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Theories *for*, *in*, and *of* Mathematics Education

Review Essay of:
Bharath Sriraman and Lyn English (Eds.). *Theories of Mathematics Education: Seeking New Frontiers*, xxx+668 pp. Heidelberg: Springer (Series: Advances in Mathematics Education), 2010. ISBN 978-3-692-00741-5 (Hardcover). $129.00.

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Prepositions are always so difficult and bothersome. Should it be theories *of* mathematics education? Or theories *in* mathematics education? Or, perhaps, theories *for* mathematics education? Where "new frontiers" ought to be sought could be any of these, really. "Theories for mathematics education" is probably most restrictive, grammatically: the OED has *only* 31 divisions in its article for "for," whereas for "in," it has 40, and for "of," a whopping 60! The difficulty of prepositions consists in these many divisions in meaning that are not always easy to tell apart. This is particularly true with the preposition "of," as can be gauged by the number of its divisions in the OED. Are theories *of* mathematics education, for instance, like members *of* Parliament, theories belonging to mathematics education, that is, theories *in* mathematics education? Could be. And if it is theories *in* mathematics education, is it perhaps theories used in mathematics education, that is, theories *for* mathematics education? But of course theories *of* mathematics could also be, more plainly, theories *about* mathematics education.

By choosing *Theories of Mathematics Education* for their title, editors Bharath Sriraman and Lyn English seem to have opted for maximum ambiguity. But maybe that is how it should be. For the ambiguity arising from the preposition only reflects the ambiguity in the subject. And, needless to say, where there is ambiguity there are questions. The title, therefore, becomes a set of questions—what are the theories of mathematics education? Are they theories in mathematics education? Are they theories for mathematics education? These questions are at the heart of the book. But, in asking them, it also asks about theory *and* mathematics education. What is the place of theory in the field? As a reader of the book, I find myself also asking whether perhaps mathematics education should maintain a certain freedom from theory. Maybe, in some sense, it should be theory-less. I will come to that later, though.

In "Surveying Theories and Philosophies of Mathematics Education," part I of the book, Sriraman and English, together with Jeremy Kilpatrick who writes the preface, do a very good job in presenting this book as one that does ask questions. The very mention of "philosophies of mathematics education" in the title goes far towards setting the tone. Indeed, Sriraman and English suggest that these questions about theory are truly philosophical ones—perhaps even the foundation of a philosophy of mathematics education. Their essay also draws attention to the particular ambiguities I referred to in my opening. They ask about theories that are "home-grown" as opposed to theories "borrowed from other disciplines" (p.16), that is, roughly, theories *in* mathematics education and theories *for* mathematics education, as I put it above. The attempt alone to divide the 19 parts of this book into categories of theories *in* mathematics education, theories *for* mathematics education, and theories *of* mathematics education or theories somehow *about* mathematics education, makes the difficulty of categorizing these accounts palpable and brings the question of theories and mathematics education into relief. Thus, as a *modus operandi* for discussing this book, I shall try and sort out its parts into these categories, allowing for their inevitable overlapping and blurriness at the borders. This also serves the purpose of giving readers of this review an idea of the contents and breadth of the work—it is, after all, a very big book, comprising as it does, over 650 pages, 19 Parts, and, in one form or another, over fifty authors!

Let me start with theories *for* mathematics education, since, as I said, this is the most restrictive category of the three. One can include here Paul Ernest's "Reflections on Theories of Learning" (Part II), Richard Lesh and Bharath Sriraman's, "Re-conceptualizing Mathematics Education as a Design Science" (Part V), Stephen Campbell's "Embodied Minds and Dancing Brains: New Opportunities for Research in Mathematics Education" (Part X), Judith E. Jacobs' "Feminist Pedagogy and Mathematics" (Part XIV), Andy Hurford's "Complexity Theories and Theories of Learning: Literature Reviews and Synthesis" (Part XVII), and, to some extent, Nathalie Sinclair's "Knowing More than We Can Tell" (Part XVIII).

Of these, probably the least controversial case is Campbell's paper concerning the application of neuroscience to mathematics education. But besides being a good example of a paper in this category, Campbell's piece also brings out the difficulty of "borrowing" theories, to use Sriraman and English's phrase, namely, that one risks losing the particularity of mathematics education and its own perspective. Throughout the chapter Campbell, himself, seems to be aware how the claim that, "our biology gives us clues about how it learns and functions best," is deeply problematic. Thus he writes:

> One might ask: what does the brain have to do with learning? And one might glibly answer: try learning without one! This question, however, is not as naive as one might think. It can be asked quite rightly in the spirit of wondering how, or in what ways, knowledge of neurons, synapses, and calcium channels could possibly inform the teaching of traditional topics found in the K-12 curriculum. There is a grand gulf to bridge between education and the neurosciences (p.310-11).

There is nothing dubious in asserting that because we think with our brains there is a biological basis to learning, thinking, and knowing. But it is the phenomenological matters that are of concern to the educator, that is, we are interested in what learning and knowing are to *us*—it is precisely what Campbell keeps mistakenly ascribing to neuroscience: an understanding of our *lived* experience. For this reason, I think, Campbell cannot convincingly answer the objection he himself raises on p.318: "Scratch away at the surface of an extensible object as much as one might, some aspects of the interior always remains 'hidden'."

The problem of wearing clothes tailored for another comes into play also with Hurford's paper on complexity theories and theories of learning. Naturally, most complicated phenomena will have certain commonalities, statistical properties, sometimes scaling properties (e.g. Zipf's law): a classroom does sometimes look like a crowd! But as Campbell said so nicely above, what is on the outside does not necessarily reveal what is going on inside. Thus when Hurford places, "Chaos theory—the 'Lorenz Butterfly Effect' where minute differences in initial conditions evolve quickly into vastly different states," alongside the observation that, "Regardless of how concrete straightforward, and simplistic direct instruction may be, learners often emerge with radically different understandings" (p.572, Table I), I have trouble seeing the comparison as anything but contrived. What the comparison misses is that the great interest in complex systems is in the ability to obtain these complex behaviors from simple dynamics, that is, from a simple set of relations, so that complex shapes and patterns in biological systems can be the result of a few rules that iterate and interact. However, complex behavior can still be brought about by complex dynamics, that is, something complex need not be a complex system. And in that case there is little surprise and no insight. As far as I can see, this is the case with education for the most part.

I put Nathalie Sinclair's paper in this category of theories *for* mathematics education hesitatingly, for it is much better included among theories *in* mathematics education, where of course I also place it as well. It does borrow from outside mathematics education, drawing, for example, on the work of Michael Polanyi and on psychoanalysts like Donald Winnicott in developing its central theme of covert phenomena in mathematics education, and it does this very successfully to my mind; however, precisely because it has one foot planted firmly *in* mathematics education and, more generally, in mathematical activity, the theories it looks at work so well *for* mathematics education. Sinclair makes it clear that this was truly her intention from the start:

> My goal has been to suggest a way of creating distinctions somewhat differently, more inclusively, and to try to understand some of the similarities between distinct and highly specialized areas of research in mathematics education such as gesture, intuition, anxiety, and aesthetics. I have done this by starting within mathematics, rather than within psychology or sociology (p.609).

With that, let us turn to theories *in* mathematics education or "home-grown" theories. One can again include here Paul Ernest's "Reflections on Theories of Learning" (Part II) and, as already noted, Nathalie Sinclair's "Knowing More than We Can Tell" (Part XVIII). But certainly one must include John Pegg and David Tall's "The Fundamental Cycle of Concept Construction Underlying Various Theoretical Frameworks"(Part VI), Luis Moreno-Armella and Bharath Sriraman's "Symbols and Mediation in Mathematics Education" (Part VII), Gerald Goldin's "Problem Solving Heuristics, Affect, and Discrete Mathematics: A Representational Discussion" (Part VIII), Lyn English and Bharath Sriraman's "Problem Solving for the 21st Century" (Part IX), Guershon Harel's "DNR-Based Instruction in Mathematics as a Conceptual Framework" (Part XI), Günter Törner, Katrin Rolka, Bettina Rösken, and Bharath Sriraman's "Understanding a Teacher's Actions in the Classroom by Applying Schoenfeld's Theory *Teaching-In-Context*:

Reflecting on Goals and Beliefs" (Part XIII), and Judith E. Jacobs' "Feminist Pedagogy and Mathematics" (Part XIV).

Harel's paper provides a good representative of a "home-grown" theory. Like Sinclair, Harel emphasizes that the source of his ideas come from mathematics and mathematical activity themselves. He also says that the way mathematics education has drifted from mathematics has been a weakness of the field:

> ... attention to mathematical content is peripheral in many current frameworks and studies in mathematics education...The body of literature on whole number concepts and operations, rational numbers and proportional reasoning, algebra, problem solving, proof, geometric and spatial thinking produced since the 70s and into the 90s has given mathematics education research the identity as a research domain, a domain that is distinct from other related domains, such as psychology, sociology, ethnography, etc. In contrast, many current studies, rigorous and important in their own right as the might be, are adscititious to mathematics and the special nature of the learning and teaching of mathematics (p.343).

And Harel underlines the last point by remarking that one can often excise the word "mathematics" from a mathematics research paper, substitute some other field, and still have a coherent and sensible account. His own paper stays very close to mathematics as it might really appear in a classroom; indeed, it does so much more than most of the other papers in this volume. One does not have to work very hard to see how his triad of Duality, Necessity, and Repetition (DNR) is rooted in mathematical practice and mathematics learning. Duality, which refers to "ways of understanding" and "ways of thinking," for example, does catch that doubleness in mathematics learning where students can understand the logic and method of a particular proof or problem while missing what a proof is and what problem-solving is about. With this rootedness, Harel can facilely translate his principles into concrete "lessons," and that he does in his paper.

Harel also draws from theories outside of mathematics. In the course of laying out his "premises," he refers to Piaget's ideas of assimilation, accommodation, and equilibration and his constructivism, and to Vygotsky. "These premises-with the exception of the Mathematics Premise," he writes, "...are taken from or based on known theories, as the corresponding references for each premise indicate" (p.353). Yet, while I find the DNR scheme cogent and enlightening as to mathematics teaching and learning, here and in Harel's other writings, I find the connection with these other theories somewhat forced. I might even go as far as to say that just as one can often remove "mathematics" from writings purportedly on "mathematics education," "Piaget" and "Vygotsky" could be safely removed here without damaging DNR. For example, in describing the principle of "Repetition," he writes, "The Emphasis of *DNR-based instruction* is on repeated reasoning that reinforces desirable ways of understanding and ways of thinking" (pp.359-360). If anything, one hears stronger echoes here of the behaviorist Skinner than of the constructivist Piaget, try though Harel may to distance himself in the next sentence from "mere drill and practice of routine problems" (p.360)! I know Harel is in fact saying something more nuanced than "mere drill"—and I myself tend to think that in our zeal for understanding and "meaningful learning" we too quickly and too thoroughly reject any role for memory, practice, and repetition—but the point is that one has to strain to fit this part of the theory with the "premises" that are meant to make the theory theoretical.

What I mean is that without these "premises," DNR (except, perhaps, for D) begins to look less like a theory and more of a summation of known good teaching practice. In Bharath Sriraman, Hillary VanSpronsen and Nick Haverhals' commentary on Harel, its positive tone notwithstanding, I sense a hint of this suspicion when they write:

> All three of these principles (duality, necessity, and repeated reasoning) are interrelated throughout mathematics proof writing. As the literature suggests, none are new concepts in the research. However, to bring them all together into one theory, as one conceptual framework together, is a new and intriguing idea. Rather than treat any one component separately from the others, DNR-based instruction suggests that we attend to all three simultaneously, and take care to employ these ideas from these areas in our own teaching and when designing and conducting research in mathematics education (p.376).

Comparing this chapter to Nathalie Sinclair's, one sees an interesting state of affairs. In her chapter the psychoanalytic theory and philosophical ideas flow easily and naturally into ideas from mathematics education such as gesture and aesthetics; yet, despite her beginning with mathematics, as she says, it is hard to imagine lessons with concrete mathematical content to match the ideas, as one can with Harel's presentation. It is as if to the extent we have good theory we have weak mathematical content and to the extent we have good mathematical content we have weak theory. But it may be that all this only begs the question of what *is* "a good theory" and what *is* "mathematical content."

This edges us into the third category, namely, theories *of* mathematics education. For perhaps a theory of mathematics education *ought* to be a summation of known good teaching practices. But perhaps mathematical content, in the usual sense, should not be the focus of theory in mathematics education at all, but rather broader issues of a socio-political nature; perhaps too there are aspects of mathematics education that lend themselves better to theoretical accounts. Perhaps it is not the content of mathematics education, whether mathematical or political, that should be our main concern but a peculiar methodology. Should we, maybe, tolerate many kinds of theory in mathematics education, each having a different sense of what a theory is and what its focus is? Must a theory *in* or *for* mathematics education be chosen according to a single set of criteria? Must we even be interested in theory in the first place?

Some of these issues and questions were already brought up in Sriraman and English's opening paper, "Surveying Theories and Philosophies of Mathematics Education" (Part I), as I have already said. So naturally this should be the first among the papers treating theories *of* mathematics. Other papers in this category, each touching on one or another of these issues, include Frank Lester's, "On the Theoretical Conceptual, and Philosophical Foundation for Research in Mathematics Education" (Part III) first published in 2005 in ZDM, Stephen Lerman's, "Theories of Mathematics Education: Is Plurality a Problem?" (Part IV), Richard Lesh and Bharath Sriraman's "Re-conceptualizing Mathematics Education as a Design Science" (Part V), Stephen Hegedus' "Appreciating Scientificity in Qualitative Research" (Part XII), Judith E. Jacobs' "Feminist Pedagogy and

Mathematics" (Part XIV) once more, Angelika Bikner-Ahsbahs and Susanne Prediger's "Networking of Theories—An Approach for Exploiting the Diversity of Theoretical Approaches" (Part XV), Helga Jungwirth's "On Networking Strategies and Theories' Compatibility: Learning from an Effective Combination of Theories in a Research Project" (Part XVI), Uwe Gellert's "Modalities of a Local Integration of Theories in Mathematics Education" (also Part XVI), and Bharath Sriraman, Matt Roscoe, and Lyn English's "Politicizing Mathematics Education: Has Politics Gone too Far? Or Not Far Enough?" (Part XIX).

Generally speaking, questions of mathematical content would seem to belong more properly in the category of theories *in* mathematics education than in this category. For example, Gerald Goldin's paper (Part VIII), which I included above in theories *in* mathematics education, looked at how discrete mathematics may provide opportunities for mathematical discoveries and prompt the development of problem-solving heuristics. Somewhat more generally, Harel's paper highlighted the importance of theories that emphasize mathematical content, as we already discussed. But, in those papers, what mathematical content is was never in doubt. In a different paper that I placed in the category of theories *in* (and *for* and *of!*) mathematics education mathematics content does come into question. It is Judith Jacobs' paper on "Feminist Pedagogy and Mathematics," originally published in 1994. Jacobs argues that women have a genuinely different way of thinking and so mathematics itself must be viewed in a different light: "Feminist pedagogy includes not only how mathematics is taught but the very nature of the discipline of mathematics" (p.436). In her preface to the paper, Gabriele Kaiser refers accordingly to "mathematics reconstructed" as the final phase of a feminist perspective in mathematics. Since feminist perspectives begin to challenge the way in which we think about mathematics, they demand rethinking about the very nature of mathematics education. One can see why then it must be placed in this category of theories *of* mathematics education as well in the others.

The feminist perspective also represents a more general shift of attention in mathematics education from a field having an agreed upon subject matter to one in which the subject matter is conditioned by its relationship to one group or another. Thus, Gilah Leder in her commentary on Jacobs' piece quotes Leone Burton who said that to know mathematics is, "to question the nature of the discipline in such a way that the result of such questioning is to open mathematics to the experience and the influence of members of as many different communities as possible" (Burton quoted by Leder, p. 450). It becomes inevitable from here that those different communities, their character, their needs, the ways in which they have been trapped in hierarchies of power, take center stage, and equity and social justice turn into fundamental themes for mathematics education: *those* themes become the content of the field. This is subject of Bharath Sriraman, Matt Roscoe, and Lyn English's paper "Politicizing Mathematics Education: Has Politics Gone too Far? Or Not Far Enough?" The commentator on that chapter KeikoYasukawa has little doubt about the answer to the question. She writes:

> If we believe that mathematics learning can be a resource to increase democratic participation in society, to increase equity and social justice, then mathematics learning cannot be divorced from learning the politics of the world in which we live. Has the study of politics in mathematics

> education gone far enough? Evidently not. Can it go further? Yes, through critical mathematics education that will awaken learners to the ways in which mathematics is concealed but active in the dominant discourses that are influencing the ways we think about the fundamental principles of equity and fairness (p.643).

The extent to which mathematics education has moved away from what one generally calls mathematics was made concrete in the centenary of the *International Commission on Mathematics Instruction* (ICMI) in 2008 when the possibility was raised by some speakers at the centenary that the ICMI be separated from its original parent organization, the *International Mathematics Union* (see Menghini, et al., 2008) and, therefore, from the actual discipline of mathematics. As a theory of mathematics education, this new socio-political mathematics education, therefore, says 1) that mathematics is not at the heart of mathematics education and must be subordinated to more general social issues, or, at the other extreme, 2) that mathematics has privileged position in dealing with global social problems such as poverty and gender inequality. Either way, feminist pedagogy, which on the face of it should be a theory *in* or *for* mathematics alone, becomes a paradigm for genuine theory *of* mathematics.

The statement by Yasukawa ends the entire book. It is hard to accept it, however, as the last word. To start, one cannot help but join Harel in his concern about disregarding work in traditional mathematical areas that has "...given mathematics education research the identity as a research domain, *a domain that is distinct from other related domains, such as psychology, sociology, ethnography, etc.* [emphasis added]" (see above). This was also a concern Theodore Eisenberg voiced passionately in his "dialogue" with present reviewer:

> I am not saying that all mathematics educators should be mini-mathematicians nor that knowing mathematics is all they need to be good teachers, but they should have taken a good chunk of formal mathematics: they should like mathematics and they should maintain an interest in mathematics. This last sentence was Polya's mantra, and I agree with it totally. But I am embarrassed to say that I know mathematics educators who denigrate mathematics (and in so doing, they also unwittingly denigrate themselves.) (Eisenberg & Fried, 2009, p.145)

Opponents from the critical mathematics education camp might claim this is mere sentiment; however, the two possible claims of a socio-political or critical mathematics education, either the strong claim 2) or even the weaker claim 1), are not much easier to support. This is partly the case exactly because the stronger claim, namely, that mathematics education has a privileged position to deal with social issues, is lurking behind the weaker and superficially more acceptable claim. The problem has to do with the *priority* supporters of critical mathematics education want to give these matters of empowerment and social justice, especially when there are other disciplines—political science, economics, history, etc.—that may be better suited to investigate them. Leaving one's identity as a mathematics educator aside, one might decide, and not unjustly, that social issues are of supreme importance. But it does not follow that when I do put on my mathematics educator's cap I am obliged to dedicate my efforts to such issues as opposed to functions, algebra, and geometry, unless and only unless, my training and role as a mathematics educator makes me especially fit to do so.

If, however, one allows political aspects of mathematics education to be circumscribed, that is, if one recognizes that socio-political theories can be theories *for* mathematics education and that social justice can be considered *part* of the content mathematics education, even of mathematics, then the question we ask is different. Indeed, it becomes part of a much broader question, namely, how can very different kinds of theories constitute a theory of mathematics education? This is the topic of several of the papers that I have placed in the category of theories *of* mathematics education, in particular, in Stephen Lerman's, "Theories of Mathematics Education: Is Plurality a Problem?" and in the three papers on Networking of Theories.

The question is a subtle one for there are many ways in which theories can come together in a body of knowledge or function together in a discipline. Lerman, for example, discusses Basil Bernstein's distinctions between vertical (hierarchical) and horizontal knowledge structures (both examples of what Bernstein confusingly calls vertical discourse). These distinctions, in Bernstein's own words, are between a form of knowledge that "...attempts to create very general propositions and theories, which integrate knowledge at lower levels, and in this way shows underlying uniformities across an expanding range of apparently different phenomena," as in the physical sciences, and a form of knowledge that "...consists of a series of specialised languages with specialised modes of interrogation and criteria for the construction and circulations of texts" (Bernstein, 1999, p.162) such as in the humanities and social sciences and, interestingly enough, mathematics. The distinction speaks directly to a central problem raised right at the beginning of the book in Sriraman and English's opening essay, namely, whether mathematics education in its ultimate fulfillment would comprise a single, consistent, and all-encompassing "grand theory" or an amalgam of "borrowed" or "home-grown" theories, a plurality of theories *for* and *in* mathematics education. Lerman's paper together with those of Bikner-Ahsbahs, Prediger, Jungwirth, and Gellert present us, in this light, with proposals for a kind of theory of theories, and it may be that it is this that we most need in looking for a theory *of* mathematics education.

But why are we so interested in theories altogether? We can answer this as Tommy Dreyfus does in his preface to the section on "networking of theories":

> One role of theory is to give the research study a framework within which data can be interpreted and arguments leading from the interpreted data to conclusions can be set forth. Without a theoretical framework, the interpretation of data ... becomes arbitrary and arguments may become difficult to both, make and follow (p.479).

And this is true, Dreyfus continues, even if researchers are using a theoretical framework tacitly or unwittingly:

> While we may occasionally see research reports without an explicit theoretical framework, this is not an indication that no such framework was used, though it may be an indication that the authors were not aware that they were using a framework implicitly, a framework that thus

> remained hidden not only from the readers but even [from] the researchers themselves (p.479)

The last, especially, gives one the feeling of a Kuhnian paradigm, according to which even observation, even the "objective" data, becomes theory-laden (see, for example, Kuhn 1970, pp.111-135). With that, one could argue that we must be interested in theory because whether we are conscious of it or not, whether we like it or not, theory is driving our research agendas, methods, and questions.

Yet there is something not quite satisfying about that argument. For we have to ask *which* theory we are speaking of. And that brings us right back to problem of the plurality of theories. For with so many theories, and, more importantly, so many *kinds* of theories that can be called upon to treat the questions that interest us in mathematics education—theories *for*, theories *in*, and even theories *of* mathematics education—viewed from the outside it might appear as if there were no theory at all or perhaps only theories *ad hoc*. We do not appear to be anything like a "normal science," to use Kuhn's famous phrase, where we know what we are supposed to ask and what we are supposed to do. Nor do we appear to be getting anywhere nearer to being a "normal science": I am not sure we can sanguinely share in Bob Davis's confidence when he wrote way back in 1992, "Things are beginning to come together" (Davis, 1992, p.225). Things today seem to be as far apart as ever. Do we then have a different answer to the question why we are so interested in theories? Is it because, maybe, we are worried that we may not be a proper, let alone normal, science? For proper sciences have theories, don't they?

One idea that comes in and out of the discussion is that of theory in mathematics education is a kind of *bricolage* and the researcher as a *bricoleur*. This idea originating in the anthropological work of Lévi-Strauss and introduced into mathematics education by Gravemeijer and then again by Paul Cobb and Frank Lester (in the essay republished in this volume) refers to the patching together of something new from available materials: in our case, to draw on a diverse set of existing theories to produce theories of our own addressing our own peculiar research problems. The idea while spoken about in the community does not seem to have received resounding acceptance. No doubt this is because *bricolage* is really a kind of demission of theory; a theory of mathematics education based on the idea suggests that mathematics education lacks a coherent core. In effect, then, it threatens the identity of mathematics education as a proper science. In this regard, Gellert hits the mark when he writes in his paper:

> The notion "theorizing as bricolage" has some oxymoronic quality and counteracts many researchers' attempts to develop coherent theoretical frameworks that overcome the lack of satisfaction with the theoretical tools available. The bricoleur takes whatever tool is at hand; the researcher constructs the optimal tool for the very research purpose. The criterion of optimality is precisely what is at stake when the quality of research is evaluated. *Bricolage as a way of theorizing abdicates the theorizer from her scientific responsibility as it extracts the research from principled evaluation* (p.539, my emphasis).

And of course "principled evaluation" is exactly what one expects from a "normal science," for it is such principles the governing paradigm is supposed to provide.

On the other hand, when Kuhn used the phrase "normal science" his point was it is normal only while it lasts: the methods, principles for evaluation, research aims of a science are never final and copper-bottomed. Therefore, science itself and what it means to be scientific are not as absolute as one might hope. Kuhn's work, despite the many objections to it, certainly made a strong case for this. And then we have Feyerabend who made a career of the non-absoluteness non-universality of science, calling science *anarchic* (see Feyerabend, 1988). To go back then, our interest in theory is wrapped up in our interest in being a science, and neither, at least in the case of mathematics education, appears to be very sure.

Forgetting the prestige that comes with being an objective science (and the strong arguments for funding that comes with that!), our desire to be a science with coherent theories runs very deep in our post-17th century mindset and our sense as to what it means to be a valuable inquiry. And "value," I might add is another word that flits in and out of the pages of this volume. We place great value on our inquiries being certain, objective, and methodologically sound; we hardly give a second thought in identifying *scientia*, knowledge, with science. Stephen Toulmin (e.g. Toulmin, 1990) has discussed at great length how far this value is rooted in the early modern rationalism especially of Descartes and in the spirit of Descartes—and, moreover, that this perspective is hardly self-evident.[1] And that goes not only for its basic philosophical presuppositions but, most of all, also for the particular tendencies associated with them: a preference for the written over the oral, the universal over the particular, the general over the local, the timeless over the timely, and in general, a penchant for the *theoretical* over the *practical* (see Toulmin, 1990, pp. 30-34, 186-189). We might boast of practical accomplishments, but we do not like to have our science itself be called practical, which might also have something to do with the slight distaste one feels for researchers being categorized as *bicoleurs*. This "theory-centered" style of philosophizing, as Toulmin refers to it, stands opposed to different approach to knowledge, one aligned not with Descartes but with the humanism of Montaigne—Montaigne who loves the particular and the local, who knows the theories of others intimately but does not settle on anyone of them, and who, though writing in his tower, writes as though he is conversing.

Perhaps, we too should consider relaxing our desire for theory, even one that proceeds from bricolage, let alone one with an all-encompassing rational framework. But what would mathematics education look like were it to follow Montaigne rather than Descartes? We could say only that it would be more modest, though modest *because* it had the strength to resist the seductive power of modernity, a power that Toulmin describes as laying "...in its abstract neatness and theoretical simplicity," and which, he adds, "...blinded the successors of Descartes to the unavoidable complexities of concrete human experience" (Toulmin, 1990, p.201). But to be more concrete, it might look a little like Sriraman and English's book. And here right at the end of this essay, I should say something about the form of this book. As I said at the start, Sriraman and English provided the work with a design that emphasizes questions. It does not always do this by

[1] Toulmin's ideas are not quite as extreme but certainly run in the same direction as Richard Rorty's, particularly those in Rorty's 1979 book *Philosophy and the Mirror of Nature*, as Toulmin freely admits. That said, his thoughts about modernity are clearly a culmination of Toulmin's early writings, even for example, those about argumentation.

asking questions explicitly however. Rather, creates this questioning atmosphere by including after almost every paper a commentary, and the commentaries are not necessarily complimentary: they are often quite critical of the paper they comment upon. Some of these commentaries are quite substantial, some are brief; there are some papers that have as many as three commentaries (Lesh and Sriraman's paper on mathematics education as a design science and Jacobs' paper on feminist pedagogy and mathematics), and one that has none (Hegedus' paper on *scientificity* in qualitative research); some of the commentators are also authors of main papers, some are not. There is a certain unevenness in the presentation, as another reviewer of the work pointed out (Jankvist, in press); however, it is just that unevenness that gives the reader a sense of an ongoing conversation, with some voices speaking at length, some short and critical, some sure, some tentative. What the book as a whole presents is a picture not so much of a community that puts together a theory of mathematics education or theories of mathematics education, but one that discusses theories, that can live among ideas.

This could be framed as an aim for mathematics education. Instead of speaking of "theories of," we might speak of "discussions of mathematics education." And keeping in mind that a discussion can be good, bad, deep, superficial, enlightening, and so on, calling what we do the "production of discussions" would not release us from criteria of quality or even rigor. This is because what we would look for in such a discussion is not really new empirical findings, though we might bring them into the conversation, but depth, a probing clarification of our ideas and, yes, our values. In this regard, Sriraman and English's *Theories of Mathematics Education*, in its very bulk and occasional disorderliness makes a real contribution to the discussion of our ideas. And if this itself constitutes a theory of mathematics education, then it presents a theory that this reviewer at least could very easily live with.

References

Bernstein, B. (1999).Vertical and Horizontal Discourse: An Essay. *British Journal of Sociology of Education, 20*(2), 157-173.

Davis, R. B. (1992). Understanding "Understanding." *Journal of Mathematical Behavior, 11*, 225-241.

Eisenberg, T. & Fried, Michael N. (2009). Dialogue on Mathematics Education: Two Points of View on the State of the Art. *Zentralblatt für Didaktik der Mathematik 41*(1), 143-150.

Feyerabend, P. (1988). *Against Method*. London: Verso

Jankvist, U. (in press). Theories of Mathematics Education edited by Bharath Sriraman and Lyn English: Common Ground for Scholars and Scholars in the Making. *MathematicAL Thinking and Learning*.

Kuhn, T. (1970). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Menghini, M., Furinghetti, F., Giacardi, L. and Azarello, F. (eds.) (2008) *The First Century of the International Commission on Mathematical Instruction (1908-2008):*

Reflecting and Shaping the World of Mathematics Education. Rome: Instituto della Enciclopedia Italiana.

Toulmin, S. (1990) *Cosmopolis: The Hidden Agenda of Modernity*. Chicago: The University of Chicago Press.