2015

Critical postmodern methodology in mathematics education research: Promoting another way of thinking and looking

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Recommended Citation

Stinson, D. W., & Bullock, E. C. (2015). Critical postmodern methodology in mathematics education research: Promoting another way of thinking and looking. Philosophy of Mathematics Education Journal [25th Anniversary Issue], 29, 1–18

CRITICAL POSTMODERN METHODOLOGY IN MATHEMATICS EDUCATION RESEARCH:
Promoting another way of Thinking and Looking

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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 methodology is inextricably linked to theory, each moment calls forth not only different theoretical possibilities 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 promote another way of thinking about and looking at methodology when research is framed with/in the sociopolitical hybrid of critical postmodern theory.

Keywords Critical Theory, Methodology, Postmodern Theory, Research Methods

1 Introduction

Discussions about different epistemological, theoretical, and methodological perspectives in mathematics education research were nearly non-existent in the early developmental years of the 1950s and 1960s. In its search for its own legitimacy as a research domain, mathematics education had securely aligned itself to the traditional epistemologies of mathematics, the emerging theories of cognitive psychology, and the positivist methodologies of inferential statistics (Kilpatrick, 1992). Higginson (1980), however, in discussing the foundations of mathematics education in the early 1980s, had suggested that the field be informed by four interrelated disciplines: mathematics, psychology, sociology, and philosophy. He claimed that allegiance to mathematics is self-evident, and that the "battle for the recognition of a psychological dimension in mathematics education has been won, for almost all purposes, for some time now" (p. 4). In regards to sociology, he wrote: "The recognition of the role of social and cultural factors is, however, a process which is still ongoing" (p. 4). As he argued for the inclusion of philosophy, he cautiously noted that with the inclusion of a sociological dimension it might appear to some that the gates have been open too far already. Nevertheless, Higginson believed that the inclusion of a philosophical dimension in mathematics education (research or otherwise) is important because all human "intellectual activity is based on a set of assumptions of the philosophical type" (p. 4; see also Ernest, 1991, 2004). These assumptions

> will vary from discipline to discipline and between individuals and groups… . They may be explicitly acknowledged or only tacitly so, but they will always exist. Reduced to their essence these assumptions deal with concerns such as the nature of "knowledge", "being", "good", "beauty", "purpose" and "value". More formally we have, respectively, the fields of epistemology, ontology, ethics, aesthetics, teleology and axiology. More generally we have the issues of truth, certainty and logical consistency. (p. 4)

The growing acceptance that mathematics education research, as a human intellectual activity, should be based on a set of assumptions of the philosophical type became evident, in part, when a group of mathematics educators from across the globe founded the Topic Group *Theory in Mathematics Education* (TME) at the Third International Congress on Mathematical Education in 1984 (Steiner, 1985, 1987). The primary goals of the Topic Group TME were "to give mathematics education *a higher degree of self-reflectedness* and *self-assertiveness*, to *promote another way of thinking* and of *looking* at the problems and their interrelations (1985, p. 16; emphasis in original). Encapsulating the impetus for this global sense of urgency regarding other ways of thinking and looking is beyond the scope of this article. Nevertheless, it is evident that the mathematics education research community of the time was prime for "something of a renaissance" (Higginson, 1980, p. 6).

This renaissance was clearly visible in the late 1970s and early 1980s when mathematics education researchers began to adapt theories and methodologies from the diverse disciplines of anthropology, cultural and social psychology, history, philosophy, and sociology (Lester & Lambdin, 2003). Elsewhere (Stinson & Bullock, 2012a, 2012b), in an attempt to make sense of the diverse theoretical perspectives used in mathematics education research since then, we identified four distinct yet overlapping and simultaneously operating (therefore no end dates) historical shifts or moments of mathematics education research—the process–product moment (1970s–), the interpretivist–constructivist moment (1980s–), the social-turn moment (mid 1980s–), and the sociopolitical-turn moment (2000s–). Each of these moments both contracts and expands the theoretical and methodological possibilities available to researchers, as each moment (more or less) embraces unique assumptions of the philosophical type as it rejects others.

These shifts, or moments, of mathematics education research, however, are neither universal nor without critique (English, 2008). They are often dismissed as manifestations of the growing pains of mathematics education research as a young domain. Schoenfeld (2008) attempts to allay the fears about theoretical and methodological instability within mathematics education research by asserting, "some degree of chaos is hardly surprising during the early stages of a discipline's formation" (p. 468). Although such instability can be disconcerting, is settling into a sense of "normal" a worthy goal for mathematics education research? Here and elsewhere (Stinson & Bullock, 2012a, 2012b), we argue that the mathematics education research community should resist the temptation to establish a norm and, instead, consider the chaos Schoenfeld describes as a generative space that opens the discipline to unlimited possibilities. Locating productive possibility amidst that which appears to be chaotic requires mathematics education researchers to access different theories and methodologies that allow for asking new questions or addressing old questions in new ways.

Previously, to ask new questions or to address old questions in new ways, we 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, 2012a; see also Stinson, 2009). Given that methodology is inextricably linked to theoretical perspective (LeCompte, Preissle, & Tesch, 1993), here we extend our previous discussion to explore the possibilities of a critical postmodern methodology. We begin by clarify (although briefly) how we understand the interrelatedness of theory, methodology, methods, and epistemology as a means to map the moments of mathematics education research identified onto broader paradigms of inquiry. We then discuss methodologies across the moments using "effective" or "good" mathematics teaching as just one example of a research strand in which the differences and commonalities among approaches might be highlighted. Next, we make a case for a critical postmodern methodology by exploring, hypothetically, the different and somewhat discomforting possibilities for data collection, analysis, and representation when research is framed with/in critical postmodern theory. We conclude arguing for expanding the frontiers of mathematics education by embracing the somewhat chaos of theoretical and methodological diversity.

2 Interrelatedness and Paradigms of Inquiry

In this section, we discuss the interrelatedness of elements of the research process. We then map different approaches to the research process (i.e., the different moments of mathematics education research) onto broader paradigms of inquiry.

2.1 Interrelatedness of theory, methodology, methods, and epistemology

Statements about the interrelatedness of theory, methodology, methods, and epistemology (i.e., the key elements of any research process) are found implicitly and explicitly throughout the mathematics education literature. Lester and Wiliam (2005), for example, argue that the relationship between knowledge claims and evidence regarding what is researched, how research is conducted, and how results are interpreted and represented is more than simply establishing logical consistency but rather is determined, in large part, by a set of beliefs, values, and perspectives operating in the worldview of the researcher. Similarly, Lerman (2013) claims that the theoretical lens through which a researcher organizes her of his "research, reads the data, revisits theory and interprets the findings is critical, and without such work the values of the researcher are hidden but never absent, of course" (p. 629). Valero (2004) also points to researcher "values":

> What we choose to research and the ways in which we carry out that research are constructions determined, among other factors, by who we are and how we choose to engage in academic inquiry… There are considerable 'subjective' and 'ideological' grounds—rather than 'objective' reasons—to engage in particular ways of conceiving and conducting research in mathematics education. (p. 2)

We take various phrases such as "worldview," "theoretical lens," and "subjective and ideological grounds" to mean more generally the epistemological stance of the researcher. Similar to theoretical and methodological choices, there are several epistemological stances a researcher might take up. But we do not discuss the different stances here; that has been done elsewhere (see, e.g., Ernest, 1997; Sierpinska & Lerman, 1996). Suffice it to say, however, mathematics education researchers often hold different and at times conflicting epistemological stances. These conflicts often "lie along issues such as the subjective–objective character of knowledge, the role in cognition of the social and cultural context, and the relationship between language and knowledge" (Sierpinska & Lerman, 1996, p. 829). How a mathematics education researcher views or makes meaning of these issues (and others) has a direct effect not only on her or his theoretical and methodological choices but also on the very choice of what might be placed under investigation.

Crotty (1998), in a general discussion on the interrelatedness of theory, methods, methodology, and epistemology, claims that the starting point of social science research (mathematics education or otherwise) begins with two questions (a) what methodologies and methods will be used in the proposed research project, and (b) how are the methodologies and methods justified. Implicit in the justification is the idea that methods are governed by some methodological choice, which is driven by some theoretical perspective, which, in turn, is informed by some epistemological stance. Consequentially, the initial 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)

Moving through the four questions in reverse order suggests that epistemology stance informs theoretical perspective, which drives methodology, which, in turn, governs methods: epistemology→theoretical perspective→methodology→methods. In actuality, however, the arrows are bi-directional as each element of any research process is related to or influences the other. In short, the elements are interrelated. Furthermore, at every juncture of these interrelated elements, the researcher brings a set of assumptions of the philosophical type about the nature of knowledge, being, good, beauty, and so forth; given that, science (social or otherwise) is always already entangled with/in these broader concerns of philosophy (St. Pierre, 2011).

2.2 Mapping moments of mathematics education onto paradigms of inquiry

We clearly understand that relying on Crotty's (1998) general explanation on the research process has oversimplified decades, if not centuries, of philosophical debate about the meaning of knowledge and how knowledge might be produced. Nevertheless, we use the over-simplification because it brings to the foreground the interrelatedness of elements and the entanglement with/in philosophy throughout the research process. It is the coupling of this interrelatedness and entanglement that brings us to discussing the different theoretical and methodological approaches within the broader context of inquiry paradigms.

The use of Kuhn's (1962/1996) concept "paradigm" is meant to describe 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 the term paradigm in social science research has been contested (see, e.g., Donmoyer, 2006), it has become a rather common way to speak about the interrelatedness of theoretical and methodological approaches when framing and conducting social science research. Guba and Lincoln (1994) claim that inquiry paradigms define for researchers "what it is they are about, and what falls within and outside the limits of legitimate inquiry" (p. 108). They argue that responses to three fundamental and interconnected questions—the ontological question, the epistemological question, and the methodological question—provide the basic beliefs that define inquiry paradigms. The three questions are interconnected "because the answer given to any one question, taken in any order, constrains how the others may be answered" (p. 108). Understanding how elements of the research process are interrelated, entangled, and interconnected is crucial given the proliferation of inquiry paradigms in social science research (Lather, 2006).

Here, we extend our earlier work by mapping research moments of mathematics education research onto broader inquiry paradigms (see Table 1) so that we might discuss not only the different theoretical traditions but also the different methodological possibilities available to mathematics education researchers. Table 1, adapted and modified from Lather and St. Pierre (Lather, 2006, p. 37), maps each moment of mathematics education research to one or, in some cases, two paradigms of inquiry: predict, understand, emancipate, and/or deconstruct.

Table 1

Mapping Moments of Mathematics Education Research to Paradigms of Inquiry

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

Paradigms of Inquiry

Predict	***Understand***	***Emancipate***		***Deconstruct***
*Positivist	*Interpretivist	*Critical		*Postmodern/ Poststructural
Experimental	Social constructivist	<Feminist>		Post-critical
Quasi-Experimental	Radical constructivist	Critical Race Theory		Post-colonial
Mixed methods>	Sociocultural>	LatCrit Theory	***BREAK***	Post-humanist
	Phenomenological	Critical Theories of Race>		Post-Freudian
	Ethnographic	Critical mathematics		<Discourse Analysis
	Symbolic Interaction	Social justice mathematics		
		Ethnomathematics		
		<Participatory Action Research		
		Critical Ethnography		

*Indicates the term most commonly used < Indicates cross-paradigm movement

The BREAK represents a hybrid, in-between space where the researcher might adopt a critical postmodern theoretical tradition (see Stinson & Bullock, 2012a, 2012b)

Paradigms of Inquiry adapted and modified from Lather and St. Pierre (Lather, 2006, p. 37)

Although Table 1 provides a clear visual for our purposes, there are some important caveats to be noted. First, similar to how Lather and St. Pierre's (Lather, 2006) identified or named the paradigms of inquiry, we explicitly state that the moments of mathematics education research identified are overlapping and simultaneously operating (Stinson & Bullock, 2012a, 2012b). 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 a researcher moves across some continuum. But rather both the paradigms and moments are arranged more or less in a historical chronological order. Second, we clearly understand that labels are always limiting and dangerous. Nevertheless, the labels used to identify (or name) both the moments (process–product, interpretivist–constructivist, social-turn, and sociopolitical-turn) and paradigms (predict, understand, emancipate, and deconstruct), we believe, provide somewhat of a generally accepted and direct way to describe the differences among the moments and paradigms. Third, the placement of theoretical and methodological perspectives under a specific inquiry paradigm (or paradigms) is also limiting and dangerous. Therefore, we show how some theoretical and methodological traditions cross over paradigms and we acknowledge, for example, that critical research is not only about emancipation nor is poststructural research only about deconstruction. Fourth, although Table 1 does not provide an exhausted list of theoretical and methodological possibilities, it certainly provides an expansive list as mathematics education researchers consider the theoretical and methodological interrelatedness and philosophical entanglement throughout the research process. And finally, Table 1 is not intended to provide a restrictive and definitive way of representing the complexities and messiness (or chaos) of the research process but rather intended to provide an entry point of sorts for making sense of the proliferation of theoretical and methodological choices that a mathematics education researcher must and does make, either overtly or covertly.

3 Methodologies Across the Moments: Research on Effective Mathematics Teaching

In this section, we illustrate the interrelatedness and entanglement of epistemology, theory, methodology, and, in turn, methods (i.e., data collection, analysis, and representation). And here it is important to be mindful of the distinction between methodology and methods. That is, methodology provides the general theoretical perspective(s) on knowledge and knowledge production which allows specific methods, instruments, and/or techniques for data collection, analysis, and representation to be selected; this distinction is vital to ensure that research within any paradigm "is conducted thoughtfully and to prevent it from becoming formulaic and recipe driven" (Ernest, 1997, p. 23). For demonstrative purposes only, we use exemplars of research articles on effective (or good) mathematics teaching located in each moment to illustrate how research positioned within different inquiry paradigms both contracts and expands theoretical and methodological choices and, in the end, produces different knowledge and produces knowledge differently (St. Pierre, 1997). As we do so, our intent is not to point the "right way" to where a researcher should position her or his work but rather to highlight how knowledge is both shaped by and excessive of the paradigm (or paradigms) of inquiry in which the project (and researcher) resides (Lather, 2006).

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." This article 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 (e.g., NCTM, 1989, 2000). 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. 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 Deweyan 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 oscillate 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 an 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; see also Valero & Zevenbergen, 2004). Similar to the social-turn moment, research in the sociopolitical-turn moment can be located in one of two paradigms—"critique" or "deconstruct"—or oscillate 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 very meaning 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 a 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.

3.5 Interrelatedness, entanglement, and interconnectedness across the moments

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 between 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, is clearly grounded in which paradigm (or paradigms) of inquiry the researcher (or research team) was embedded (see Table 1). Because, in the end, 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. 458)—but rather the researcher's entanglement with/in a set of assumptions of the philosophical type regarding the nature of knowledge, being, good, beauty, and so forth.

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, being, good, and so forth 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 recordings 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, being, good, and so forth are contingent on how one interprets or constructs meaning of the universe. Context here is somewhat secondary, as the primary source of knowing and being is the internalization of meaning of the cognizant individual. Gutstein, Lipman, Hernandez, and de los Reyes (1997) social-turn project, which (for us) oscillates 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, being, good, and so forth are understood as being produced and reproduced in systems of hegemonic 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) sociopolitical project, which (for us) oscillates 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, being, good, and so forth 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 the philosophical type are not reject as knowable but rather knowable only through the discourses and discursive practices of power in contexts.

4 Multiple Possibilities With/In Critical Postmodern Methodology

In the discussion thus far, we have illustrated (a) the interrelatedness, entanglement, and interconnectedness of elements of any research process, and (b) how a researcher might make meaning of these relationships is largely dependent on which paradigm (or paradigms) of inquiry she or he resides. Our aim in doing so was not to place constraining or rigid boundaries around theoretical and methodological possibilities but rather to show that elements of any research process are always already entangled with/in a set of assumptions of the philosophical type.

In this section, as critical postmodern theorists, we outline our set of assumptions of the philosophical type and explore just what a critical postmodern methodology might "look like." Here, given the limitation of space, we do not discuss how we understand critical theory, postmodern theory, and, in turn, critical postmodern theory; that has been done elsewhere (Stinson & Bullock, 2012a, 2012b; see also Stinson, 2009). But rather our focus is on opening up the research text (cf. de Freitas & Nolan, 2008) by exploring the multiple possibilities of data collection, analysis, and representation with/in critical postmodern theory.

4.1 Assumptions of the philosophical type

In an often-cited essay rethinking the possibilities of critical theory in qualitative inquiry, Kincheloe and McLaren (1994; see also Kincheloe, McLaren, & Steinberg, 2011) conjoin aspects of critical theory and postmodern theory and outlined some basic assumptions that critical (postmodern?) theorists often hold. We have extended these assumptions here by directly inserting postmodern theorists and ideas; it is these extended assumptions of the philosophical type that we "think with" as we create anew the idea of research methodology with/in critical postmodern theory:

- All thought and knowledge ("scientific" or otherwise) is fundamentally mediated by and through socio-cultural and -historical constituted discourses and power relations (cf. Foucault, 1966/1994,1969/1972,1976/1990).
- 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., 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. Nonetheless, 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.

4.2 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 set of assumptions of the philosophical type.

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.

The most significant consideration for mathematics education data collection within a critical postmodern paradigm is destabilizing the researcher–participant dyad. Making the object of inquiry—the mathematics teacher, student, content, or any other node in the "network of mathematics education practices" (Valero, 2012, p. 374)—the constant center of data collection narrows the perspective and potential to create new knowledge. Turning the lens of inquiry onto the researcher through journaling and other autoethnographic research methods can reveal how mathematics education researchers perpetuate the "exclusion and suppression" that mathematics education can promote (Skovsmose, 2012, p. 343).

4.3 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.

Mathematics education researchers can employ co-researcher relationships as one means to distribute power in the researcher–participant binary and to create opportunities for knowledge production. Many researchers engage teachers, for example, in data collection and solicit teacher feedback on interview transcripts or report narratives. Critical postmodern methodology supports making that teacher an equal participant in data analysis. This move validates the teacher's experiential practitioner knowledge base and "lay[s] bare important differences in perspective, calling for sensitive management and constructive dialogue" (Ruthven & Goodchild, 2008, p. 564). Such an approach allows for the development of both theoretical and practical knowledge (Goos, 2014). Cooperative analysis can also be a part of student research. Employing student's experiential knowledge of mathematics teaching and learning can allow the mathematics education researcher to see the discipline in new ways.

4.4 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.

The mathematics education experience, in any setting, is dynamic and complex (Skovsmose, & Borba, 2004). Mathematics education researchers should attempt to represent this complexity as accurately as possible. Although there are limitations to how research can be reported through traditional venues such as academic print journals and books, researchers can use technology available through online journal formats and various writing genres to push the boundaries of data representation. New media also offer potential for representing the complexity of mathematics education through research. Web sites, blogs, and video ethnographies and case studies provide opportunities for mathematics education research to be more dynamic and more accessible (Boaler, Selling, & Sun, 2013).

4.5 Critical postmodern possibilities through a hypothetical 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 web site dedicated to the project (Gadanidis & Borba, 2013). They also produce a short film about their findings (see, e.g., Terry, 2011). 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 (see de Freitas & Nolan, 2008 for a collection of essays by leading mathematics education researchers as they promote another way of thinking and of looking). Such research requires a tremendous investment of time, resources, and talent from the researcher and participants. The return on the investment, however, we believe 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 deconstructive project that dismantles the false hierarchies established within research production and dissemination. It represents, in a phrase, *working with/in the praxis of the critical and the uncertainty of the postmodern* (Kincheloe & McLaren, 1994; Stinson & Bullock, 2012a).

5 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 assumptions of the philosophical type 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 efforts to limit which theoretical perspective, methodology, and/or methods are relevant to mathematics education are harmful to the discipline. Such efforts, we believe, serve only to construct constraining boundaries around the possibilities of mathematics education research and how it might assist in understanding the "network of mathematics education practices" (Valero, 2012, p. 374). With the extraordinarily high global profile of mathematics as a discipline of study (Atweh, 2009; Furinghetti, 2009), 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 the mathematics education research community should embrace chaos as opportunity and as evidence of a vibrant and vital field.

References

Atweh, B. (2009). Ethical responsibility and the "what" and "why" of mathematics education in a global context. In P. Ernest, B. Greer, & B. Sriraman (Eds.), *Critical issues in mathematics education* (pp. 7–17). Charlotte, NC: Information Age.

Baker, A. A., & Lee, J. J. (2011). Mind the gap: Unexpected pitfalls in doing classroom research. *The Qualitative Report*, *16*(5), 1435–1447.

Barrett, M. S., & Mills, J. (2009). The inter-reflexive possibilities of dual observations: An account from and through experience. *International Journal of Qualitative Studies in Education*, *22*(4), 417–429.

Boaler, J., Selling, S. K., & Sun, K. (2013). Where are the foxes in mathematics education? In K. R. Leatham (Ed.), *Vital directions for mathematics education research* (pp. 189–199). New York, NY: Springer.

Bullock, E. C. (2012). Conducting "good" equity research in mathematics education: A question of methodology [Special issue]. *Journal of Mathematics Education at Teachers College, 3*(2), 30–36.

Butler, J. (1999). *Gender trouble: Feminism and the subversion of identity* (10th anniversary ed.). New York, NY: Routledge.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: Sage.

de Freitas, E. (2004). Plotting intersections along the political axis: The interior voice of dissenting mathematics teachers. *Educational Studies in Mathematics, 55*(1&3), 259–274.

de Freitas, E., & Nolan, K. (Eds.). (2008). *Opening the research text: Critical insights and in(ter)ventions into mathematics education*. New York, NY: Springer.

Delamont, S., & Atkinson, P. (2004). Qualitative research and the postmodern turn. In M. Hardy & A. Bryman (Eds.), *The handbook of data analysis* (pp. 667–682). London, United Kingdom: Sage.

Derrida, J. (1997). *Of grammatology* (G. C. Spivak, Trans. Corrected ed.). Baltimore, MD: Johns Hopkins University Press. (Original work published 1974)

Derrida, J., & Montefiore, A. (2001). "Talking liberties": Jacques Derrida's interview with Alan Montefiore. In G. Biesta & D. Egéa-Kuehne (Eds.), *Derrida & education* (pp. 176–185). New York, NY: Routledge.

Dewalt, K. M., & Dewalt, B. R. (2002). *Participant observation: A guide for fieldworkers*. Walnut Creek, CA: AltaMira Press.

Donmoyer, R. (2006). Take my paradigm ... please! The legacy of Kuhn's construct in educational research. *International Journal of Qualitative Studies in Education, 19*(1), 11–34.

English, L. D. (2008). Setting an agenda for international research in mathematics education. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed., pp. 3–19). New York, NY: Routledge.

Ernest, P. (1991). *The philosophy of mathematics education*. London, United Kingdom: Falmer Press.

Ernest, P. (1997). The epistemological basis of qualitative research in mathematics education: A postmodern perspective. *Journal for Research in Mathematics Education – Monograph 9*, 22–39.

Ernest, P. (2004). What is the philosophy of mathematics education? *Philosophy of Mathematics Education Journal, 18*. Retrieved from http://people.exeter.ac.uk/PErnest/pome18/PhoM_%20for_ICME_04.htm

Foucault, M. (1972). *The archaeology of knowledge* (A. M. Sheridan Smith, Trans.). New York, NY: Pantheon. (Original work published 1969)

Foucault, M. (1990). *The history of sexuality. Volume I: An introduction* (R. Hurley, Trans.). New York, NY: Vintage. (Original work published 1976)

Foucault, M. (1994). *The order of things: An archaeology of the human sciences*. New York, NY: Vintage. (Original work published 1966)

Furinghetti, F. (2009). On-going research in the history of mathematics education. *The International Journal for the History of Mathematics Education*, *4*(2), 103–108.

Gadanidis, G., & Borba, M. (2013). New media and research dissemination: The case of performing mathematics education research. *Journal of Educational Multimedia and Hypermedia*, *22*(1), 25–38.

Gee, J. P. (1999). *An introduction to discourse analysis: Theory and method*. New York, NY: Routledge.

Good, T. L., & Grouws, D. A. (1979). The Missouri Mathematics Effectiveness Project: An experimental study in fourth-grade classrooms. *Journal of Educational Psychology, 71*(3), 355–362.

Goos, M. (2014). Researcher–teacher relationships and models for teaching development in mathematics education. *ZDM*, *46*(2), 189–200.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 163–194). Thousand Oaks, CA: Sage.

Gutiérrez, R. (2013). The sociopolitical turn in mathematics education [Special issue]. *Journal for Research in Mathematics Education, 44*(1), 37–68.

Gutstein, E., Lipman, P., Hernandez, P., & de los Reyes, R. (1997). Culturally relevant mathematics teaching in a Mexican American context [Special issue]. *Journal for Research in Mathematics Education, 28*(6), 709–737.

Higginson, W. (1980). On the foundations of mathematics education. *For the Learning of Mathematics, 1*(2), 3–7.

Kilpatrick, J. (1992). A history of research in mathematics education. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 3–38). New York, NY: Macmillan.

Kincheloe, J. L., & McLaren, P. (1994). Rethinking critical theory and qualitative research. In N. K. Denzin & Y. S.

Lincoln (Eds.), *Handbook of qualitative research* (pp. 139–157). Thousand Oaks, CA: Sage.
Kincheloe, J. L., McLaren, P., & Steinberg, S. R. (2000). Critical pedagogy and qualitative research: Moving beyond the *bricolage*. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (4th ed., pp. 163–177). Thousand Oaks, CA: Sage.
Koro-Ljungberg, M. (2012). Methodology is movement is methodology. In S. R. Steinberg & G. S. Cannella (Eds.), *Critical qualitative research reader* (pp. 82–90). New York, NY: Peter Lang.
Kuhn, T. S. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago, IL: University of Chicago Press. (Original work published 1962)
Lather, P. A. (2006). Paradigm proliferation as a good thing to think with: Teaching research in education as a wild profusion. *International Journal of Qualitative Studies in Education, 19*(1), 35–57.
LeCompte, M. D., Preissle, J., & Tesch, R. (1993). The role of theory in the research process, In *Ethnography and qualitative design in educational research* (2nd ed., pp. 116–157). San Diego, CA: Academic Press.
Lerman, S. (2000). The social turn in mathematics education research. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 19–44). Westport, CT: Ablex.
Lerman, S. (2013). Theories in practice: Mathematics teaching and mathematics teacher education. *ZDM*, *45*(4), 623–631.
Lester, F. K. (2005). On the theoretical, conceptual, and philosophical foundations for research in mathematics education. *ZDM, 37*(6), 457–467.
Lester, F. K., & Lambdin, D. V. (2003). From amateur to professional: The emergence and maturation of the U.S. mathematics education community. In G. M. A. Stanic & J. Kilpatrick (Eds.), *A history of school mathematics* (Vol. 2, pp. 1629–1700). Reston, VA: National Council of Teachers of Mathematics.
Lester, F. K., & Wiliam, D. (2000). The evidential basis for knowledge claims in mathematics education research. *Journal for Research in Mathematics Education, 31*(2), 132–137.
Mauthner, N. S., & Doucet, A. (2003). Reflexive accounts and accounts of reflexivity in qualitative data analysis. *Sociology*, *37*(3), 413–431.
National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
Ritchie, S. M., & Rigano, D. L. (2001). Researcher-participant positioning in classroom research. *International Journal of Qualitative Studies in Education*, *14*(6), 741–756.
Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data* (2nd ed.). Thousand Oaks, CA: Sage.
Ruthven, K., & Goodchild, S. (2008). Linking researching with teaching: Towards synergy of scholarly and craft knowledge. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed., pp. 561–588). New York, NY: Routledge.
St. Pierre, E. A. (1997). Methodology in the fold and the irruption of transgressive data. *International Journal of Qualitative Studies in Education*, *10*(2), 175–189.
St. Pierre, E. A. (2011). Post qualitative research: The critique and the coming after. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (4th ed., pp. 611–625). Thousand Oaks, CA: Sage.
Saldaña, J. (2009). *The coding manual for qualitative researchers*. Los Angeles, CA: Sage.
Schoenfeld, A. H. (2008). Research methods in (mathematics) education. In L. D. English (Ed.), *Handbook of international research in mathematics education* (2nd ed., pp. 467–519). New York, NY: Routledge.
Senger, E. S. (1998–1999). Reflective reform in mathematics: The recursive nature of teacher change. *Educational Studies in Mathematics, 37*(3), 199–221.
Skovsmose, O. (2012). Towards a critical mathematics education research programme? In O. Skovsmose & B. Greer (Eds.), *Opening the cage: Critique and politics of mathematics education* (pp. 343–368). Rotterdam, The Netherlands: Sense.
Skovsmose, O., & Borba, M. (2004). Research methodology and critical mathematics education. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (pp. 207–226). Dordrecht, The Netherlands: Kluwer.
Sierpinska, A., & Lerman, S. (1996). Epistemologies of mathematics and of mathematics education. In A. J. Bishop, J. Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.), *International handbook of mathematics education* (Vol. 2, pp. 827–876). Dordrecht, The Netherlands: Kluwer.
Steiner, H.-G. (1985). Theory of mathematics education (TME): An introduction. *For the Learning of Mathematics, 5*(2), 11–17.

Steiner, H.-G. (1987). Philosophical and epistemological aspects of mathematics and their interaction with theory and practice in mathematics education. *For the Learning of Mathematics, 7*(1), 7–13.
Stinson, D. W. (2009). The proliferation of theoretical paradigms quandary: How one novice researcher used eclecticism as a solution. *The Qualitative Report, 14*(3), 498–523.
Stinson, D. W., & Bullock, E. C. (2012a). Critical postmodern theory in mathematics education research: A praxis of uncertainty. *Educational Studies in Mathematics, 80*(1&2), 41–55.
Stinson, D. W., & Bullock, E. C. (2012b). Transitioning into contemporary theory: Critical postmodern theory in mathematics education research. In L. R. Van Zoest, J. J. Lo, & J. L. Kratky (Eds.), *Proceedings of the 34th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1163–1169). Kalamazoo, MI: Western Michigan University.
Terry, C. L. (2011). Mathematical counterstory and African American male students: Urban mathematics education from a critical race theory perspective. *Journal of Urban Mathematics Education, 4*(1), 23–49. Retrieved from http://ed-osprey.gsu.edu/ojs/index.php/JUME/article/view/98, film http://sites.oxy.edu/lterry/expectations.m4v
Valero, P. (2004). Socio-political perspectives on mathematics education. In P. Valero & R. Zevenbergen (Eds.), *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology* (pp. 5–23). Dordrecht, The Netherlands: Kluwer.
Valero, P., & Zevenbergen, R. (Eds.). (2004). *Researching the socio-political dimensions of mathematics education: Issues of power in theory and methodology*. Dordrecht, The Netherlands: Kluwer.
Wilson, P. S., Cooney, T. J., & Stinson, D. W. (2005). What constitutes good mathematics teaching and how it develops: Nine high school teachers' perspectives. *Journal of Mathematics Teacher Education, 8*(2), 83–111.