and design of interventions directed at the professional development of mathematics teachers. They have been put to work in studying how to effectively support professional development of mathematics teachers, particularly in interpreting the ongoing practices of teachers in ways that enable the intervening researchers envision viable trajectories of sustained and generative professional growth. The socio-cultural perspective also seems promising in developing theoretical resources that inform the process of initial negotiation, of effective collaboration with groups of teachers participating in significantly diverse types of intuitional settings.

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