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Scholars before researchers: Philosophical considerations in the preparation of mathematics education researchers

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Abstract

In this essay, the author explores how research in mathematics education is always already entangled with and in ontological, epistemological, and ethical considerations—that is, philosophical considerations—of the researcher from beginning to end. The danger in too much of the existing mathematics education research, however, is limited acknowledgement of how philosophical considerations drive both knowledge production and knowledge dissemination in the field. "Practical" definitions of ontology, epistemology, and ethics are provided as well as descriptions of how each concept is made sense of across the paradigms of inquiry spectrum: predict, understand, emancipate, and deconstruct. The author concludes the essay with a summative argument of where and how to begin engaging philosophical considerations and a brief discussion of an emerging paradigm of inquiry.

Keywords Mathematics Education Research, Paradigms of Inquiry, Philosophical Considerations

1. Introduction

On-tol-o-gy where? E-pis-te-mol-o-gy what? Ethics… Yay, finally, I know what ethics are … I think? But what do ethics have to do with those other two concepts?

For over a decade, I have been teaching an introduction to the PhD degree program in mathematics education course at Georgia State University. The above statement is representative of the often-expressed puzzled reactions of students to three concepts that, although initially somewhat unfamiliar, are continuously revisited throughout the introductory course (and all of my doctoral courses). When I see the puzzled looks on students' faces as we begin to explore the meanings of ontology, epistemology, and ethics, I often pause and share with them my own puzzlement two decades earlier when I was sitting in a similar course at the University of Georgia (Dr. Jeremy Kilpatrick was the professor). Back then, I tell the students, if I reached far into my own schooling experiences, I could recall the concepts from my introductory philosophy course in my initial undergraduate degree some twenty years earlier (Dr. James Humber was the professor). But I failed to recall their exact meanings, and I certainly did not understand how significant the concepts would become to my future as a mathematics education researcher. I proceed then to explain to the budding mathematics education researchers that, from my perspective, considerations of ontology, epistemology, and ethics—in short, philosophical considerations (Paul & Marfo, 2001)—are the most important considerations to continuously revisit as they progress through

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the degree program, and throughout their newly chosen profession as a mathematics education researcher. The degree that they are seeking, after all, is a Doctor of Philosophy.

In this essay, I argue for the centrality of philosophical considerations throughout the process of conceiving, planning, and conducting mathematics education research. I being with a brief discussion of the current attacks on philosophy in general, providing a counterargument to those who might see the discipline philosophy as esoteric. I then provide a brief historical tracing of the inclusion of a philosophical dimension to mathematics education (research or otherwise). Next, I define the concepts ontology, epistemology, and ethics and provide descriptions of how each concept is made sense of across the paradigms of inquiry spectrum: predict, understand, emancipate, and deconstruct. Interestingly, the title of this essay is a coupling of the titles of two essays that I use in my introductory doctoral course: "Scholars Before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation" (Boote & Beile, 2005) and "Preparation of Educational Researchers in Philosophical Foundations of Inquiry" (Paul & Marfo, 2001). Both essays make convincing arguments that preparation of educational researchers needs to move away from teaching research as mere technical methods and procedures and toward teaching research as philosophical endeavors of scholarly inquiry.

It is important to note that I do not intend the discussion to provide a complete exploration of philosophical considerations of mathematics education (research or otherwise); philosophical considerations have been explored and debated for millennia. Nor do I intend the discussion to provide a complete survey of different theoretical and methodological possibilities for conducting mathematics education research. But rather my intention here is for the discussion to act as a primer of sorts to assist doctoral students in organizing and making sense of the proliferation of choices throughout the process of conceiving, planning, and conducting education research (cf. Lather, 2006). In other words, I hope that the discussion marks a reasonable starting point for novice researchers: an exploration and integration of one's own beliefs about existence, knowledge, morality, and so on—beliefs that either knowingly or unknowingly drive choices made throughout the research process. In the end, I hope that the discussion convincingly shows new (and even old) mathematics education researchers that philosophical considerations are always already entangled with and in research from beginning to end (St. Pierre, 2011).

2. Philosophy and Mathematics Education Research

Philosophy as an intellectual pursuit, it seems, is continuously under attack as the corporatization of higher education accelerates in these neoliberal, anti-intellectual times (Peters, 2019; Olssen & Peters, 2005), attacks which have included complete closures of philosophy departments (see, e.g., Claremont Graduate University, 2018; Seltzer, 2017; Wolff, 2010). Recently, however, one of the celebrated stewards of U.S. education, Dr. Howard Gardner (2018), provided an alternative to these attacks. Rather than the closure of philosophy departments, Gardner puts forth the compelling argument that every undergraduate student should be required to complete two philosophy courses. These two courses, one at the beginning of students' undergraduate experience and one at the end, would explore questions of identity, purpose, virtues and vices, and existence. The first course would be a general exploration of the "Big Questions of Life," attempting to avoid using the word philosophy altogether. The second course would explore the discipline more directly through the use of classical and contemporary philosophy texts that survey enduring as well as present-day issues, issues such as "just and unjust wars, human and artificial intelligence, bioethics, the nature of consciousness" (para. 14). The purpose of these two courses: "to

equip graduates with a philosophical armamentarium they could draw from—and contribute to—for the rest of their lives" (para. 15).

Equipping mathematics educators (researchers or otherwise) with a philosophical armamentarium that they might draw from and contribute to for the rest of their careers, as well as their lives, was in part the purpose I suppose in Higginson's (1980) proposal for the inclusion of a philosophical dimension to mathematics education (research or otherwise). Proposed in the early foundational years of the discipline, Higginson suggested mathematics education be informed not simply by mathematics and psychology but also by sociology and philosophy. The inclusion of philosophy is important, he claimed, because all human "intellectual activity is based on a set of assumptions of a philosophical type" (p. 4). 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)

Throughout the past 30 years or so, several mathematics education scholars and researchers have explored just what the inclusion of a philosophical dimension might provide the discipline mathematics education. In the early 1980s, this inclusion was demonstrated through the formation of the Topic Study Group on Theory in Mathematics Education in 1984 at the 5th International Congress for Mathematical Education. In the discussions of this group, philosophical considerations often took center stage. The purpose of the group, as Steiner (1985) summarized, was "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" (p. 16, emphasis in original). International collaborations found in edited volumes from the 1990s, 2000s, and 2010s have continue to illustrate the importance of including philosophical dimensions. For instance, edited volumes such as the International Commission on Mathematical Instruction study *Mathematics Education as a Research Domain: A Search for Identity* (Sierpinska & Kilpatrick, 1998) and the three editions of the *International Handbook of Mathematics Education* (Bishop et al., 1996, 2003; Clements et al., 2013) contain several chapters exploring philosophical dimensions. Paul Ernest, through his many books and edited volumes (see, e.g., Ernest, 1991, 1994a, 1994b, 1998) and his founding and ongoing editorship of the *Philosophy of Mathematics Education Journal* (Ernest, n.d.), approaching its 30-year anniversary, is the most noted scholar who continues to bring philosophical dimensions to the fore in mathematics education.

Ernest (1991), in his foundational and often-cited book *The Philosophy of Mathematics Education*, surveys the philosophical dimensions of both mathematics and mathematics education. Drawing on Higginson's (1980) argument that all human intellectual activity rests on assumptions of a philosophical type, Ernest questions some of the ontological, epistemological, and ethical problems and issues (among others) surrounding the philosophy of mathematics, the nature of learning, the aims of education, the nature of teaching, and the philosophy of mathematics education. Recently, Ernest (2016b) contended that applying philosophical methods to

> mathematics education matters because it gives people new 'glasses' through which to see the world. It enables people to see beyond official stories about the society, mathematics, and

education. It provides thinking tools for questioning the status quo, for seeing 'what is' is not 'what has to be'; enabling us to imagine alternatives [*sic*] possibilities. (p. 2)

In the remainder of this essay, I aim to assist others in imagining alternative possibilities by exploring the sense making of ontology, epistemological, and ethics within the context of social science research in general and mathematics education research in particular. Throughout the essay, I provide multiple references for further explorations. I begin, however, by connecting philosophical considerations to paradigms of inquiry (i.e., theoretical and methodological considerations)—more familiar terrain for mathematics education researchers.

3. Paradigms of Inquiry and Philosophical Considerations

I take this slight detour into paradigms of inquiry to bring in sharp relief that questions of being, knowledge, goodness, among others, are always already entangled throughout the research process. Details of various paradigms of inquiry available to mathematics education researchers through the overlapping and simultaneously operating historical 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–)—are provided elsewhere. (See Stinson and Bullock [2012, 2015] for details of each moment and identified exemplars of mathematics education research studies within each moment.) Without recounting the details, Table 1 (Stinson & Walshaw, 2017, p. 133) maps these ongoing historical moments (i.e., no end dates) to different paradigms of inquiry—predict, understand, emancipate, and deconstruct—which, in turn, support different theoretical frameworks and methodological approaches. Paradigms of inquiry highlight for researchers "what it is they are about, and what falls within and outside the limits of legitimate inquiry"; they are defined by responses to three fundamental and interrelated questions: the ontological question, the epistemological question, and the methodological question (Guba & Lincoln, 1994, p. 108). The three questions are interrelated "because the answer given to any one question, taken in any order, constrains [more times than not] how the others may be answered" (p. 108).

Although Table 1 provides a sharp visual for organizing and structuring the interrelatedness of paradigms and moments, given the often objectionable responses I have received over the years in presenting Table 1 (either in publications or at conferences), there are some important caveats to be noted. Maybe the unavoidable sharp edges of categories have motivated these responses? Nevertheless, caveats that were noted when I initially presented an earlier version of the table (see Stinson & Bullock, 2015) require being repeated and extended here. First, similar to how Lather and St. Pierre (Lather, 2006) categorized the paradigms of inquiry (predict, understand, emancipate, and deconstruct), the moments of mathematics education research categorized (the process–product moment, the interpretivist–constructivist moment, the social-turn moment, and the sociopolitical-turn moment) are understood as overlapping and simultaneously operating (Stinson & Bullock, 2012). It is also important to note that neither Lather and St. Pierre nor I claim that movement among the paradigms 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 historical chronological order. Second, I unequivocally acknowledge that categories are always limiting and dangerous. Nonetheless, the categories used to label both the paradigms and the moments provide somewhat of a generally accepted and direct way to mark the stark differences among the paradigms and moments. Third, the placement

of theoretical and methodological perspectives under a specific inquiry paradigm (or paradigms) is also limiting and dangerous; in that, for example, critical research is not only about emancipation nor is poststructural research only about deconstruction. The table therefore list several theoretical and methodological traditions under each category and illustrates how some traditions crossover multiple paradigms. 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 theoretical and methodological interrelatedness and philosophical entanglement throughout the research process. And fifth, Table 1 is not intended to provide a restrictive and definitive way of representing the complexities and messiness of the research process but rather intended to provide a visual for making sense of the proliferation of theoretical and methodological choices that a novice (and seasoned) mathematics education researcher must and does make.

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		*Poststructural/
Experimental	Social constructivist	<<Feminist>		Postmodern
Quasi-experimental	Radical constructivist	Critical Race Theory>		Postcritical
Mixed methods>	Sociocultural>	Latino/a Critical Race Theory>	*BREAK*	Postcolonial
	Phenomenological	Critical Theories of Race>		Posthumanist
	Ethnographic	<Participatory Action Research		Post-Freudian
	Symbolic Interaction	Critical Ethnography		<Discourse Analysis

Note. *Indicates the term most commonly used; < or > indicates cross-paradigm movement. The BREAK in the original Lather and St. Pierre table indicated a shift from the Enlightenment humanist paradigms on the left to the post-Enlightenment, posthumanist paradigm on the right. Here it indicates a hybrid, in-between space where the researcher might adopt a critical postmodern theoretical tradition (see Stinson & Bullock, 2012, 2015).

Paradigms of inquiry adapted from table by P. A. Lather and B. St. Pierre, 2005, found in "Paradigm Proliferation as a Good Thing to Think With: Teaching Research in Education as a Wild Profusion," by P. A. Lather, 2006, *International Journal of Qualitative Studies in Education*, 19(1), p. 37.

Note: Reprinted from "Exploring Different Theoretical Frontiers for Different (and Uncertain) Possibilities in Mathematics Education Research," by D. W. Stinson and M. A. Walshaw, 2017. In J. Cai (Ed.), *Compendium for Research in Mathematics Education*, p. 133. Copyright 2017 by the National Council of Teachers of Mathematics.

In the end, Table 1 is intended to show that within each of the moments, within each of the paradigms, and within each of the theoretical frameworks and methodological approaches questions of ontology, epistemology, and, I add, ethics (among others) are always already entangled and are either knowingly or unknowingly engaged. Given that theoretical frameworks and methodological approaches are embedded in paradigms of inquiry, and paradigms of inquiry are em-

bedded in assumptions of a philosophical type (cf. Crotty, 1998), no researcher (or research team) working in any moment, any paradigm, or any framework or approach, I believe, should be absolved from engaging questions of a philosophical type.

Mirroring others (e.g., Crotty, 1998; Lather, 2006; Guba & Lincoln, 1994; Lincoln, Lyntham, & Guba, 2011), I use Table 1 to structure the remainder of the discussion. In that, the concepts ontology, epistemology, and ethics are presented in the contexts of the different paradigms of inquiry: predict, understand, emancipate, deconstruct. How each of these concepts are made sense of across the paradigm spectrum illustrates not only the divergences in approaches to research (mathematics education or otherwise) but also the interrelatedness of the concepts.

But before I discuss ontology, epistemology, and ethics, two caveats are necessary. First, although the concepts are presented as discrete, they are in fact continuous (i.e., interrelated); in that, to speak about one always includes speaking implicitly or explicitly about the other two (see Cannon, 2019, for a brief discussion of Karen Barad's ethico-onto-epistem-ology in mathematics education research). Philosophical engagement in general is complex and multilayered; it requires filigree ways of thinking with multiple and overlapping trajectories; ways of thinking that embrace uncertainty and openness rather than the fictions of certainty and closure. Second, the discussion is intended to be neither an argument between quantitative science versus qualitative science (see Ercikan & Roth, 2006) nor an argument between continental philosophy versus analytic philosophy (see Cooper, 1994). But rather, an informative discussion in which no matter where a person positions herself or himself (or themself) on the paradigm spectrum she or he (or they) sees the importance of knowingly engaging philosophical considerations throughout the research process. To ease the reader into the discussion, I begin each section simply with the familiarities and practicalities of the "official" *Merriam-Webster* definition of the concept, moving to more complex ideas as the exploration of each concept ensues.

3.1 Ontology

Definition of ONTOLOGY

1 : a branch of metaphysics concerned with the nature and relations of being • *Ontology* deals with abstract entities.

2 : a particular theory about the nature of being or the kinds of things that have existence (*Merriam-Webster*, 2018)

Ontology is one of those philosophical concepts that philosophers and theorists as well as researchers acknowledge but most attempt to quickly move over, under, or around in efforts to avoid meeting it head on. Its metaphysical part is its most avoided. The concept is older than Plato's Forms (cf. Plato, *trans*. 1996), and can be understood as having four different yet related conceptions:

- Ontology 1: the study of ontological commitment, that is, what we or others are committed to;
- Ontology 2: the study of what there is;
- Ontology 3: the study of the most general features of what there is, and how the things there are relate to each other in the metaphysically most general ways; and
- Ontology 4: the study of meta-ontology, that is, saying what task it is that the discipline of ontology should aim to accomplish, if any, how the questions it aims to answer should

> be understood, and with what methodology they can be answered. (*Stanford Encyclopedia of Philosophy*, para. 27, 2017a)

In modern-day philosophy, Carnap (1950/1956) rejects ontology altogether; Quine (1948) contends that its problem "is its simplicity" (p. 21) and refers to it as a "crusty old word" (Quine, 1951, p. 66). While Levinas (1989) claims that it is fundamental: "To take up once more the problem of ontology (implicitly resolved by everyone, be it only under the form of forgetfulness), is to establish a fundamental knowing, it seems, without which all philosophical, scientific, or common knowledge remains naïve" (p. 121).

Recall, in the context of social science research in general, the ontological question is the first of three interrelated questions to ask with respect to which paradigm(s) of inquiry the researcher might be positioned: "What is the form and nature of reality and therefore, what is there that can be known about it" (Guba & Lincoln, 1994, p. 108). Ontology in the context of mathematics education (research or otherwise) is further complicated by the "realness" (or not) of two specific entities: mathematical objects and human beings (Ernest, 2016a). The prevailing ontology of mathematical objects for over two millennia, Platonism, asserts that mathematical objects exist independent of human beings' thought, language, and practices. Ernest (1998), however, in careful detail discusses and critiques this ontological stance and others in his argument for a social constructivism as a philosophy of mathematics and, in turn, of mathematics education (research or otherwise) (see also Davis & Hersh, 1981/1998; Hersh, 1997; Tymoczko, 1998). The move toward a social constructivism as a philosophy of mathematics teaching, learning, and research engages ontological considerations of the nature of human beings. Here, it is not only a question of the nature of mathematical objects but also a question of the nature of "the 'non-essential essence' of learners, teachers and persons in general presupposed by teaching, learning and research in mathematics" (Ernest, 2016a, p. 7). Such ontological considerations support the claim that the radical constructivism versus social constructivism debate (see, e.g., Lerman, 1996, 2000; Steffe & Kieren, 1994; Steffe & Thompson, 2000) is not only epistemological but also ontological (Packer & Goicoechea, 2000).

Ontological considerations, as previously noted, are understood differently in each of the paradigms of inquiry: predict, understand, emancipate, and deconstruct. For instance, ontology in the predict paradigm (i.e., positivists) is objective realism, a view that objects—for example, mathematical objects—exist independent of the knower. Reality here is "objective" and "found" (Lather, 2006). This objective found reality is ordered by natural laws and mechanisms; the "'way things are' is conventionally summarized in the form of time- and context-free generalizations, some of which take the form of cause–effect laws" (Guba & Lincoln, 1994, p. 109). Direct experience not speculation is the foundation of science, which advances "by a study of the 'given' (in Latin *datum* or, in the plural, *data*)" (Crotty, 1998, p. 20).

Ontology for the interpretivists and constructivists of the understand paradigm is subjective relativism. The real here is "apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature…and dependent for their form and content on the individual persons or groups holding the constructions" (Guba & Lincoln, p. 110–111). Although there are important differences between the relativism of interpretivists and the relativism of constructivists, an essential similarity is that both *uncritically* accept the realness of their individual and collective interpretations and constructions (Crotty, 1998); and critical here is understood in the critical theoretical sense (cf. Bronner, 2011). In short, reality is subjectively yet uncritically interpreted and constructed (Lather, 2006).

Historical realism is the ontology of the emancipate paradigm (i.e., critical theorists). What is real is shaped by current and historical social, cultural, political, economic, racial, ethnic, gender, and so forth discourses (Guba & Lincoln, 1994). Discourses here are to be understood not only as language but also as the complex web of institutions, structures, signs, and practices that order and sustain socio-historical, -cultural, and -political constructed forms of social existence (Leistyna, Woodrum, & Sherblom, 1996). These discourses are reified and sustained with and in hegemonic structures that "are now (inappropriately) taken as 'real,' that is, natural and immutable" (Guba & Lincoln, 1994, p. 110). Hegemony constructs people as *objects*—those who are acted upon, rather than *Subjects*, those who act—who become so entrenched in their own oppressive condition that they do not realize their own subjugation or their complicity in the perpetuation of unjust social and economic systems (Freire, 1970/2000). Reality in brief is constituted with and in hegemonic systems of socio-historical, -cultural, and -political discourses of power (Lather, 2006).

Reality for the poststructuralists and postmodernists of the deconstruct paradigm is unknowable: that which exist is always already contingent, multiple, fragmented, and becoming. There is an incredulity toward universal metanarratives of being (cf. Lyotard, 1979/1984). The one universal mind of the rational human subject is replaced here with multiple minds, multiple subjects, and multiple knowledges that reflect different socio-historical, -cultural, and -political locations (Seidman, 1994). The ontology of the deconstruct paradigm therefore is an anti-universal realism that attempts "to pass beyond man [human] and humanism" (Derrida, 1978, p. 292). Such an ontology, however, is more than simply a critique of realism; in that, "it questions representation and the underlying belief of a reality that is independent of representation yet capturable by it" (Usher & Edwards, 1994, p. 14). Or said in another way, "the real is not only what can be reproduced, but that which is already reproduced" (Baudrillard, 1983, p. 146).

3.2 Epistemology

Definition of EPISTEMOLOGY

> : the study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity (*Merriam-Webster*, 2018)

Epistemology, unlike ontology, is often embraced by philosophers, theorists, and researchers as a productive site for research. The absence per se of a metaphysical component makes engaging epistemological considerations more consistent with the Enlightenment—the Age of Reason (cf. Foucault, 1978/2003b). The growth of epistemological perspectives has been exponential; for every discipline of human pursuit there seems to be a proliferation of epistemologies. The *Stanford Encyclopedia of Philosophy* (2005) extends the definition of epistemology to include both the study of knowledge and the study of justified beliefs. As such, there are two sets of questions that might be asked:

Questions about Knowledge—

- What are the necessary and sufficient conditions of knowledge?
- What are its sources?
- What is its structure, and what are its limits?

Questions about Justified Beliefs—

- How are we to understand the concept of justification?

- What makes justified beliefs justified?
- Is justification internal or external to a person's own mind? (*Stanford Encyclopedia of Philosophy*, 2015, para. 1)

Recall, the epistemological question is the second of three interrelated questions to ask with respect to researcher position across the paradigm spectrum: "What is the nature of the relationship between the knower or would-be knower and what can be known?" (Guba & Lincoln, 1994, p. 108). In the context of social science research in general, Crotty (1998) defines epistemology as "the theory of knowledge embedded in the theoretical perspective and thereby in the methodology" (p. 3). Such a definition makes explicitly engaging epistemological considerations throughout the research process inescapable. Where a researcher might be able to engage ontology implicitly (or not at all), such a strategy is not possible here. In the context of mathematics education, researchers and educators often hold different and at times conflicting epistemological stances (e.g., recall the radical constructivists vs. social constructivists debate previously noted). 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). These conflicts stretch across the paradigm spectrum, given that epistemology too is understood differently in each paradigm of inquiry.

Objectivism, for instance, is the epistemology for the positivists of the predict paradigm. Here, the researcher and the researched "object" are independent entities, and the researcher is capable of researching the object without influencing it or being influenced by it (Guba & Lincoln, 1994). Ideologies and biases of the researcher do not influence research findings as long as the prescriptive procedures of positivist science are rigorously followed (Guba & Lincoln). Objective knowledge is not only ideologically free but also universal; replicated findings are not only possible but also "true."

The interpretivist and constructivist of the understand paradigm maintain a subjectivist epistemology. The researcher and the researched object here are forever linked through interactions; therefore, the findings are essentially produced in and through the research process (Guba & Lincoln, 1994). The world and objects do not exist independent of interpretations and constructions of the world and objects. In other words, consciousness—interpretivist and constructivist—"is always consciousness *of something*" (Crotty, 1998, p. 44, emphasis in original). Interpretivists understand knowledge as "culturally derived and historically situated interpretations of the social life-world" (p. 67). Constructivists, on the other hand, understand knowledge as "contingent upon human practices, being constructed in and out of interactions between human beings and their world, and developed and transmitted within an essentially social context" (p. 42). Different people and groups interpret and construct meanings differently; in that, both interpretations and constructions are socially and experientially based and local and specific in nature.

Similarly, critical theorists of the emancipate paradigm also acknowledge that different people and groups interpret and construct meanings differently. These interpretations and constructions, however, are embedded in a critical subjectivist epistemology that is forever intertwined with and in hegemonic discourses of socio-historical, -cultural, and -political power (cf. Kincheloe & McLaren, 1994; Kincheloe, McLaren, & Steinberg, 2011). Knowledge therefore is neither ideologically free nor universal but rather made in and through discourses of domination and oppression (Freire, 1970/2000).

The epistemological stance in the deconstruct paradigm is one in which the "nature" of knowledge found in humanism is replaced with the "discursive formation" of knowledge made

in and through discursive events (Foucault, 1969/1972, p. 38). Knowledge as discursive formation is not concerned with uncovering the "truth" of statements and discourses that comprise discursive events per se but rather with the "historical conditions, assumptions, and power relations that allow certain statements, and by extension, certain discourses to appear" (St. Pierre, 2000, p. 496). The field of discursive events, however, is a grouping that is always finite and limited at any moment to the linguistic sequences that have been formulated; these sequences may be innumerable, they may exceed the capacities of recording, memory, or reading; nevertheless, they form a finite grouping (Foucault, 1969/1972, p. 27). In effect, knowledge as discursive formation no longer maintains its privileged status as an objective reality, but rather knowledge itself becomes subjected to and limited by the very socio-historical, -cultural, and -political conditions, assumptions, and power relations against which natural knowledge within the humanist tradition claimed immunity (Stinson, 2016).

3.3 Ethics

Definition of ETHIC

1 ethics *plural in form but singular or plural in construction*: the discipline dealing with what is good and bad and with moral duty and obligation

2 **a**: a set of moral principles: a theory or system of moral values • the present-day materialistic *ethic* • an old-fashioned work *ethic*—often used in plural but singular or plural in construction • an elaborate *ethics* • Christian *ethics*
b: ethics *plural in form but singular or plural in construction*: the principles of conduct governing an individual or a group • professional *ethics*
c: a guiding philosophy
d: a consciousness of moral importance • forge a conservation *ethic*

3 ethics *plural*: a set of moral issues or aspects (such as rightness) • debated the *ethics* of human cloning (*Merriam-Webster*, 2018)

Ethics is often regarded as the most accessible branch of philosophy given that "many of its presuppositions are self-evident or trivial truths: All human actions, for example, serve some end or purpose; whether they are right or wrong depends on an actor's overall aims" (*Stanford Encyclopedia of Philosophy*, 2017b, para. 4). Dewey and Tufts (1932/1985) describe ethics simply as "a systematic account of our judgments about conduct, in so far as these estimate it from the standpoint of right or wrong, good or bad" (p. 9). Similar to epistemology, there has been a proliferation of "codes of ethics" with nearly ever discipline of human pursuit developing its own. A commonality of these multiple codes with respect to research is that they often provide guidelines on four overlapping areas of procedural concern: informed consent, deception, privacy and confidentiality, and accuracy (Christians, 2011; see also Sowder, 1998).

In the context of social science research in general, Guillemin and Gillam (2004) identify two dimensions of ethical concern: "procedural ethics and 'ethics in practice'" (p. 262). They define procedural ethics as those ethical concerns most often addressed by research ethics committees (e.g., Institutional Review Boards). They define ethics in practice as the ongoing day-to-day ethical concerns that arise throughout the research process (e.g., the disclosure of sensitive information from a research participant). Although Guillemin and Gillam perceive continuity between the two dimensions, they frame ethics in practice within reflexivity. Reflexivity requires thinking about the researcher's positionality and how the process of conducting research affects the study

and the human relationships developed throughout the study (Glesne, 1999). In being reflexive, the researcher becomes alert not only to concerns related to knowledge creation (i.e., epistemology) but also to the ethical concerns of research (Guillemin & Gillam). Here, the researcher adopts "a continuous process of critical scrutiny and interpretation, not just in relation to the research methods and the data but also to the researcher, participants, and the research context" (p. 275).

Similarly, in the context of mathematics education research, Ernest (2012; see also Adler & Lerman, 2003) makes a four-point argument for ethics as the "first philosophy" of mathematics education research. First, ethics is at the center of the research process with respect to seeking informed consent, causing no harm or detriment, and ensuring confidentiality for all those involved (i.e., procedural ethics). Ernest claims that any research that does not conform to these most basic standards "is ethically flawed and its knowledge claims are suspect" (p. 13). Second, mathematics education researchers are participating "in the great, age-old human conversation that sustains and extends our common knowledge and cultural heritage," as such "we and others benefit and grow" (p. 13.) Third, the species of human beings depends on its survival by sharing in ethical social and life behaviors with fellow humans. Fourth, drawing on Levinas and his ethics as first philosophy, Ernest states—

> we owe a debt to the other that precedes and goes beyond reasons, decisions, and our thought processes, and precedes and exceeds any attempt to understand the other. Our infinite responsibility to the other person is, of course, ethical: "Ethics precedes ontology […] ethics primarily signifies obligation toward the other, that it leads to the Law and to gratuitous service, which is not a principle of technique" (Levinas, 1987, p. 183). (p. 13)

In the end, Ernest (2012) contends that positioning ethics as the first philosophy for mathematics education research enables the larger research community "to rethink and re-evaluate some of the taken-for-granted commonplaces of our practices" (p. 14). Such re-thinking and -evaluating opens up different possibilities for theorizing and researching mathematics teaching and learning. (Also see Ernest [2019] for or an "ethical audit" of mathematics and mathematics education.)

How ethics is taken up across the paradigm spectrum is not so much about difference as it is about degree. Each of the paradigms—predict, understand, emancipate, and deconstruct—acknowledge at varying levels the importance of ethics throughout the research process. (Addressing and monitoring ethical concerns, however, have not always been practiced: e.g., the Tuskegee Syphilis Study.) The difference is the degree to which the researcher's focus is on procedural ethics, ethics in practice, or somewhere in between (Guillemin & Gillam, 2004). Or, in the case of mathematics education research, points one and two (i.e., procedural ethics) or points three and four (i.e., ethics in practice) (Ernest, 2012).

The positivists of the predict paradigm rely heavily on the check boxes of the Institutional Review Boards; that which is ethical is knowable, discernable, and demonstrable. Objective ethical procedures drive the research process; these procedures exist independent of both the researcher and the researched. In the understand paradigm, ethics is a both–and concern for the interpretivists and constructivists. In that, both procedural ethics and ethics in practice are taken up (Guillemin & Gillam, 2004). Reflexivity here becomes key as questions about researcher and participant positionality and how the process of conducting research affects both the study and

the human relationships are continuously engaged (Glesne, 1999). Reflexivity is key for the critical theorists of the emancipate paradigm as well. But here reflexivity is intertwined with and in critical socio-historical, -cultural, and -political interrogations of the so-named ethical procedures and practices (cf. Cannella & Lincoln, 2011). Conceptualizations of "good" research are expanded to include human well-being (Hostetler, 2005) and public interest (Ladson-Billings & Tate, 2006). Ethics in the deconstruct paradigm is interrogated further as even the possibility of ethics is considered. In other words, ethics, similar to existence, is always already contingent, multiple, fragmented, and becoming. Here, the governmentality (i.e., the way in which the state exercises control of its populace) of ethics becomes a grave concern as the ideal of a universal moral code of ethics is catastrophic (Foucault, 1978/2003a, 1984/1996).

3.4 Summary of Ontology, Epistemology, and Ethics

Although dangerous, Table 2 provides a summary of the three philosophical considerations—ontology, epistemology, and ethics—across the paradigms of inquiry spectrum—predict, understand, emancipate, and deconstruct. It is dangerous because reducing a few thousand words down to a few dozen always erases the nuances of that which has been discussed. Nonetheless, similar to Table 1, Table 2 is provided here to offer a sharp visual summative account of the discussion.

Table 2
Philosophical Considerations across the Spectrum of Paradigms of Inquiry

Considerations/ Paradigm	**Predict**	**Understand**	**Emancipate**	**Deconstruct**
Ontology – study of existence	Objective Realism: existence independent of knower	Subjective Relativism: existence dependent on uncritical interpretations and constructions of knower	Historical Realism: existence through socio-historical, -cultural, and -political discourses of power	Anti-Universal Realism: existence always already contingent, multiple, fragmented, and becoming
Epistemology – study of knowledge	Objectivism: knowledge independent	Subjectivism: knowledge in and through interactions: interpreted and constructed	Critical Subjectivism: knowledge in and through discourses of domination and oppression	Discursive Formation: knowledge in and through discursive events
Ethics – principles of morality	Objective procedural ethics	Procedural ethics and reflexive ethics in practice	Critical integrations of procedural ethics and reflexive ethics in practice	Ethics always already contingent, multiple, fragmented, and becoming; anti-universal moral code of ethics

4. Where and How to Begin? Interrogate One's Own Worldview

It is important to acknowledge that ontology, epistemology, and ethics are not the only philosophical considerations that are explicitly or implicitly engaged during the research process. Higginson (1980) also pointed to considerations about beauty (i.e., aesthetics), purpose (i.e., teleology), and value (i.e., axiology). In more general terms, how a researcher understands the possibilities or impossibilities of issues such as "truth," "certainty," and "logical consistency" is dependent on how she or he (or they) positions herself or himself (or themself) across the paradigm spectrum. Such decisions are not only about theoretical frameworks and methodological approaches but also, and more germane, about worldviews: a particular standpoint or philosophy for living in and making sense of the world.

Lester and Wiliam (2000) claim 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. Comparably, Lerman (2013) contends that the theoretical framework through which a researcher organizes her or his (or their) "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)

In the end, considerations of ontology, epistemology, ethics, values, subjective and ideological grounds, and so on—that is, the researcher's worldview—should precede not follow theoretical and methodological considerations. Explicitly and critically interrogating one's worldview should be the starting point of any research project. In so doing, the frantic search that novice (and even seasoned) researchers experience in selecting theoretical frameworks and methodological approaches more times than not becomes self-evident and trivial.

It is also equally important to acknowledge that predict, understand, emancipate, and deconstruct are not the only identified paradigms in the social sciences. One additional (there are others) paradigm that has attracted attention in the past decade or so has had multiple labels: posthumanism (Ulmer, 2017), post-qualitative (St. Pierre, 2019), new materialism (de Freitas & Sinclair, 2013), the ontological turn (Lather, 2016). The umbrella label often used is "post-post"; key to this paradigm is a rethinking of humanist ontology in post-qualitative social science. These new new ways of thinking and being bring the entire project of social science into question—

> If we cease to privilege knowing over being; if we refuse positivist and phenomenological assumptions about the nature of lived experience and the world; if we give up representational and binary logics; if we see language, the human, and the material not as separate entities mixed together but as completely imbricated "on the surface"—if we do all that and the

> "more" it will open up—will qualitative [or quantitative] inquiry as we know it be possible? Perhaps not. (Lather & St. Pierre, 2013, pp. 629–630)

Given the limitation of space and my own lack of familiarity with this emerging paradigm, it was not explored here. Nevertheless, as our understandings of the world and universe continue to expand, I am confident that there will continue to be new new ways of living in and making sense of the world and universe; therefore, there will be new new ways of researching the world and universe around us. But no matter what new new ways of thinking and being become possible, philosophical considerations will always already be entangled with and in mathematics education research.

Acknowledgments

An abridged version of this argument can be found in Stinson (in press).

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