Critical Postmodern Methodology in Mathematics Education Research:

Opening Up Previously Unseen Vistas for Data Collection, Analysis, and Representation

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Abstract

Mathematics education research over the past half century can be understood as operating in four distinct yet overlapping and simultaneously operating historical moments: the process–product moment (1970s–), the interpretivist–constructivist moment (1980s–), the social-turn moment (mid 1980s–), and the sociopolitical-turn moment (2000s–). Each moment embraces unique theoretical perspectives as it critiques or rejects others. And given that it has been argued that methodology is inextricably linked to theory, each moment calls forth not only different theoretical perspectives but also different methodological possibilities. In this article, the authors briefly discuss and critique the methodologies that are “traditionally” found in each moment and explore some of the methodological possibilities made available in the sociopolitical-turn moment. Specifically, the authors explore the methodological possibilities when research is framed in the sociopolitical hybrid of critical postmodern theory—a theoretical perspective and methodology that opens up previously unseen vistas for data collection, analysis, and representation in mathematics education research.

Keywords Critical Theory, Mathematics Education Research, Methodology, Postmodern Theory, Research Methods
1 Introduction

In 2002, the National Research Council (NRC) published the report *Scientific Research in Education* (SRE). This report reignited a 30-year-old theoretical and methodological debate within social science generally and educational social science specifically. The key, two-part question of the debate: *What is “science” and who decides?* The directness of this question is seen in the specific charge to the SRE authoring committee: to examine and clarify the nature of scientific inquiry in education through a review and synthesis of “recent literature on the science and practice of scientific educational research and consider how to support high quality science in a federal education research agency” (2002, p. 1). Since its publication, SRE continues to be vigorously debated at conferences such as the annual meeting of the American Educational Research Association and the International Congress of Qualitative Inquiry as well as within the pages of books (e.g., Baez & Boyles, 2009) and special and theme issues of journals (e.g., Jacob & White, 2002; Lincoln & Cannella, 2004; St. Pierre & Roulston, 2006). In many ways, the debate could be argued to hinge on the purpose of educational social science. On the one side are those who look toward science to provide concrete “answers” to complex (yet too often oversimplified) problems. On the other side are those who look toward science to generate more (better?) questions that might produce different knowledge and produce knowledge differently (St. Pierre, 1997). St. Pierre (2006) underscores the gravity of the debate, arguing that the stakes are high, because the very nature of science and scientific evidence and therefore the nature of knowledge itself is being contested by scholars and researchers who think and work from different epistemological, ontological, and methodological positions as well as by those postmodernists who challenge the metaphysical project altogether. If one believes that different theoretical frameworks are grounded in and
structured by different and, perhaps, incommensurable assumptions about the nature of knowledge, truth, reality, reason, power, science, evidence, and so forth, then one can see why educators are taking sides in this debate that is already organizing the limits and possibilities of what we can think and know and, thus, how we can live in the complex and tangled world of educational theory, research, policy, and practice. (pp. 239–240)

Within the context of U.S. mathematics education\(^1\) social science the ideological inscription of the two opposing sides is visible within the pages of the *Foundations of Success: The Final Report of the National Mathematics Advisory Panel* (NMAP, 2008) and in a response special issue of the *Educational Researcher* (Kelly, 2008). Throughout the pages of both the final report and the response special issue it is often noted, explicitly and implicitly, that supporting or favoring certain theoretical and methodological perspectives does not mean complete abandonment of others. But as politics took the place of scientific inquiry (Boaler, 2008), both the SRE and the NMAP final report took direct aim toward some epistemological possibilities, and thus theoretical and methodological possibilities. For instance, the SRE rejected postmodernism altogether (St. Pierre, 2002) and the NMAP final report erased “race” from the conversation on mathematics teaching and learning (Martin, 2008). Nevertheless, whatever the “fair and balanced” intent of reports such as SRE and the NMAP final report, we argue the influence of both in limiting the possibilities of science is evident through an examination of the recursive cycle that too often determines the types of dissertations produced, the methods of research projects funded, and the nature of findings published—findings which eventually

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\(^1\) The explicit notation on U.S. mathematics education is intentional, in that, we are not suggesting that the NRC and/or NMAP reports have directly influenced the possibilities of scientific inquiry throughout the world. We do, however, suggest that the ideological inscription of neoliberalism, which frames both reports, has become an international phenomenon in “developed” and “developing” countries alike.
become the scientific base for subsequent dissertations. In short, ideologically inscribed reports producing a recursive cycle of limited knowledge reproducing limited knowledge. Our intent here is not to jump into the fray of this reignited and ongoing debate. We make note of it here only to make clear that our discussion must be placed in the larger “complex and tangled world of educational theory, research, policy, and practice” (St. Pierre, 2006, p. 240).

Elsewhere, in an attempt to make sense of the complex and tangled world of divergent theoretical perspectives in mathematics education research, we identified four distinct yet overlapping and simultaneously operating (therefore no end dates) historical shifts or moments in mathematics education research over the past four decades: the process–product moment (1970s–), the interpretivist–constructivist moment (1980s–), the social-turn moment (mid 1980s–), and the sociopolitical-turn moment (2000s–) (Stinson & Bullock, 2012a, 2012b). We showed that each moment (more or less) embraces unique theoretical traditions as it rejects others. We also made an argument for a hybrid critical postmodern theoretical approach to conducting mathematics education research where the researcher continually and simultaneously negotiates the praxis of the critical and the uncertainty of the postmodern (Stinson & Bullock, 2012; see also Stinson, 2009). Here, given that methodology is inextricably linked to theoretical perspective (LeCompte, Preissle, & Tesch, 1993), we extend our previous discussion to explore data collection, analysis, and representation possibilities—that is, methodological possibilities—through the four shifts or moments. We use “effective” or “good” mathematics teaching as just one example of a research strand in which the differences and commonalities among methodological approaches might be highlighted. But before we engage in the discussion, we must clarify (although briefly) how we understand the interrelationship of theoretical
perspective, methodology, and methods within the context of educational research generally and mathematics education research specifically.

2 Epistemological Stance→Theoretical Perspective→Methodology→Methods

Often times one of the most difficult terrains for novice (and sometimes even seasoned) education researchers to negotiate is the complex interrelationships among theoretical perspective, methodology, and methods. Over the past decade or so, there have been several discussions around the use of theory (and methods) in mathematics education research (see, e.g., Brown & Walshaw, 2012; Cobb, 2007; Lerman, Xu, & Tsatsaroni, 2002; Lester, 2005; Schoenfeld, 2007; see also the edited volumes de Freitas & Nolan, 2008, and Sriraman & English, 2010). These discussions have shown the dichotomous perspectives on the use of theory (and methods) in mathematics education research. Some researchers suggest designing a “grand” theory of sorts for mathematics education research (Silver & Herbst, 2007) while others suggest that mathematics education researchers act as bricoleurs: adapting theoretical concepts and ideas from a range of theoretical perspectives (Lester, 2005). And yet, still others suggest using “theory as a vehicle for new productive possibilities in mathematics education…to rework the epistemic responses that go hand in hand with the current image of mathematics education” (Brown & Walshaw, 2012, p. 3). Throughout many of these discussions, researchers often attempt to place ridged boundaries around theoretical perspective, methodology, and methods creating a one-to-one mapping of sorts where a specific method is mapped to one and only one specific theoretical and methodological approach. We, however, see the mapping among theoretical perspective, methodology, and methods not as a one-to-one mapping but rather as a multiple collection of relations that is first and foremost determined by the researcher’s philosophical and/or epistemological stance (Lester, 2005; Crotty, 1998).
In examining the goals of mathematics education research and the role of theory in
general, Lester (2005) claims that the philosophical (or epistemological) stance of the researcher
influences the very sort of research that is conducted: the “problems” that are identified, the
questions that are asked, the practices that are enacted. Crotty (1998), in a more general
discussion of social science research, notes that epistemology “is the theory of knowledge
embedded in the theoretical perspective and thereby in the methodology” (p. 3). He argues that
the starting point of social science research (mathematics education or otherwise) begins with
two questions: (1) What methodologies and methods will be used in the proposed research
project? and (2) How are the methodologies and methods justified (i.e., what theoretical
perspectives drives the methodology and methods chosen)? Accordingly, these two questions
quickly expand to four:

1. What methods are proposed?
2. What methodology governs the choice and use of methods?
3. What theoretical perspective drives the chosen methodology?
4. What epistemology stance informs the specific theoretical perspective? (p. 2)

Crotty provides the following direct (and most useful to our argument) definitions of each
italicized term:

- **Methods**: the techniques of procedures used to gather and analyse [and represent] data related to some research question or hypotheses.
- **Methodology**: the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of
  methods to the desired outcomes.
• *Theoretical perspective*: the philosophical stance informing the methodology and thus providing a context of the process and grounding its logic and criteria.

• *Epistemology*: the theory of knowledge embedded in the theoretical perspective and thereby in the methodology. (p. 3)

In short, epistemology drives theoretical perspective, which drives methodology, which, in turn, drives methods: epistemology \(\rightarrow\) theoretical perspective \(\rightarrow\) methodology \(\rightarrow\) methods.

We clearly understand that relying on Crotty’s (1998) explication has oversimplified decades, if not centuries, of philosophical debate about the meaning of knowledge and how knowledge might be produced. But the reliance brings us back to the key, two-part question of the debate noted in the introduction: *What is science and who decides?* And given that education scholars and researchers who work from different ontological, epistemological, and methodological positions are debating this question, here, for the purposes of our argument, we believe that it is helpful to somehow make sense or capture, although briefly, some of these different positions. To that end, we believe that Lather and St. Pierre’s *Postpositivist New Paradigm Inquiry Table* (Table 1) provides a means to capture the commonalities and difference among possible positions (see Lather, 2006, p. 37 and Lather, 2007, p. 164 for complete details about how the table was constructed). As evident, they organize the possible positions using Kuhn’s (1962/1996) concept “paradigms”: shifts in the traditions of “normal science” (i.e., firmly based historical traditions of science) that are differentiated not by failure of one method to another but rather by the “incommensurable ways of seeing the world differently and of practicing science in it” (p. 4). Although the use of paradigms in social science research has been contested (see, e.g., Donmoyer, 2006), Lather (2006) argues that the use of Kuhn’s paradigms
(although she questions its linearity) is an attempt “to capture the play of both the dominant and emergent knowledges vying for legitimacy in order to open up a history of what contains thought and how thought is both shaped by and excessive of that containment” (p. 36).

It is important to note that in our previous work (Stinson & Bullock, 2012a, 2012b), similar to Lather and St. Pierre’s (see Lather, 2007) paradigms identified, we explicitly state that the moments of mathematics education research identified are overlapping and simultaneously operating. It is also important to note that neither Lather and St. Pierre nor we claim that movement among the paradigms—and in our case, moments—occurs in some linear fashion, arriving at a “best” or “better” place as one moves across some continuum. But rather both the paradigms and moments are arranged more or less in a historical chronological order. Below, we map specific moments of mathematics education research to specific paradigms (see Table 1):

- Process–Product Moment (1970s–)→Predict
- Interpretivist–Constructivist Moment (1980s–)→Understand
- Social-turn Moment (mid 1980s–)→Understand (albeit, contextualized understanding) or Emancipate (or osculate between the two)
- Sociopolitical-turn Moment (2000s–)→Emancipate or Deconstruct (or osculate between the two, i.e., the Break)

### Table 1

**Postpositivist New Paradigm Inquiry**  
Patti Lather and Elizabeth A. St. Pierre (Revised June 2005)

<table>
<thead>
<tr>
<th>Predict</th>
<th>Understand</th>
<th>Emancipate</th>
<th>Break</th>
<th>Deconstruct</th>
<th>Next??????</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Positivist</td>
<td>*Interpretive</td>
<td>*Critical</td>
<td>*Poststructural</td>
<td>Poststructural</td>
<td>Neo-positivist</td>
</tr>
<tr>
<td>Mixed methods</td>
<td>Naturalistic</td>
<td>Neo-Marxist</td>
<td>Post-colonial</td>
<td>Neo-pragmatist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constructivist</td>
<td>&lt;Feminist&gt;</td>
<td>Post-critical</td>
<td>Citizen Inquiry</td>
<td></td>
</tr>
<tr>
<td>Phenomenological</td>
<td>Critical Race Theory</td>
<td>Critical Race Theory</td>
<td>Post-humanist</td>
<td>Participatory Dialogic Policy Analysis</td>
<td></td>
</tr>
<tr>
<td>Ethnographic</td>
<td></td>
<td></td>
<td>Post-Fordist</td>
<td>Post-theory</td>
<td></td>
</tr>
<tr>
<td>Symbolic Interaction</td>
<td>Praxis-oriented</td>
<td></td>
<td>Queer Theory</td>
<td></td>
<td>Post-theory</td>
</tr>
<tr>
<td>Interpretive Mixed</td>
<td>&lt;Freirean</td>
<td></td>
<td></td>
<td></td>
<td>Post-post</td>
</tr>
</tbody>
</table>
For us, however, the “Break” does not represent so much of a break from a modernist epistemological stance to a post-modern one, as suggested by Lather and St. Pierre (see Lather, 2007), but rather represents a hybrid, in between space where the researcher might adopt a critical postmodern epistemological stance in which she or he continually and simultaneously negotiates the praxis of the critical and the uncertainty of the postmodern (Stinson & Bullock, 2012a).

3 Methodologies Across the Moments: Research on Effective Mathematics Teaching

In this section, what we aim to illustrate is how, as Crotty (1998) suggests, epistemological stance leads to theoretical perspective and thereby methodology, which, in turn, leads to choices of methods (i.e., data collection, analysis, and representation). For demonstrative purposes only, we use exemplars of research articles on effective or good mathematics teaching within each moment to illustrate how epistemological stances both produce and limit knowledge creation. As we do so, our intent is not to point the “right way” to where a mathematics education researcher should position her or his work but rather to highlight how knowledge is both shaped by and excessive of the epistemological stance of the researcher.
3.1 Process–product moment

The process–product moment (1970–) is characterized by linking processes of classroom practice to student achievement outcomes or “products.” Clearly positioned in the “predict” paradigm of inquiry (see Table 1), theoretically and methodologically, researchers in this moment rely primarily on quantitative statistical inference as a means “to ‘predict’ social phenomena by ‘objectively’ observing and measuring a ‘reasonable’ universe” (Stinson & Bullock, 2012a, p. 43). An exemplar of process–product research is Good and Grouws’s (1979) article “The Missouri Mathematics Effectiveness Project: An Experimental Study in Fourth-Grade Classrooms.” It reports a research project that sought to create a single picture for all contexts of what the effective mathematics teacher does in the classroom. Initial data collection included pre- and post-test data on student achievement to select teachers across a school district who were “consistent and relatively effective or ineffective in obtaining student achievement results” (p. 355). Once “labeled,” these teachers were observed in their classrooms for approximately three months, and based on analyses of tallied behaviors observed a behavioral profile was created for each teacher. Good and Grouws then separated the teachers who they had labeled as “effective” and “ineffective” from the achievement test data and created a composite profile of both groups. The differences between those profiles were used as indicators in developing a set of characteristics of teacher effectiveness. Data representation consisted of a table indicating “Key Instructional Behaviors”: observed behaviors from the effective teachers along with the time spent on each behavior. The table was presented as a rubric of sorts that administrators and mathematics teacher educators might use to “train” teachers to “perform” in ways that student achievement outcomes could be predicted.
3.2 Interpretivist-constructivist moment

In the interpretivist-constructivist moment (1980s–), the aim of the researcher is no longer to predict social phenomena but rather to understand it. Here, and elsewhere (see Stinson & Bullock, 2012a), due to their near-simultaneous occurrence in mathematics education research in the 1980s, interpretivist research and constructivist research is combined into a single moment. Nevertheless, it is important to note that although both of these two research strands are securely positioned in the “understand” paradigm (see Table 1), they seek understanding in different ways. Therefore, they take up different theoretical and methodological possibilities.

At the one end, the interpretivist researcher seeks to understand social phenomena by attempting to access the meaning(s) that people assign to social phenomena. An example is Wilson, Cooney, and Stinson’s (2005) article “What Constitutes Good Mathematics Teaching and How it Develops? Nine High School Teachers’ Perspectives.” It reports results of a project that examined the “views of nine experienced and professionally active teachers about what they consider good teaching to be and how it develops” (p. 83). The project is evidently positioned in the interpretive paradigm as Wilson and colleagues inferred notions of good mathematics teaching from case study data related to the participating teachers’ beliefs and attitudes about effective teaching. Here, rather than rely solely on observations (cf. Good & Grouws, 1979), the methods of data collection comprised of conducting and transcribing three, semi-structured interviews with seasoned teachers who were mentoring student teachers. Two overarching questions guided the interviews: “What constitutes good mathematics teaching? How do the skills necessary for good mathematics teaching develop” (p. 89)? To analyze the transcribed interview data, Wilson and colleagues used a qualitative coding approach: developing a preliminary coding scheme in an initial analysis and modifying that scheme as they repeatedly
moved through the data. The purpose of the analysis was not to build a theory of good or effective mathematics teaching but rather to interpret the teachers’ understandings of effective teaching and to determine if their understandings were congruent (or not) with the standards of effective teaching as advocated in the National Council of Teachers of Mathematics’ documents. Data representation consisted of several direct quotations from the interview transcripts and a modified frequency table that described the characteristics of effective teaching that the teachers identified and how they believed those characteristics were best learned. The frequency table, however, was used as a means of providing justifications to the characteristics as described by the teachers (and interpreted by Wilson and colleagues) rather than as a tallied table of behaviors to be replicated (cf. Good & Grouws, 1979).

At the other end, the constructivist researcher understands meaning(s) as something that is constructed through experience. Or, said in another way, the focus of research is on understanding and identifying the processes of how people acquire or construct different meaning(s) over time. For instance, in “Reflective Reform in Mathematics: The Recursive Nature of Teacher Change,” Senger (1999) investigated how elementary teachers’ changed (or constructed) their beliefs about good mathematics teaching in the context of curriculum reform (i.e., after the release of the 1989 NCTM Curriculum and Evaluation Standards for School Mathematics). Videotaped lessons, field notes, and audiotaped interviews from a purposeful sample of elementary teachers comprised data collection. Analytical tools incorporated qualitative data analysis software and discourse analysis as a means to ground a theory of how teachers might change their beliefs about good mathematics teaching through Deweyian reflection. This analysis “revealed that the integration of a new belief did not occur suddenly or as a single event—that is, from new information directly to new belief—but rather as a complex
and thoughtful process over time” (p. 214). Data representation consisted of teacher narratives and a table comparing snapshot data from three of the teachers. Additionally, a schematic model of “Teachers’ Ways of Perceiving Mathematics Reform” was presented—a flowchart or theory of sorts of teacher change. Unlike Wilson and colleagues (2005), whose purpose was just to interpret the teachers’ meaning-making processes of good teaching, Senger aimed to develop a theory of mathematics teacher change as they moved toward good teaching. Nevertheless, although Senger presented a schematic model, she did not position teachers as reaching a goal of being “good teachers” but rather used systematic teacher reflection to show progression along a continuum of teacher effectiveness. In the end, similar to Wilson and colleagues (2005), Senger pushed against the idea of presenting a rubric of good mathematics teaching (cf. Good & Grouws, 1979).

3.3 Social-turn moment

Researchers whose work is positioned in the social-turn moment acknowledge that understanding social phenomena is intimately attached to the sociocultural contexts in which phenomena occurs. In that, meaning, thinking, and reasoning are understood as products of social activity in contexts (Lerman, 2000). Research in this moment can be located in the “understand” or “emancipate” paradigms of inquiry or osculate between the two (see Table 1). For example, in “Culturally Relevant Mathematics Teaching in a Mexican American Context,” Gutstein, Lipman, Hernandez, and de los Reyes (1997) make the social turn by placing culture and context at the center of a Freirean participatory, culturally relevant mathematics teaching project. The purpose of the project was “to contribute to a theory of culturally relevant teaching…of mathematics in a Mexican immigrant community” (p. 709). It is important to note, however, that Gutstein and colleagues saw their work as a contribution to the existing body of
knowledge; they did not profess to be creating a theory that would predict mathematics success for all Mexican immigrant children. Several data sources were used. Demographic and contextual data (nearly two pages) about the school and participants were included as well as classroom observations and documents, reflections, and interviews—interviews with both teachers and students. The demographic and contextual data presentation is a noteworthy contrast to Wilson and colleagues (2005) who discuss context tangentially in two mere paragraphs. Also in direct contrast to the previously exemplars identified in the other moments, Gutstein and colleagues positioned themselves within the classroom as participant observers—including their own reflections as data—and framed the study as a form of action research—including the teachers as co-researchers. Positioning the teachers as co-researchers honored and valued the collective wisdom of the group of teachers as a community of practice. Similar to Senger (1999), grounded theory methods were employed as a means of data analysis. But here attempts to develop a model or theory were guided by literature on culturally relevant pedagogy. Data representation included extended participant quotes and descriptive vignettes. These extended data representations contributed to building a intricate model for culturally relevant mathematics teaching, which, in turn, revealed the complexities of mathematics teaching and learning embedded in a Mexican American context.

3.4 Sociopolitical-turn moment

Researchers who explore the wider social and political picture of mathematics education characterize the sociopolitical-turn moment (2000s–). This moment signals a shift toward “theoretical [and methodological] perspectives that see knowledge, power, and identity as interwoven and arising from (and constituted within) social discourses” (Gutiérrez, 2013, p. 40). Similar to the social-turn moment, research in the sociopolitical-turn moment can be located in
one of two paradigms—“critique” or “deconstruct”—or osculate between the two in the “break” (see Table 1). For instance, in “Plotting Intersections Along the Political Axis: The Interior Voice of Dissenting Mathematics Teachers,” de Freitas (2004) used “fiction-as-research” to access inner dissenting voices to illustrate how the discursive practices of mathematics instruction are determined by the regulative and normative discourses that frame society. In this postmodern project, unlike the previous studies identified, the binary of scientific/non-scientific is placed under erasure (i.e., sous rapture; cf. Derrida, 1974/1997). Through deconstructing (cf. Derrida & Montefiore, 2001) the notion of scientific new possibilities for data collection, analysis, and representation emerge. Here, de Freitas was compelled to use fiction (as data) as only through fiction can dissenting voices of mathematics teachers be explicitly heard. In that, “fiction, as a methodology, has the potential to defamiliarize, to cross boundaries, to transgress cultural norms” (p. 272). Data analysis became storytelling, as “data representation” consisted of Agnes’s, the fictional teacher of de Freitas’s inquiry, reflections upon her experiences as both a student and teacher of mathematics. Agnes recalled times when, as an exemplary mathematics student, she questioned the purpose of the mathematics tasks that she encountered, surmising that the only one who stood to benefit was the teacher. As the student, Agnes believed her spoken voice was mere disruptive interference. Agnes lamented that now as the mathematics teacher she was “part of the fraudulence that torments youth” (p. 268) and expressed remorse for the students for whom she continued to surrender to normative expectations due to their exhaustion produced by resistance. Nevertheless, Agnes emerged resolutely from her guilt and confusion determined to expose the scandalous foundation of mathematics to right a terrible wrong.
4 Epistemological Stances Across the Moments: Research on Effective Mathematics Teaching

In each of the five summarized studies, the well-intended researcher(s) was attempting to make sense of the dynamics of an effective or good mathematics classroom: the multiple intra- and inter-actions that occur within and among teachers, students, and mathematics in the context of mathematics teaching and learning. How the researcher(s) approached her or his sense making and presented her or his conclusions and recommendations, we argue, is clearly grounded in which paradigm of inquiry the researcher (or research team) was embedded (see Table 1). In other words, it is not the methods of “data” collection, analysis, or representation that determine what might be deduced or concluded with/in a research project—“actual data have nothing to say” (Lester, 2005, p. 6). But rather the epistemological stance of the researcher: the theory of knowledge held by the researcher(s), which is embedded in the theoretical perspective(s) used to frame the project and methodology employed. However, and most important, as noted previously, different epistemological stances often lead to incommensurable assumptions about the nature of knowledge, truth, reality, and so on. Therefore, epistemological stance makes some methods of data collection, analysis, and representation possible and others impossible.

Good and Grouws (1979) process-product project, embedded in the predict paradigm, only endorsed the collection, analysis, and representation of “objective” sources of data. These data, in turn, were used to determine once and for all the pedagogical practices of the effective mathematics teacher and how to replicate such practices. In the predict paradigm, knowledge, truth, and reality are knowable through objectively observing and measuring a reasonable universe irrespective of context. Wilson, Cooney, and Stinson’s (2005) and Senger’s (1999) interpretivist-constructivist projects, both embedded in the understand paradigm, permitted the
collection, analysis, and representation of interviews and video-recorded and field notes of mathematics lessons taught from a purposeful sample of teachers. These data, in turn, were used to determine how a selected group of teachers interpreted or constructed meaning of effective mathematics teaching. Therefore, in the understand paradigm, knowledge, truth, and reality are contingent on how one interprets or constructs meaning of the universe. Context here is somewhat secondary, as the primary source of knowing is the internalization of meaning of the cognizant individual. Gutstein, Lipman, Hernandez, and de los Reyes (1997) social-turn project, which (for us) osculates between the understand and emancipate paradigms, allowed the collection, analysis, and representation of multiple sources of data from all people engaged in the research project. Here, the line between researcher and participants was blurred as they became jointly engaged in building a theory of culturally relevant mathematics teaching. In the emancipate paradigm, knowledge, truth, and reality are understood as being produced and reproduced in systems of domination and oppression. Context is moved from the margins to the center, as concepts of empowerment, class struggle, asymmetrical relations of power, and so forth are critically explored and uncovered. And finally, in de Freitas’s (2004) socio-political project, which (for us) osculates between the emancipate and deconstruct paradigms, the possibility of data collection, analysis, and representation is completely destabilized as the normative discursive practices of “science” are troubled and the boundaries of what constitutes research are blurred. In the deconstruct paradigm, the very concepts of knowledge, truth, and reality are contested and destabilized, opening each to contingent and uncertain possibilities. And similar to the emancipate paradigm, context is central in the deconstruct paradigm, as the concepts of knowledge, truth, and reality are not reject as knowable but rather knowable only through the discourses and discursive practices of power in contexts.
5 Different Possibilities With/In Critical Postmodern Methodology

In this section, we outline our assumptions as critical postmodern theorists and explore just what a critical postmodern methodology might “look like.” Our aim is not to place constraining boundaries around the possibilities of a critical postmodern approach but rather to open up the research text of mathematics education research to different possibilities (cf. de Freitas & Nolan, 2008). In an often-cited essay rethinking the possibilities of critical theory in qualitative inquiry, Kincheloe and McLaren (1994) conjoined aspects of critical theory and postmodern theory and outlined some basic assumptions that critical (postmodern?) theorists often hold. Here, we have extended the assumptions by directly inserting postmodern theorists and ideas; it is these extended assumptions that we “think with” as we create anew the idea of research methodology with/in a critical postmodern theoretical perspective:

- Facts, “truth,” or knowledge can never be isolated or removed from some form of ideological (re)inscription; that is, science is always already entangled with philosophy (St. Pierre, 2011).
- The relationship between concept and object and between signifier and signified is never static and is often mediated by the social behaviors embedded in capitalism.
- Language and discourses (cf. Butler, 1999; Foucault, 1969/1972; Gee, 1999) are central to the formation of subjectivity and identity.
• Certain groups in any society are privileged over others and the oppression that characterizes contemporary societies is most forcefully reproduced when subordinates accept their social status as natural (i.e., Gramsci’s concept hegemony).

• Focusing on only one form of oppression at the expense of others often eludes the interconnections among the multiple faces of oppression.

• Mainstream research practices (i.e., science in general) are often implicated in the reproduction of the oppressive hegemonic systems of race, class, gender, sexuality, dis/ability, religion, language, and so on.

Given these assumptions, our premise is that, by destabilizing the research process in such a way that neither the researcher nor the subject is at its center, the line between the researcher and the participant blurs. In this ambiguous space, research becomes multi-directional, more collaborative, and less hierarchical. It does appear that our use of the terms “researcher” and “participant” reify the separation that we desire to blur, but we remain open to renaming these positions, using them here only for ease of communication.

5.1 Critical postmodern data collection

There is no data collection method that captures a setting or experience in totality and it is up to mathematics education researchers to accept this inevitable partiality (Barrett & Mills, 2009). They must engage in efforts to produce research that brings the picture more into focus, understanding that a picture is always a replica that never fully captures the subject or object of inquiry. In the five studies previously described, participant observation and interviewing were the primary methods of data collection. These two methods have become staples in classroom-based research (Baker & Lee, 2011; Ritchie & Rigano, 2001). But these staples often prove insufficient “in studies that aim to reconceptualize and relocate complex social and institutional
structures of oppression and exclusion” (Koro-Ljungberg, 2012, p. 82) because they are often researcher-centered and do not capture the dynamic complexities of classroom interactions. Although we fully support efforts to bring new methods of data collection into mathematics education research, we use participant observation and interviewing as examples based on their familiarity to the audience of mathematics education research. By examining how these two common methods might be rethought from a critical postmodern perspective, we hope to demonstrate that the changes that we propose do not require the acquisition of a new skill set but rather a new mindset—that is, a new epistemological stance.

Dewalt and Dewalt (2002) define participant observation as “a way to collect data in naturalistic settings by ethnographers who observe and/or take part in the common and uncommon activities of the people being studied” (p. 2). They describe a continuum of participation that range from nonparticipation where the researcher observes from outside the setting to complete participation in which the researcher temporarily forgoes her or his position as researcher and becomes a part of the research setting. The further the researcher appears to move along this continuum toward complete participation, the more it appears that she or he breaks down the wall of power that separates her or him from the setting that she or he observes. In reality, however, the researcher is never fully a part of the setting; her or his position as researcher prohibits her or him from subsuming her or himself into the setting. A critical postmodern perspective on observation would ignore the continuum of participation that Dewalt and Dewalt describe by not making any claims toward dissolving the barrier between the researcher and the participant. Instead, the researcher would recognize the limitations of observation from her or his perspective and collect observation data from others in the setting.
Similar to participant observation, qualitative interviewing has long been a staple in classroom research (Baker & Lee, 2011). Such interviews use varied levels of structure to elicit responses from participants regarding the issue being investigated. Although interviews vary in their degree of formality, there exists a clear division between the researcher and the participant. Critical researchers loosen the structure of their interviews to allow more space for the participants’ voices, which are often subjugated, to come forward (Rubin & Rubin, 2005). Ritchie and Rigano (2001) define a postmodern approach to research interviewing as one that “foregoes the search for one true or real meaning of the data and adopts a more relational concept of meaning by emphasizing differences and ambiguities” (p. 744). The result of such interviewing is a narrative that is constructed by both the participant and the researcher and that acknowledges and values the participant’s knowledge. Interviewing from a critical postmodern perspective not only maintains the elements of loose structure and the co-constructed narrative but also disrupts the notion of the researcher as the center of data collection. Where the researcher would develop an interview protocol, ask the questions, and listen to the responses, in the critical postmodern interview, participants interview each other or the participant creates the interview questions. In each scenario, the researcher is no longer at the center of the data collection process, providing a space for new and different data.

5.2 Critical postmodern data analysis

Analogous to data collection, approaching data analysis from a critical postmodern perspective requires the researcher to incorporate participants into the analysis process. While critical data analysis looks for evidence of oppression and agency, postmodern data analysis is not as readily located (Delamont & Atkinson, 2004). In postmodern data analysis, the researcher resists claims of authority, understanding that her or his account represents “just one ‘story’ among an infinite
number of possible stories” (Mauthner & Doucet, 2003, p. 423). This resistance leaves the postmodern researcher reticent to drawing any conclusions from the data. Critical postmodern data analysis seeks out evidence of the effects of power, but maintains a more flexible position as the researcher looks for power in multiple forms operating from multiple directions, rather than simply as a form of oppression.

5.3 Critical postmodern data representation

As evident in Gutstein and colleagues’ (1997) study, critical researchers represent data using descriptive elements and long quotes that resist the erasure of the participant’s voice in the narrative. Postmodern data representation plays with the form of reporting, embracing genres such as fiction (cf. de Freitas, 2004). Within critical postmodern methodology, the researcher looks beyond the constraints of the scholarly journal that is traditionally acceptable in academe. She or he develops a plan of representation that includes various media and genres that reach different audiences and invite dialogue (Gadanidis & Borba, 2013). In addition to scholarly articles, the researcher may also use video, audio, fictional, and artistic representations to package the data in ways that different communities might access and interact with it. The researcher might also play with authorship, allowing participants to present data in ways that they believe most accurately represent them.

5.4 Considering critical postmodern possibilities through a fictional study

The possibilities that we have briefly outlined for data collection, analysis, and representation may seem imprecise. As an example of a possible study that embraces critical postmodern methodology, imagine for a moment a study seeking to ascertain what “is” effective mathematics teaching. At the beginning of the study, the researcher conducts a brief workshop for students, teachers, parents, administrators, and the community—all of whom become co-researchers—
about the research process. During this workshop, the researcher explains what she or he is doing with the study, provides tips for recording observation data and interviewing, and commissions the group to address the question “What is a good mathematics teacher?” She or he asks the group to present observation data to her the following month. She offers the classroom as an observation space, but remains open to other ideas that the co-researchers may have about spaces in which they may observe activity that addresses the question. In the classroom, the researcher encourages a student who seems least engaged to observe for some time. A community leader, a parent, and another teacher also observe the class. The principal observes a meeting of the mathematics department. Each observer brings her or his field notes back to the researcher to discuss her or his approach to the observation and what she or he saw. This conversation becomes a mix of interview and analysis as co-researchers work together through the data collected.

During the month of collecting observation data, the researcher works with students in the class to develop a set of interview questions for the teacher. The students conduct and record the interviews and work with the researcher during transcription. The teacher and researcher also sit down for an interview in which the teacher asks the researcher questions about how mathematics education researcher depicts the effective mathematics teacher and responds to these depictions from her or his experience. Finally, the researcher conducts more traditional semi-structured interviews with the teacher, students, community members, and the principal.

After amassing this data, the researcher works with all willing participants to analyze the data as a research team. They listen to interviews, read observation field notes, and write analytic memos (Saldaña, 2009), interacting with all of the data. As they make observations based on the data, they discuss those observations and the claims that they feel comfortable making with the
existing data. The group also develops a strategy for disseminating its work. For the researcher, it is important to present a traditional research article, but she or he also wants to present something that the different constituencies represented in the research team—teachers, students, administrators, and the community—can access. The team plans to produce poetry and songs based on the collected data and makes them available on a website dedicated to the project (Gadanidis & Borba, 2013). They also produce a short film about their findings. The researcher invites the team to her or his university mathematics methods course to present the data to pre-service teachers in a way that highlights for those teachers a multi-dimensional picture of effective mathematics teaching. At a national educational research conference, the team presents the idea of effective mathematics teaching through drama. In the end, the researcher had invested in the community that supported her or his research and presented to the academic community a group of voices that have previously been present in conversations about mathematics education research as participants veiled by the anonymity of research.

This sketched fictional account is by no means complete, but it is our hope that it motivates the reader to think about ways that she or he can take steps toward a decentered critical-postmodern research space. The fictional researcher shows mathematics education researchers that there are ways to open up the field of mathematics education research, but these approaches take time and careful thought. Such research requires a tremendous investment of time, resources, and talent from the researcher and participants. The return on the investment, however, is a robust body of work that stretches the boundaries of mathematics education research and builds a bridge between research and communities of practice. This body of work represents both an emancipatory project that brings marginalized voices to the forefront and a
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deconstructive project that dismantles the false hierarchies established within research production and dissemination.

6 Concluding Thoughts: Constraining Boundaries or Expanding Frontiers

Each of the four moments of mathematics education identified—process–product, interpretivist–constructivist, social-turn, and sociopolitical-turn—can be mapped more or less to one or two paradigms of inquiry—predict, understand, emancipate, and/or deconstruct. Consequentially, each moment depends primarily on different epistemological stances and thus on different methods of data collection, analysis, and representation. We believe that embracing methodological diversity assists in expanding the landscape of mathematics education research so to address persistent inequities in new ways (Bullock, 2012). Therefore, we believe that value judgments about which theoretical perspective, methodology, and/or methods might result in “high quality science in a federal education research agency” (NRC, 2002, p. 1) are misguided. They are just that—value judgments. Such judgments, we believe, serve only to construct constraining boundaries around the possibilities of science and how science might assist in understanding the teaching-learning/learning-teaching dynamic of the mathematics classroom.

With the extraordinarily high profile of mathematics as a discipline of study (e.g., the study of mathematics was explicitly mentioned in President Obama’s 2013 Inaugural and State of the Union speeches), now is not the time to construct constraining boundaries. Rather, the mathematics education community should encourage expanding the frontiers of science by supporting not only those who look toward science to answer concrete questions but also to those who look toward science to generate different questions that might produce different knowledge and produce knowledge differently (St. Pierre, 1997). In the end, we believe that debates regarding the two-part question What is science and who decides? should not be based on
methodology but rather on philosophy. After all, science is always already entangled with philosophy and any attempt to make invisible this inextricable entanglement is most dangerous indeed (St. Pierre, 2011).

**References**


