

Chapter 2

Re-searching Methods in Educational Research: A Transdisciplinary Approach

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Academic educational research has been criticized for its inability to address the most intractable problems of public education. While critics point to the lack of impact educational research has had on policy and practice as evidence that the problem lies in a commitment of educational researchers to make a difference in the real context of schools, there is a more fundamental flaw with our ability to conduct meaningful educational research that requires a shift in our thinking about the goals and practices of educational research.

As a dean, I was always defending my faculty to policy makers and community leaders because they wanted to see research that was site based, scalable, and relevant to schools, practitioners, and policy makers. Even as I described some of the really outstanding research my faculty was doing and many of the innovations in which they were involved, community leaders felt the research being done was too “ivory tower” and not grounded in the real world.

This disconnect between the educational research being done by my faculty and the expectations of policy makers for definitive answers to significant challenges in education goes beyond a difference in purposes and goals of educational research. I know my faculty wanted to make a difference in the real context of schools. They wanted to impact and shape the future of education in positive ways. The disconnect points to the need for educational research to catalyze and sustain change in educational contexts. The drive to relevancy, however, does not require all educational research to be field based or empirical. The relevancy comes from a system of research, not separate research studies, that informs practice, promotes change, and makes a difference in meeting the goals of education.

This paper is an attempt to bridge the policy-researcher expectations gap by presenting a systems perspective of education research that addresses the

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complexities of educational contexts, scalability of innovation, and sustained change. Interrogating the questions we pose and the research methods we employ supports a systems view of research that includes transdisciplinary application of complexity sciences approaches to educational research.

A systems perspective of educational research engages the “re” in research by creating a system of inquiry that is layered, recursive, self-reflexive, and conversational (interconnected). This multidimensional approach of re-searching involves a dynamic interplay across contexts, inquiry, and modes of inquiry. This re-searching process requires what Wittgenstein (1953) would refer to as a change in aspect (Fleener, 2002), specifically in this case, what Ton Jörg refers to as “thinking in complexity” (Jörg, 2011). Building on Morin’s notions of complex thought and method, this approach advocates for a more complex understanding of educational research as a system of re-searching. From the questions we ask to the methods we employ, our ability to address the challenges of education requires a system of research/inquiry that “reconnects that which is disjointed and compartmentalized” (Montuori, 2008, p. vii) and layers research and innovation across contexts and scales (Coburn, 2003).

The Question of Questions

The first issue of re-search is thinking about the kinds of questions that are asked. We have all experienced the unending litany of “why’s” from an inquisitive 5 year old. While we may ultimately end this type of recursive questioning with “because I said so,” the profundity of the child’s inquiry is shaping their world. Before we ever approach the “how” or “what” of research, we first need to question the “why” (Fleener, 2002, 2004).

Sometimes in exploring the “why” we discover even deeper questions that become even more central to the problems at hand. Reaching a point of impasse, as with the 5 year old, we are forced to create new solutions to our problems (or at least acknowledge defeat!). The biologist Humberto Maturana tells the story of problematizing the meaning of life as a pivotal point in his ultimate creation of the notion of “autopoiesis” or “self-creation” as a way to think about living systems (Maturana, 1980). As he explored attempts to answer the question “what is life” he discovered both internal and external contradictions with the approaches. Either attempts to answer the question would enumerate all of the characteristics of living systems, reaching a point where an artificial line ends up being drawn, or, as the list continues to be enumerated ad infinitum, the distinction between living systems and nonliving systems starts to become blurred. In either case, the ultimate answer to the question of a definition of life seemed to suggest we already knew the answer! The “why” that problematized assumptions (about the meaning of life) also exposed our limitations in understanding (of life) and opened up entirely new avenues of exploration. Maturana and his student Francisco Varela created a notion of life that was self-reflective, self-reflexive, and self-generating. The “why” problematizes our thinking, allowing us to escape hidden assumptions and create new ways of thinking about problems in more complex ways.

There is another aspect of the “why” that is important in educational contexts. Sometimes we forget to provide opportunities for our students to interrogate their learning to open up new possibilities and engage them in expanding their world and their place in it. As an example, from my experience in teaching computer programming, I had one of those “take back” moments where I wished I had been more prescient about the kinds of questions computers can and cannot solve and more open to the possibilities of computer intelligence. The standard curricula for teaching introductory computer science detailed beginning programming instruction with definitions of an algorithm. I would assign students homework to define their algorithms for getting ready for school, preparing a meal, or going on a trip to initiate discussion in class about computer algorithms. I would lead discussions to probe students to think about what kinds of problems computers can solve and, importantly, not solve. Computers, we would decide, cannot solve complex problems that require intuition and insight. Computers need clear algorithms as step-by-step procedures, we decided, per the curriculum. Problems like war, poverty, and discrimination were not problems for the computer!

These discussions with my computer science students were occurring at the same time as an entirely new kind of mathematics was being developed. It was not until 1975 that Benoit Mandelbrot invented the word “fractal” to describe patterned relationships that embody unpredictability, indeterminacy, and “chaos” (Gleick, 1987). The next year, Kenneth Appel and Wolfgang Haken solved the four color problem using computers, raising issues of a new kind of computer intelligence and proof based on recursive problem solving and the ability to perform more calculations than a single human could in a lifetime. And just 13 years earlier, Lorenz developed analytic modeling tools that proved weather was not predictable beyond a few days and logistic functions provided new insights into unfolding patterns in chaotic systems (Gleick, 1987). These and other twentieth century scientific pioneers invented new approaches to inquiry that embraced rather than attempted to control for ambiguity and complexity, exploring patterned emergence, reorganization, and complex dynamics.

By failing to complexify the re-searching of educational problems, we also pass on our unexamined assumptions to our graduate students, the next generation of educational researchers. We tell our graduate students they must have clearly definable terms and constructs with answerable questions. As we probe their thinking about key constructs, we encourage them to go to the literature to find definitions of terms like “learning,” “problem solving,” and “knowing” that they can use. These very constructs, when pushed to their limits, invite multilayered discourse across multiple domains of inquiry including cybernetics, philosophy, sociology, anthropology, and the learning sciences. Too often, we fail to invite this complicated conversation across inquiry domains because we perceive the questions too irrelevant to educational contexts or the methods out of reach.

Complexifying our questioning exposes connections and relationships across intellectual domains and opens up the possibilities for new ways of thinking about problems. We have seen this process ebb, flow, and progress throughout the twentieth century in the sciences, for example, when Einstein first proposed the

general theory of relativity (1915), the Copenhagen Conference debated the nature of quanta (1928), Gödel proved the incompleteness of mathematics (1931), the Macy Conferences (1944–1954) developed interdisciplinary approaches to study systems and invented the field of cybernetics (Umpleby & Dent, 1999), and the 1984 convening of physicists and economists in Santa Fe explored transdisciplinary approaches (Morin, 2008) and invented complexity research (Waldrop, 1992). This list of great twentieth century scientists and convenings, of course, is incomplete, as there are many pioneers who have shaped our understandings by interrogating the questions they were asking and looking outside of traditional boundaries to address significant problems in their fields.

Complexifying questions can often lead to the core of a problem, helping us arrive at a point where we have to reach outside traditional boundaries of thought. As we complexify educational research, we challenge the kinds of questions we might pose and need to extend our methods to include approaches to inquiry that address the inherent complexity of education as a social system. Education is also an important social system that impacts and shapes the vitality of any society. Educational innovation and reform, as an example, have their own set of implicit and explicit goals and assumptions that constrain how our work is done in schools (Hatch, 1998). Questions about curriculum, teaching, teacher preparation and development, school leadership, school organization, and so on, create a metaphorical Tower of Babel like scenario for educational researchers. To overcome the challenges to educational research, we need to interrogate our own “why” questions to understand how all of these different pieces of the educational research landscape come together, not as a puzzle that, when completed creates a clear picture, but as an ecosystem that is multidimensional, dynamic and is best understood by a systems approach examining all of its dynamic elements and interactions. And, as we interrogate our “why” questions of educational research, we open possibilities for complicated conversations across educational contexts and inquiry domains, efforts more likely to respond to and engage stakeholders.

The “Why” of Educational Research

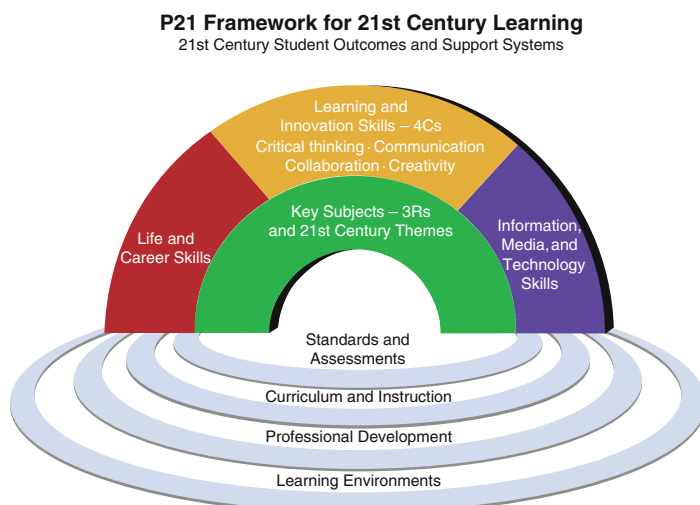
I recall, as an early career teacher, I engaged in strategic planning at my school. We were asked to define the purpose of education and our goals for student outcomes. We debated issues of college and career readiness, the role prepared students would play in the future of society, the need for students to be lifelong learners, and the hope that students would become lovers of learning. Fortunately, these pre-No Child Left Behind (NCLB) discussions and requirements did not have to address the assessment and accountability challenges.

Regardless of where we stand on assessment and accountability, to meet the dynamic challenges of this mandate for universal and equitable education for all, educational research needs to be focused on studying and transforming how we prepare the next generation of thinkers and doers. This is a multidimensional

challenge, as curriculum, instruction, learning theory, problem solving, teacher preparation, and all the rest are factors in ultimate student success for the future. If we can agree (and, of course, I invite thoughtful interrogation of this idea) that preparing students as the next generation of thinkers and doers is a fundamental purpose of education and therefore the central focus of educational research, if this is, indeed, the “why” of education and educational research, what are the “what’s” and “how’s” of educational research? These are the questions of methods.

Before transitioning to the question of methods, however, we need to tease out the “why” of education a bit more. What does it mean to be prepared for the future in our current societal context? Many States and school systems across the USA, as well as most state departments of education have some set of skills and competencies defined as twenty-first century learning, skills and dispositions for students upon which curriculum and instruction should be based. Although assessments are lagging behind these ideas of twenty-first century learners for which there is some overall acceptance, it is clear that, as a society, we recognize “reading, writing and ’rithmetic” are not sufficient and that unquestioned memorization will not prepare students of the future to be creative problem solvers, inventors, and adaptors in a world that is rapidly changing, technologically evolving, and economically globally intertwined.

The Framework for Twenty-First Century Learning developed by the P21 Partnership, the Partnership for Twenty-First Century Learning, is used by many states in the USA and provides a perspective of the purpose and goals of education (see Fig. 2.1). As seen in the figure below, the P21 (2009) emphasizes **Life and Career Skills** (including flexibility, adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and



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Fig. 2.1 Partnership for twenty-first century learning framework for twenty-first century learning

responsibility), **Information, Media, and Technology Skills** (including the ability to access, evaluate, and use information creatively to solve problems and share new understandings), **Learning and Innovation Skills** (including critical thinking, communication, collaboration, and creativity), and **subject matter knowledge** framed within **twenty-first century themes** (that include global awareness, financial, economic, business, and entrepreneurial literacy, civic literacy, health literacy, and environmental literacy).

Participating in a variety of businesses, public and private partnerships, and task forces for rethinking teacher education, I have observed how complex the conversation becomes when twenty-first century learning skills, for which there is basic agreement, are considered through the lenses of standards, assessments, curriculum, instruction, teacher and principal qualifications and development, and alternative approaches to education. Within the Twenty-First Century Framework, the idea of these fundamental supports for student learning as “pools of connectivity” provides a scaffold for educational research. From a complexity perspective, these “pools of connectivity” suggest a systems approach to educational research, what Bateson (1972, 1979) would refer to as ecologies of knowing.

Bateson’s notion of “schismogenesis” describes a process of inquiry through progressive differentiation, literally, “the birth of separation.” As described by Jewett (2005), Bateson’s application of schismogenesis in and over time revolutionized anthropological methods, placing, distancing, and re-placing the researcher within the context of the researched as both are subject to recursive scrutiny. The unfolding of research is a re-searching process that creates its own system subject to continually renewed inquiry, connectedness across contexts and time, and patterned emergence. The layering of contexts, symmetries, and differences provides an inquiry of the approaches to inquiry (recursively, an inquiry of inquiry approach), that complexifies and scaffolds research. Eschewing the goal of inquiry as final answers, this approach creates the opportunity for a “complicated conversation” across researchers and researched; a complicated conversation (Fleener, Carter, & Reeder, 2004; Lu, 2011) that is ongoing and transformative; re-search in its truest form as perpetual inquiry. The complicated conversation that is research as a system of inquiry embraces the ever-broadening and recursive understandings in concert.

Through this complex approach to inquiry, we have the opportunity to understand and to transform educational contexts in ways that invite revisiting and re-engaging the questions we explore while continually interrogating the “what’s” and “how’s” of educational research. This approach to inquiry is an approach that recognizes the recursive challenges of thinking about thinking. It invites an approach to research methodologies that is self-reflexive and dynamic. Such inquiry describes a questioning of questions and a method of methods whereby inquiry itself becomes part of that which is studied, adapted, and transformed.

By “complexifying” our methods to include these meta-loops of recursive inquiry, we open approaches to research that can engage in the “complicated conversation” of re-searching. Through “complexification” we create a “generative complexity” that recursively and dynamically interrogates method (see Jörg, 2011) and creates a system of research designed to address the “why’s” of education and expands the “what’s” and “how’s” of method.

Method of Methods

To interrogate the method of methods, our first step is to consider the limitations of traditional research methods. In his book, “Scientific Literacy and the Myth of the Scientific Method,” Henry Bauer (1994) describes the dangers of applying the scientific method to social sciences research. Abstracting the researcher from the researched, and applying methods that assume objectivity and rationality are impossible in social science research, he argues, not only because of the reality and messiness of contexts, but because the notion of pure science, itself, is a myth. The “knowledge filter” of scientific inquiry, in an attempt to eliminate bias, subjectivity, and error removes the researcher-as-participant in the process; a human who has hunches, insights, makes mistakes, and disavows the role context and the researcher play in human discovery. This is not to say scientific research methodologies are worthless in educational contexts, nor that the scientific method cannot be applied to the social sciences, but, he warns, we need to engage in “reality therapy” that continually investigates our methods and our results. He intuitively describes what Morin describes as the musical complexity of research, “construction in movement that transforms in its very movement the constitutive elements that form it” (Quoted by Montuori, 2008, p. vii).

To play, a bit, with this notion of musical complexity, one comes to understand a musical ensemble as both skilled application of musical technique and improvisation that captures the unique context of the moment (Forehand, 2005). The dance of the musical ensemble is one that continually plays off of structure and interpretation, form and function, global and emerging patterns, and recursive dynamics. The ensemble metaphor used in the context of our exploration of the method of methods validates the importance of traditional attempts to address objectivity, consistent application of methods, and clearly articulated goals. These are the backbones of inquiry. But our meta-method must also engage the improvisation, the differences that make a difference, the layers of complexity, the role of the researcher within the researched, and the complicated conversation that connects and reconnects across contexts, methods, and researchers. The musical ensemble is the system of the performance and multiple playings that become the complicated conversation of the arts.

The method of Cartesian doubt as the basis of modern inquiry and the culture of method (Doll, 2005) needs to be interrogated as its own limitations and boundaries become a part of the complicated conversation of research. The researched and researcher are within their own transformational dance that changes both through the process. By developing a culture of method that is open to possibilities and fearless in the face of ambiguity, uncertainty, and complexity, we have the opportunity to create an approach to methods that is multilayered, patterned, relational and connected. Such a method of methods allows for networked knowing across dimensions with intersections at key nodes of purpose to create a system of interrogation that solves complex, real-world problems in the context of education. As a system, the method of methods based on a culture of method that embraces

complexity becomes an autopoietic system (Maturana & Varela, 1980) itself, a dynamic system much greater than a mere depository of discrete knowledge “chunks.”

The culture of method that invites the complicated conversation of educational research also opens up the possibility of using methods designed to explore complex dynamics and the evolution of systems. Engaging research methodologies from the complexity sciences extends the capabilities to engage in the messiness of educational contexts and address issues of scale, complexity, and dynamics.

Edgar Morin (2008) advocates a transdisciplinary approach in educational research to avoid the pitfalls of unquestioning assumptions of method. Transdisciplinarity is driven not by methods, *per se*, not by “problem solving in the context of the agenda of a specific discipline . . . not in attempts to create abstract theoretical frameworks, or to further the agenda of a new discipline, but in the need to find knowledge that is pertinent for the human quest to understand and make sense of lived experience, and of the ‘big questions’” (as quoted by Montuori, 2008, p. xii). Morin, as described by Montuori (2008), distinguishes interdisciplinary approaches whereby “methods of one discipline (are used) to inform another” from transdisciplinary research which “draws on multiple disciplines while actually challenging the disciplinary organization of knowledge,” avoiding the pitfalls of “reductive/disjunctive way of thinking that makes up what Morin was to call the ‘paradigm of simplicity’” (Montuori, 2008, p. xxi). Transdisciplinary approaches to research, according to Montuori (2005), are inquiry driven, meta-paradigmatic, connected, contextual, and transparent. These approaches are important for interrogating contexts that are complex and creating a system of inquiry that has the capacity to interrogate itself. Applying approaches to research developed in the complexity sciences is supported by the culture of transdisciplinary method, providing opportunity for the complicated conversation guided by Bateson’s schismogenesis, and opening up inquiry to what Pierce referred to as the world of the probable (Truett, 2005) where knowledge is incomplete and open to infinite inquiry.

Re-searching the Culture of Method

As we think of educational research from this complex learning systems perspective and begin to engage a culture of method that is open to transdisciplinarity, we begin to see a layered or dimensional approach to the “what’s” and “how’s” of research. Educational research, as a system, then, engages the “why’s” of education through a dynamic process, driven by the “why” of educational research, namely, to support the educational agenda.

Re-searching the questions of education interrogates and connects layers of complexity in educational contexts. Questions of curriculum, class size, uses of technology, and models of education (charters, magnets, autonomous networks, and traditional) have policy implications for funding that shape the educational experience and the future of society, at one dimension, and directly impacts students in a

particular classroom in a particular context, at another dimension. Questions of teacher evaluation, teacher effectiveness, teacher preparation, teacher professional development, and teacher credentialing similarly shape the educational context across multiple dimensions of the educational landscape. The role of technology in education opens a series of questions that challenges across dimensions curricular decisions, educational organization, the role of the teacher, class size, and equity, among others.

Re-searching the culture of method engages a method of methods process that scales educational inquiry across contexts, psychic and social domains, and intellectual disciplines. The problem of scaling research to address the complex questions of education is similar to the challenge of scaling innovation in education. Cynthia Coburn (2003) describes a scale research framework for addressing the need for and challenges of studying education innovation across settings that is useful for framing educational research as a whole. Making educational research relevant for the real context of schools requires a system of research as a whole that provides useful information for teachers, administrators, policy makers, and community leaders in the same way that scale research of education innovation considers the multiple dimensions of implementation innovation that include “depth, sustainability, spread, and shift in reform ownership” (p. 4).

Deep change in instructional innovation, according to Coburn (2003), is multi-layered and impacts practices, beliefs, classroom norms and values. Studies of classroom implementation of instructional reforms need to explore the depth of implementation and, therefore, these various dimensions of change. From a research perspective, depth of research includes research across the many dimensions of the implementation process. Implementation dynamics are both across time and across settings.

Sustainability of reform extends the question of depth of implementation to understand change over time and across implementation sites (Freeman, Corn, Bryant, & Faber, 2015). Clarke and Dede (2009) describe the challenges of scaling innovation when moving from the pilot phase, where additional resources and support are available, to replication of innovation at other sites. The same challenges exist for initial implementation sites as these resources are removed. Just as with sustainability of innovation, educational research needs to recursively reconnect research across contexts and time. Sustainability avoids the pendulum swings of innovation resulting from the lack of sustainable processes and resources being put in place after the initial innovation is tested. Beyond the sustainability of resources, however, Coburn (2003) describes that sustainability ultimately requires new ways of thinking, valuing, and interacting across multiple levels of the educational enterprise. This is apparent in diffusion of innovation studies where new technologies may be applied to classroom instruction, for example, but thinking about what it means to know in the context of a technology rich environment does not change and technology use is reduced to rote practice or enrichment of traditional instruction (Fleener, 1995).

The spread of educational reform is another dimension of innovation in education discussed by Coburn (2003) that considers how whole school contexts or

district policies change to accommodate and support innovation. Policies and decisions that support change, including demonstrated values about where funds are allocated, decisions about professional development, and peer mentoring across classroom implementation of reform, reflect that deep change to the system has occurred. Sustaining and scaling innovation requires more than replication; it requires whole system commitment. Scaffolding research similarly requires spread from the perspective of policy changes and changes in school operations. We have seen, for example, how a few teachers using the Flipped Classroom approach (McCammon, 2011) to mathematics instruction ultimately influenced the entire school mathematics department to adopt Flipped classroom approaches. The principal's role in the spread of this innovation was instrumental in its success.

As educational innovations are scaled, we have already seen how replication is not sufficient to ensure significant change has occurred. Another dimension of the application of innovation is when practices, policies, and understandings are "owned" locally by those implementing the innovation. Adoption of innovation ultimately requires contextual adaptation and local ownership that creates a system of support for the innovation. Until our research can inform and change practice and those who change adopt the changes as their own, we have not had a true impact on schools.

Understanding education innovation and reform from the perspectives of depth, sustainability, spread, and shift in ownership requires inquiry over time and across many dimensions of the educational context. If we place these parameters for investigating success of educational reform efforts, or the implementation of innovation in educational settings, as focal points for organizing inquiry, we begin to see the complexity of research across domains and scales of educational contexts. Individual learners, teacher expertise, administrative commitment, redistribution of resources, changing beliefs about teaching and learning, and policy impact are just some of the dimensions of interconnectedness required for re-searching and impacting educational change.

Making a Difference Through Educational Research

The graphic below (Fig. 2.2) attempts to capture the layered and dimensional aspects of a system of educational research that is self-reflective, dynamic, and adaptive through time. Coherence is what gives the system identity, in this case, as the body of educational research. Within the dimensions of inquiry, transdisciplinary approaches are important to maintain system openness with intellectual domains and practices relevant to the complex social system that is education. Inquiry driven research ensures the "why's" of research are grounded in real problems of education. Relevance of individual research studies is layered across dimensions as part of the interrogation of the why's, what's, and how's of the research, adapting research findings to differing contexts. As a coherent system, divisions across methodologies are erased as all research is entered into the

Framework for Coherence



Fig. 2.2 A systems perspective of educational research

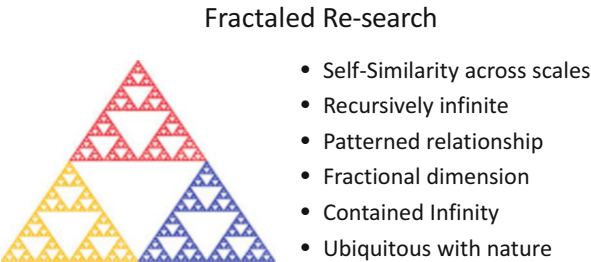


Fig. 2.3 Sierpinski triangle

complicated conversation of the purpose of education and change occurs through the complex approach of scaling.

For those who understand how fractals are created (or even the Ying and Yang of Eastern thought), the coherence of a system of educational research that is open, relational, recursive, and dynamic can also be represented by the Sierpinski triangle, depicted in Fig. 2.3 (Wikimedia Commons, 2015). Here, we see infinite layers of complexity within a defined space; the recursive process of the re-search approach, and scaffolding research across scales and contexts. Fractals, with the characteristics listed below, disrupt ideas about dimensionality, introducing the notion of fractional dimensions. Found in nature, fractals describe amazing complexity within finite spaces. The average size of human lungs, for example, has the surface area approximating the size of a tennis court (Gleick, 1987). This would not be possible were it not for the fractal relationships constituting the lungs.

We can imagine that at different levels of the Sierpinski triangle, R1–R3 reside as a framework for re-search that is ever present at all scale dimensions. The repeating patterns of the fractal suggest a local and global “intelligence” of the system where, in our case, the dimensions of research are ever present. And finally, the coherence of this system of research ensures relevance and connection to the real-world context of schools.

So what does this mean for schools, policy makers, community leaders, and educators who look to educational research for answers to preparing students for the twenty-first century? To our stakeholders, we are obliged to articulate the grounding of our research in the “why’s” that matter to them; to engage them in the recursive “why” process to come to common understandings about the purposes of our research; and to change our own ideas about the role educational research should play in educational reform.

As we utilize transdisciplinary approaches to our research, there is another layering of complexity as our research methods engage in the complicated conversation across disciplines about the nature of knowing and knowledge. The patterns that connect across disciplines reveal important insights for knowing that have the potential to change ways of thinking, continuing the recursive process of inquiry to inform social understandings across social system domains.

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