

The sociocultural turn in science education and its transformative potential

When Springer Publishing agreed to create Cultural Studies of Science Education (CSSE), Wolff-Michael Roth and I successfully argued there was a pressing need for a science education journal to provide an alternative to mainstream fare. We considered the major science education journals to be much the same as one another; four or five journals differing mainly in terms of relative prestige, but publishing similar material. We made the case for a different type of journal to publish scholarly articles that would provide a concentration of research that utilized sociocultural frameworks, thereby expanding access, visibility, and legitimacy to research with a sociocultural orientation and positively impacting the status of a marginal strand of science education. In approximately a decade since the journal began to accept manuscripts more than 1,000 pages per year have been published in CSSE. These publications highlighted difference as a resource for learning within a spectrum of sociocultural theories and are reflective of editorial policies and intended practices to enhance the quality of research and avoid many of the ambiguities and contradictions associated with publishing work in mainstream journals. The availability of CSSE as a journal that requires publications to address sociocultural theory explicitly has expanded and concentrated literature in this focus area. Notably, CSSE's presence has not prevented science educators with a sociocultural orientation from publishing their work in high-impact journals such as the *Journal of Research in Science Teaching* and *Science Education*.

A sociocultural turn in science education

It comes as no surprise to science educators that theories change the way we experience the world. Knowledge of science can certainly add to the aesthetics of everyday life as evidenced in activities such as gazing at the sky on a clear night, walking on the beach at dusk, and recording a video with the latest iPhone. As our expertise grows in a field we are privy to an expanding repertoire of interpretive frames for being in the world. Learning other discourses enriches our experience of new phenomena and provides alternative insights i.e., making the strange familiar and the familiar strange. In this context I address some of the sociocultural perspectives I have employed in my research in the past 20 years as affordances for experiencing, describing and researching the landscape of science education.

Polysemia is a powerful construct that acknowledges people's social positioning in the world as primary frames for what is regarded as socially true. Having accepted a polysemic stance it behooves us not to judge from outside a framework, but to endeavor to step inside to understand what is happening and why it is happening from the perspectives of an insider – that is, to adopt an emic perspective. Being a science educator from the early 1960s until now has given me an inside seat into ways in which mainstream perspectives of what counts as science have marginalized many discourses, which are often regarded as nonscientific (e.g., indigenous knowledges). In this way, the domain of science education can be impoverished and may not connect with everyday life experiences of important stakeholders. As we face grand challenges associated with issues such as sustainability and wellness the question of what counts as science education has never been more important. Adopting a polysemic stance, there are

advantages in thinking about science broadly, looking at other discourses from the perspective of what they afford; how they can open up possibilities for science education and thereby enhance the quality of life. By expanding the vision of what counts as science education, roles of science educators can be enhanced, increasing possibilities to connect in important ways to problems faced by humanity, other species, and better understanding networks of social relationships that can sustain and nourish a fertile and hospitable universe.

In search of interpretive frameworks

My research focus from 1973 onwards was on the quality of science teaching and related challenges associated with becoming an effective science teacher i.e., learning to teach. I searched for theories to illuminate teaching and learning in classrooms and for research designs that allowed researchers to study educational problems that were meaningful to those with the highest stakes in education. Unless meaningful research could be undertaken it seemed pointless to do it. Accordingly, my first study in science education began a quest to identify and use powerful theories that would make a difference to the practice of science education. The search began with Piaget (1964), researching psychological models to probe how teaching could enhance learning, taking account of differences in students' formal reasoning ability. The models were interesting, especially as they became more complex. After all, teaching and learning of science are complicated processes. However, there were many dissatisfiers associated with pervasive, ever-present, tenets of positivism that saturated the common sense of doing research. These included, but certainly are not limited to, the reductionism of parsimony, tightly defining variables, testing a-priori hypotheses, and assuming independence of learning from the social milieu. Assumptions such as these were contrary to my experience as a teacher and hence, from the beginning, I looked for ways to complexify my research. Initially this was done through the use of increasingly more sophisticated statistical models.

The positivistic models that provided a foundation for my process-product research in my first decade of research (i.e., from 1973) were oversimplified; reductive, and assumed that learning could somehow be accomplished independently of others. Furthermore, assumptions made to justify the use of inferential statistics and associated statistical generalizability could not be accomplished and arguments to the effect that violations of assumptions were insignificant were unconvincing (Tobin and Capie 1982). I was in search of new methodologies and theoretical frameworks to make sense of teaching and learning. The search for more appropriate frameworks was arduous, continuous, and unbounded – now spanning more than three decades (Tobin 2012). Even so, my experience is that positivism was, and still is, dominant – as crypto-positivism, which saturates what the mainstream regards as common sense, especially as it applies to research methodology (Kincheloe and Tobin 2009).

A less visible problem was the dominance of psychological models in educational research. My early studies assumed learning to be primarily an individual endeavor. Accordingly, the models I adopted examined relationships, for example, between the teacher and the student, as if participants were independent. What teachers did was assumed to be primarily due to their knowledge of teaching. Similarly, students were considered to learn science with the assistance of teachers, in a process of making sense of what teachers say and do, what they know already, and resolution of cognitive

conflicts en route to conceptual equilibrium. I struggled to identify and create models that regarded learning and teaching as social processes – involving more than individuals being in a social context. What was involved was an effort to understand and apply theories of Pierre Bourdieu (1992), Lev Vygotsky (1962) and Mikhail Bakhtin (1986). Within the science education fraternity new scholars, including Wolff-Michael Roth, William Cobern, and Angela Calabrese Barton were getting started and bringing with them a range of perspectives grounded in sociology (Roth 1995), anthropology (Cobern 1993), and social justice (Calabrese Barton 1998).

Studying social phenomena

Several theoretical rationale framed my ongoing research, including a methodology that was saturated with crypto-positivism and a theory of learning that reflected individual constructivism. Differences between frameworks raised contradictions, which became drivers of change, especially those that juxtaposed positivism and constructivism. I employed hermeneutic phenomenology and ethnomethodology as frameworks for interpretive research. At a crypto level my approach incorporated a Geertzian theory of culture (Geertz 1973), which was embedded in Frederick Erickson's interpretive methodology, and polysemia, which became a catalyst for ongoing change when I adopted the authenticity criteria from fourth-generation evaluation (Guba and Lincoln 1989). The criterion of ontological authenticity addressed polysemia and encouraged me to re-examine purposes of research and especially relative interests of different types of participant.

The quest for a scientific method and social theories that are universal, parsimonious, and empirically verifiable disallows many tenets that underpin my research. For example, we¹ regard difference as a resource for learning and a central characteristic of ways in which social life is experienced, whether it is in research, other aspects of professional life, or everyday life. Since we theorize contradictions as ever-present, a consistent aspect of our research is to search for contradictions and learn from them, thereby expanding what can be learned from the research (Tobin 2009a). Furthermore, rather than search for one social truth, we consider social life to be characterized by multiple truths, most phenomena being polysemous. Consistent with this view we accept positivistic research and seek to learn from it – ironically, those who embrace monosemia may not accept the legitimacy of research such as ours. Accordingly, research with a non-positivistic orientation might suffer in peer-review, can be ignored when it is published, and is likely to have less impact on policy and other aspects of professional education. Positivism has penetrated social life to such a degree that it saturates common sense arguments and supports oversimplified aspects/versions of scientism (Kincheloe and Tobin 2009).

Because of our research interest in the teaching and learning of science, the sociocultural turn in science education had impacted our thinking in the early 1980s. An emerging set of sociocultural theories that we employed in our research in urban education embraced a view of culture that was post-Bourdieuian (Sewell 2005). William

¹ I use the pronoun we from here on to acknowledge that my research and associated theorizing involved others – throughout my career. Obviously this extended far beyond publications and includes conversations of many genres (e.g., dialogue, argument, lecture).

Sewell Jr., a historian who grounded his work in cultural sociology, expanded the work of Pierre Bourdieu (1992) and Anthony Giddens (1990) to produce a multilogical framework we adapted for our research on learning to teach, and teaching and learning science (Tobin, Seiler and Elmesky 2005). Sewell explained how actors experience culture as schemas and practices that have thin coherence and ever-present contradictions. What this meant for us is that when culture is experienced there will always be patterns that can be observed along with contradictions to those patterns. That is, the contradictions provide nuance to descriptions of culture, and can be experienced by social actors as resistance.

Our focus on culture was associated with field – a social space in which culture was produced continuously in a dynamic structural flux consisting of symbolic, social, and material resources. In theorizing the urban context it was important to examine how culture from multiple fields provided resources for activity in a focal field such as science education. This theoretical interest pushed us to relate characteristics of electric, magnetic, and gravitational fields, in a metaphorical sense, to social fields. We began to see the desirability of fields being unbounded entities and field strength being related to the distance of social actors from the "center of mass" of a given field. In this way it became progressively clearer how resources associated with fields like the home, recreation, hobbies, and employment, for example, were salient to learning science. To some degree this brought into focus the importance of cultural and other forms of capital and the rich and continuous structural flux that flowed through fields.

The sociocultural methodologies we find most useful in social inquiry parse social life and associated experiences in terms of constructs we consider to be constituents of a whole. A dialectical relationship is assumed between the parts – i.e., each is recursively related, presupposes the existence of the other, does not exist independently of the others, and does not precede the others temporally. As constituents, dialectical components cannot be aggregated to stand for the whole, but instead under represent it (i.e., the whole always exceeds the sum of its parts). We use a Sheffer stroke between constructs to show a dialectical relationship (e.g., individual | collective). If more than two constructs are dialectically related we use the term multilectical to refer to the relationships between all possible pairs of the social constructs being considered (Fellner 2014). The incorporation of multilectics into our methodological framework made a big difference to the design and conduct of research. For example, the individual | collective relationship implies that anything associated with an individual is at the same time interconnected with the collective. That is, an individual's enactment of culture in a field must be considered along with collective enactment of culture in the same field. All cultural enactment is both individual and collective. Similarly, the self and other are dialectically related. From this perspective any property of self is dialectically interconnected with properties of non-self and other. Accordingly, a construct like identity can be considered dialectically in relation to salient features of non-self.

The dialectical way of thinking necessitates changes in how we plan and enact research, in all its phases. For example, what we learned from research could be expressed in terms of cultural production (i.e., enactment) and would necessarily include schemas and practices, all claims being represented in nuanced ways that describe culture in terms of patterns having thin coherence and contradictions that are ever-present. Furthermore, cultural production in social interactions reproduces culture while

transforming it (i.e., reproduction | transformation).

We regard knowing as cultural enactment, being experienced by social actors as schemas and practices, which are dialectically related (i.e., schemas | practices). By enacting reflexive practices, social actors become aware of aspects of their conduct that they may not have been aware of previously, creating possibilities for intentionally making changes for the purpose of improving the quality of social life. That is, exercising agency in a conscious, goal directed manner could change practices. New forms of culture can be enacted by appropriating structures, which are transformed in action. The enacted culture then becomes part of a dynamic flux of structures that are available to be appropriated by any of the participants in a field.

Agency, as a conscious process, can only account for part of continuous cultural production. As structures penetrate a field they produce culture in a non-agentic process in which production occurs continuously as actors participate with others in a field (Roth 2007). The process, described as passivity, is appropriated from the work of Emmanuel Lévinas (1999). Following Martin Heidegger (1996), we employ the mantra of "becoming like the other by being in with," incorporating the idea of learning by being in a field at the elbows of others (Tobin and Roth 2006). As Michael Juffé pointed out, passivity can be a misleading term, since the essence of what is involved is receptivity to learn from others, including social artifacts. Accordingly, it is useful to think of passivity in a dialectical relationship with structures, agency, and a necessary ingredient in production. That is, production always consists of agency | passivity. We also employ other useful dialectical relationships, appropriating key ideas from activity theory (Roth and Lee 2007). These include individual | collective, goals (of individuals) | motives (of collective), and action (of individual) | activity (of collective). Consistent with multilogical methodology, additional theoretical entities are considered if, when, and as necessary. We employ an expansive heuristic whereby constructs can be understood through the way we use them in our work – the meanings of social constructs, such as field, emerge from our uses of them in the research (i.e., meanings in use).

Hijacking science education

My journey away from positivism was arduous, largely because tenets of positivism have saturated common sense in the Academy. It was quite common for peer-reviewers to apply tenets of positivism in their reviews and request changes they felt were needed to strengthen my work – that I align submitted papers with tenets they accepted as true. Accordingly, in order to publish our work, we had to respectfully address issues such as objectivity, sample size, statistical generalizability, and parsimony even though we did not always accept such premises as viable. Also, published research, from the mainstream, was frequently accepted as true (or known) and this made it difficult to present alternative perspectives and associated visions as salient priorities for research, policy formulation, and changed practices.

The mainstream has in several ways taken control of what is, is not, and can be regarded as science education. Several years ago, after delivering a keynote address at a science education conference in Barcelona, Spain, I was confronted and intrigued by the audacity of another of the keynote speakers, a person I would regard as a learning sciences scholar, who suggested that my research on emotions and urban education,

though grounded in the teaching and learning of science, were not legitimate studies of science education. His act of labeling was one of marginalizing my work. His argument was that what we learned was applicable to any of the curriculum areas – not especially to science education. This has been a familiar, though flawed and imperialistic perception of science education that, in my view, contributes to the reproduction of pervasive and ongoing problems. This person expressed a mainstream view that is damaging, not only because it allows him to ignore my research, as if it were never undertaken, but because he can also classify other studies of teaching and learning as irrelevant to science education because they are applicable to other curriculum areas.

Unfortunately, the view of this colleague is not confined to just one or two individuals. For example, at a recent meeting of the National Association for Research in Science Teaching, as I listened to a keynote address delivered by a leading scholar in the learning sciences, I noticed numerous possible connections to our ongoing work. However, she seemed unaware of research that was outside of the conceptual change/individualism framework – not only to our projects but also the work of others who adopted a sociocultural perspective. I wondered whether this failure to connect and acknowledge would be tolerated in the natural sciences and felt a rising tide of emotion-based on an articulated belief that her failure to acknowledge and learn from our research was a sign of poor scholarship and more generally a deep malaise in science education. This person, like the guy in Barcelona, was selected because of her perceived eminence and anticipation that she would inspire and shape research in science education. However, to me, her presentation was just another example of parochial, self-serving research in a mainstream that is increasingly irrelevant and inward looking.

Acknowledging and learning from difference is a central issue for science educators to address, irrespective of the categorical labels each scholar might apply to him/herself. Multilogicality is here to stay and the field of science education cannot afford, and should not allow its scholars to ignore, silence, and discredit research that is grounded in different systems of logics. It is not so much that every pathway has equal claims to viability; it is just that, as a way of illuminating social life, affordances provided by a given framework might not be visible through other frameworks. Failure to look and see alternative visions might direct science education to a pathway headed toward extinction.

The gold standard in educational research was presented to me in my doctoral program, back in the late 1970s, as an experiment – a study that included random assignment of objects/subjects and employed a design that was protected by internal and external generalizability. Unfortunately many tenets associated with experiments are used to judge research that is not experimental and that eschews the logics of experimental research. For example, we regard those who participate in research as social beings who are unique – we do not see them as objects or interchangeable subjects. Accordingly, we do not do research for the purpose of generalizing to others like those involved in the research (Tobin 2009). Instead we regard the purposes of our research as learning more about theories and creating toolkits for promising practices that potentially can be used by those who see possibilities and choose to use the toolkit, as is or as adapted (Eisenhart 2009). Similarly, theory production is an affordance for seeing social life differently, including problems and possibilities. New theory is part of an expansive agenda that opens up conversations about social life.

How can you generalize from an n of 1? This question and the heavy-handed criticism that goes with it are usually delivered courtesy of blind review. An assumption in the question is that participants in a study are a sample selected from a population (i.e., n stands for sample size). The n is expected to be representative of N , which stands for the size of the population. Statistical generalizability usually necessitates random selection and random assignment to groups. In our research this is never the case since we select participants who are accessible, educated about the research, and chosen because we expect to learn from them. In fact, participants are invited to join a study serially, contingently, and explicitly because of their differences from one another. Purposefully selecting participants is not regarded as weakness – it is a feature of research methodology that is responsive to contingencies. As a result the design of research is necessarily flexible and continuously in flux as we learn and decide what is best to do to learn even more (Tobin and Ritchie 2011).

Sometimes the question of selecting participants is framed in terms of cherry picking – that is, we select participants to provide the results we get. To some degree this is exactly what we do. However, we adhere to the criterion of ontological authenticity whereby each researcher seeks to change his/her ontology as a result of learning that occurs in the research. We do not ascribe to research where hypotheses are formulated in a directional sense between variables and a study is then set up to test those hypotheses. Instead, research we do involves hermeneutic phenomenology. We seek to learn expansively from lived experiences of all participants and we design our research to ensure changes in the subjectivities of all participants, including researchers (Tobin 2006). Whereas we select participants who can provide the kind of information we are looking for, we do not begin with a-priori hypotheses that are tested. Instead, what we learn emerges from ongoing research and is nuanced and polysemic. When contradictions are observed we make every effort to learn from them and certainly do not pass off differences as unimportant. The patterns of coherence that emerge are an important outcome of research and so too is nuance, which takes the form of contradictions to any patterns of coherence that are experienced.

Structure of the remainder of the chapter

The remaining sections of the chapter address some of the milestones passed on the way to our present research practices. These include interpretive inquiry, authentic inquiry, event-oriented inquiry, interventions, expanding horizons for science education, and expanding horizons for science education.

Interpretive inquiry

Our search for a viable framework for improving research in science education led to Michigan State University, where Erickson had just completed an advanced draft of a chapter on interpretive research – to be published in 1986 (Erickson 1986). This meeting with Erickson turned out to be most fortuitous and within a short time we were adopting and adapting interpretive research methods as a primary methodology for our research.

We were intrigued by Erickson's description of interpretive research as an umbrella term for participant observation because it explicitly addressed and acknowledged

subjectivity as a strength of interpretive research. Furthermore, the necessity to address what is happening and why it is happening from participants' perspectives immediately raised serious issues about how to deal with differences of perspective. Not so apparent was a related issue of not privileging any voice in interpretive inquiry. Initially the methodology seemed to apply writ large to researchers like us, who were university-based – a reminder to silence our voices. However, soon we realized that, as participants, our voices were important and should be considered along with others' voices from each of the stakeholder groups. Interpretive inquiry was designed to be polyphonic, providing opportunities to learn from many voices. Just how polyphonia was to contribute to high quality research in our project was yet to be worked out, but it was clear that no stakeholder group should be omitted or deleted and no stakeholder group should have a privileged voice. Complexity and difference were as much a part of interpretive methodology as coherence.

The tenets of interpretive research were strikingly different than those of traditional positivistic-oriented research, which tended to identify central tendencies and consider deviations from the center of mass as errors or anomalies. In contrast, in interpretive research the approach was to understand and explain deviations from central tendencies, or assertions defined by patterns having thick coherence. Interpretive inquiry embraced a theory of culture based on the work of Clifford Geertz, an anthropologist (Geertz 1973). From this perspective, explaining the exceptions was just as important as explaining central tendencies.

Having accepted that all research involves participant observation and that the presence of the research and researchers make a difference, there seemed little to be gained from convincing others that differences made by research were negligible. First, it is impossible to tell what would have happened in the absence of research and, second, offering an explanation might inadvertently reinforce the idea that subjectivity is a weakness of research design. On the contrary, subjectivity can be regarded as a distinct advantage that generates many possibilities for improving the quality of research.

Authentic inquiry

Using a particular theory can be generative of new issues to resolve because of novel ways of experiencing. Accordingly, questions, answers, and possibilities unfold. Within the framework of authentic inquiry we seek ways to improve equitably at collective and individual levels.

Egon Guba and Yvonna Lincoln (1989) incorporated a constructivist perspective into what was then an exciting new evaluation methodology. The approach broke free of shackles of positivism and advocated criteria for judging quality of an evaluation in terms of ethics and what they referred to as authenticity criteria. The methodology appealed as highly appropriate to our research in the 1990s and we adopted and continuously refined the authenticity criteria and associated "fourth-generation evaluation" to meet the needs of our ongoing research in science education. We refer to the approach as authentic inquiry, which employs research designs that are contingent, emergent, and dynamic. Theory and changed practices are both outcomes from participation in authentic inquiry. As our research projects developed from the 1980s onward they incorporated both interpretive and authentic inquiry as methodologies that tended to supplant approaches

often described by the data resources used in the study (i.e., qualitative, quantitative, mixed). However, the trajectories of changing methodologies were steep and reflected growing emphases on sociocultural theory.

Changing perspectives on what is happening

Authentic inquiry addresses additional values concerning ethics, and acknowledges that knowledge is inherently political, reflecting participants' positions in social space. According to this methodology, what is learned from research does not constitute a unique social truth but instead is saturated by lived experiences. To the extent that participants do learn from one another, their descriptions of what is happening and why it is happening also differ. We consider such differences as valuable resources in research – providing insights into different ontologies. We do not regard perspectives that cohere as correct and contradictions (i.e., not conforming) as mistakes. Rather, different perspectives can reflect different positions of participants in social spaces—mediating lived experiences, learning, ontologies, and social realities. We accept social life as polysemic, characterized by many social truths/realities. Furthermore, as researchers, we value the importance of learning about and from others' realities, or ontologies. Rather than a small number of privileged university-based researchers learning from doing research, authentic inquiry anticipates that all participants should change their ontologies as they participate in the research. That is, participants would change the stories they tell about the fields of social life being researched. From a design perspective research can examine the extent to which progressive subjectivities occur within salient stakeholder groups progressively documenting participants' changes in ontologies and conduct.

Becoming self-aware and learning from others' perspectives

Educative authenticity affords participants learning from one another's ontologies without seeking to change perspectives that differ from their own. Educative authenticity regards differences as learning resources and assigns high value to each individual's rights to be (and remain) different. That is, participants in all stakeholder groups (e.g., researchers, teachers, students, school leaders, parents) can learn from their active participation in a study. This criterion acknowledges different participants having different goals and associated perspectives on what is happening and why it is happening. To address this criterion it is important to identify outcomes valued by different participants and ensure that research design has sufficient malleability to study varied goals and diverse levels of success and benefits from participation in research.

Catalyzing institutional change and equity

Through learning it is possible that positive changes can occur to participating individuals and institutions. Authentic inquiry acknowledges that participants are not equitably placed to gain advantage by participating in research. Researchers accept an obligation to help those who are unable to help themselves to benefit from participating in research. Once the educative potential of participating in research is realized then designs can be planned and enacted to maximize authenticity in terms of education, catalyzing institutional changes, and ensuring that all individuals benefit equitably from being involved in research.

An increasing emphasis on authentic inquiry, as a component of a multilogical

bricolage, heightened our awareness of the importance of both creating new theories and applying them to improve the quality of the aspects of social life being studied – in our case teaching, learning, and learning to teach. Accordingly, a major outcome of our research was the creation and testing of interventions that could be components of toolkits others might use to improve their practices. I address this important aspect of our research in a section of this chapter in which I address interventions.

Event-oriented inquiry

Our acceptance of difference as a resource for transforming culture and learning from research translated into a gradual shift in our ways of thinking about and doing research. To an increasing extent we viewed contradictions as an expected feature of social life – not an inconvenience that needed to be explained away before we could conclude a study. Furthermore, because of a dialectical relationship between reproduction and transformation, we began to view contradictions as seeds for social change. Accordingly, as an essential component of our multilogical approach to research, we embraced identification of contradictions and associated changes in patterns of coherence (Tobin 2008).

Fortunately, Sewell had articulated event-oriented inquiry in the context of historical research, searching for and interpreting contradictions in macrostructures in his studies of historical events such as the French Revolution. We adapted event-oriented inquiry to our multilevel research in science education. We regarded a contradiction as a spike in the curve, something important that was against the grain. For contradictions of interest we identified and contextualized associated events and the episodes of social life that contained them (i.e., for each contradiction we identified an associated event and the episode in which it was contained). We then adopted a hermeneutic phenomenological approach to describe what happened and why it happened during episodes, seeking to capture the salience of the event, which was then further analyzed using multilogical and multi-method analyses.

Randall Collins' framework heightened sensitivity to synchrony and entrainment, which we began to consider in terms of resonance and passivity (Collins 2004). When Michael Roth and I first started to apply this framework I remember standing near an elevator at the University of Pennsylvania, looking back at clusters of people in a cafeteria. As we surveilled a landscape of numerous groups we observed synchrony and asynchrony in changes in orientation and movement of the body (i.e., including fingers, hands, arms, shoulders, torso, and legs), head, eyes, and facial expressions. Patterns were observed at moments in time and across intervals of time. From this time forward our collaboration on urban science education began to include descriptions of culture that examined patterns and contradictions in proxemics, within a framework of interaction ritual theory.

Our research in urban schools revealed just how central expressed emotions were to teaching and learning specifically and to social life more generally (Tobin and Llena 2011). At every instant emotions were enacted as part of cultural production – including curricular goals such as science learning. At times emotions were intensive and their presence catalyzed interaction chains that disrupted teaching and learning. In fact, there were instances of angry outbursts that alerted us to the fact that intense emotions might

be damaging to the health of teachers and students. We wondered how intense emotions related to physiological factors such as pulse rate, oxygenation of the blood, blood pressure, and body temperature. Our ongoing research revealed that our fears were well grounded. Teachers and students might protect their wellbeing if they had strategies for ameliorating intense emotions. Our research on physiological expression of emotion confirmed many fears we had about teaching and learning. Most urban classrooms we studied and otherwise experienced in our professional lives were highly toxic for teachers, who expressed intense emotions in terms of heightened blood pressure, high pulse rate, and low percentages of oxygen in the blood. From the perspective of authentic inquiry we felt an ethical obligation to intervene to improve the quality of life for the participants in our research.

Research on the intensity and focus of emotions has implications for teaching science. For example, during a lesson on conversion of units a teacher and several students were frustrated with student performance on a recent quiz (Tobin and Llena 2011). The teacher had been absent due to illness and a substitute had been teaching the class. Students were having difficulty following the teacher's efforts to re-teach the work. As a student leant across to clarify for another student the teacher reprimanded her for speaking while he was speaking and an altercation broke out. In many respects the learning environment became dysfunctional. The teacher's focus on his anger was intense and he represented anger through his gestures, prosody, and semantics of the spoken text. Consistent with intensity of emotion increasing focus, the teacher was less able to attend to teaching students about conversions from one unit to another (e.g., liters to milliliters). His oral presentation was slow, contained long pauses, and included utterances about "rude student." In many respects the text was unintelligible, becoming an object for humor and ridicule for some students who regarded the altercation as a performance, and laughed at what was happening. For students who had been reprimanded, phrases such as "rude student" were inflammatory and catalyzed further outbursts, ratcheting up the intensity and distribution of high emotions.

A significant publication that employed event-oriented inquiry was situated in Philadelphia (Roth and Tobin 2009). The study was multilogical, involving video analysis and an approach to research that featured the use of students as researchers in their own classes. On this occasion several youth reviewed a video and selected a short vignette they felt was an example of a good approach to learning. Multiple methods employed in the study included conversation analysis, prosodic analysis, proxemics, and facial expression analysis. Interpretively we examined relationships among constructs such as power, synchrony, solidarity, and interaction chains. When it came to proxemics we focused to some extent on rhythm. Classroom interactions seemed to have a rhythm represented in synchrony between prosody and proxemics. Our efforts to capture the essence of the rhythm looked at patterns and contradictions evident in head nods, leg and hand movement, peaks in the intensity of talk, and clicks made by chalk on the chalkboard. Adopting the idea of resonance we looked at classroom participation in terms of students tuning into this prevailing frequency (i.e., the rhythm of the classroom) in order to successfully interact.

Interventions

Authentic inquiry addresses the moral aspects of doing research. For example, it is not appropriate to do research that identifies problems without endeavoring to resolve identified problems. As we learned more about collaborative approaches to teaching and learning, such as cogenerative dialogue (cogen) and coteaching, new pathways for enacting curricula emerged. Even so, we experienced dysfunctional classroom environments in which teachers and students exhibited intense emotions. Circumstantial evidence raised concerns that intense emotions were deleterious to the health of teachers and students. For example, one of the teachers in our research had heart disease that we connected to his anger – that we felt occurred too frequently. Teaching and learning should not make participants sick and it behooves researchers to do more than just identify problems and exemplary practices. Interventions also should be developed to utilize what is learned from the research to improve the social lives of research participants.

Based on the work of Pierre Philippot, Gaëtane Chapelle and Sylvie Blairy (2002), we knew of relationships between breathing patterns and emotions. That is, emotions could be changed by changing the pace and depth of breathing and also emphasizing the diaphragm or the belly while breathing. Also, as emotions changed, so too did breathing patterns. Accordingly, we decided to use breathing meditation at the beginning of lessons to ameliorate emotions. The benefits of breathing meditation were well documented in the literature and they began to be apparent in our research. Similarly, another tried and tested intervention involves reflexivity – becoming aware of the unaware. We adopted this principle in the design of a number of heuristics to make participants in education (e.g., teachers and students) aware of characteristics of constructs we regarded as salient to improved teaching and learning. As examples of our uses of heuristics, in this section of the chapter I present mindfulness and mindfully speaking. These are examples from heuristics that have been developed for cogen, coteaching, radical listening, mindfulness, mindfully speaking, and mindfully listening.

Mindfulness

Our research on emotion and growing evidence of students getting stuck with an emotion, which then mediated their ongoing conduct in deleterious ways forged a pathway into research on being in the moment—our mantra for mindfulness. Our goal was not so much advocating for mindful practice, as it was to heighten participants' awareness about its salient characteristics. The rationale was that knowing the characteristics of mindfulness would provide windows into the practices of self and others, opening up possibilities for considering changes in conduct if and when it was deemed desirable by particular stakeholders.

We developed a heuristic that consisted of short descriptions we considered salient to the circumstances of our research. We thought of the heuristics as shape shifters, in that characteristics would change to reflect the context, which was continuously changing. Some of the key components of mindfulness were maintaining focus, being aware of what is happening, minimizing attachments of ongoing conduct to emotions, and showing compassion to self and others. Because of our interest in wellness and emotion we included characteristics associated with pulse rate, body temperature, breathing patterns,

and emotional styles (e.g., resilience). Some of the characteristics included in the heuristic are: I am curious about my feelings as they rise and fall; I can tell when something is bothering other students; I find words to describe the feelings I experience; I am aware of my emotions as they are reflected in my face; I identify distracting thoughts but let them go (without them influencing future action); the way in which I express my emotions depends on who is present; I am not hard on myself when I am unsuccessful; I can focus my attention on learning; the way I position and move my body changes my emotions; and I recover quickly when I am unsuccessful.

Mindfully speaking

As a form of action, speaking is a way to represent what is known about the topic of discussion. In dialogue with others, speaking aloud allows a speaker to represent what s/he knows, for others to listen and make sense of what is said, and for responses to be formulated for purposes such as to elaborate, expand, clarify, question, refute, and accept. Accordingly, when such actions occur there are benefits for the speaker in terms of speaking and in terms of hearing what is said after the initial talk. Similarly if there are no follow-ups to an utterance the person misses out on learning from a response – or putting it another way learning from others' talk. In dialogue it seems as if a turn at talk is an opportunity to represent what is known and thereby to learn through action and then to receive responses to what has been said, which creates further opportunities for learning to occur. If the focus remains on what is being said originally then successive turns at talk become resources for speakers and listeners to learn from one another. The value in symmetry, when it comes to speaking, is that every speaker has a chance for the double benefit of acting through speech and acting through listening to others' responses to what was said.

When interacting with others it is important to understand their perspectives, build respect for what others believe and value highly, and regard others as resources for personal learning. Whether the dialogue involves a Shakespearean play, how to cook a kimchi pancake, or using the subway to get from Grand Central Station to New York University, dialogue will necessarily involve a balance that reflects turns at talk and time of talk. The distribution among participants in the dialogue should be relatively equal for a given topic of conversation.

Mindfully speaking involves speakers monitoring the amount of time they have been speaking and the number of turns of talk they have had in relation to others involved in the dialogue. A mindful speaker would wind up a talking turn if and when the amount of time starts to exceed the bounds of what is reasonable. This can be accomplished by transferring the speaking turn to another speaker, preferably one who has not spoken on the topic or has not contributed equitably. Rather than speaking excessively a speaker shows his/her awareness of the value of sharing talk by involving others and thereby to maintaining balance. An important indicator of whether the amount of talk is becoming excessive is the emotions represented in the faces and body movements of others. If speakers carefully monitor others' actions as they participate in dialogue as listeners there can be signs that it is time to transfer opportunities to talk to others rather than continuing to speak. When the signs of others' emotions are such that their interests are waning the speaker can adopt a strategy of opening up the conversation, leaving the decision of who

will speak next to the group as a whole, or s/he can redirect the turn of talk to an individual. By monitoring others' emotions information can be gleaned about their levels of comprehension, their interests in what is being said, and the synchrony of their emotional responses with the present utterance/speaker and the topic of dialogue. When asynchronies occur it is important to understand them and act appropriately.

As well as monitoring others' emotions it is important when speaking mindfully to monitor personal emotions as they emerge, taking care they do not stick to ongoing conduct, mediating what happens in a deleterious manner. Note, it is not necessary to try to eliminate emotions or to soften their intensity. What seems important is that emotions do not stick to ongoing conduct unless it is seen as important for them to continue and build. This would be true of any emotion. The undesirable feature would be that emotions would build to an extent that dialogue is disrupted and/or diverted in undesirable directions. If this occurs than strategies need to be enacted to become unstuck – that is to let the emotions go so that the focus can return to the purpose of the dialogue. In this example becoming unstuck is a repair ritual. A repair ritual involving "letting go" of emotions is just one example. Another would be when a speaker is interrupted by others' emotions or by others' actions such as gestures and body movements, verbal fillers such as umm, urr, ah, etc. When breaches in the fluency of dialogue occur it is important for the speaker to be able to repair the interaction and either continue with an utterance or transfer a turn of talk to others. A condition of mindfully speaking is to be aware that a breach has occurred and assume responsibility to repair the breach and create fluent dialogue as a condition of successful dialogue.

When a participant in dialogue shows an interest in participating orally it is important not to intentionally shut that person out. The right to speak is neither an individual nor a collective matter – instead, it is an outcome of an individual | collective dialectic. When a person signals an intention to speak, in all the ways that such signals can be transmitted, the speaker should not raise his/her voice to speak over any attempt of the other to get involved by beginning to speak. Although it might be legitimate to argue that the person seeking to speak should not speak until the speaker has finished, it is important to acknowledge the rights of a listener to contribute to dialogue when, if, and as necessary. That is, the right to speak is not preordained as an ongoing (unconditional) right of a speaker. Rather, such a right is contingent on what is happening and there need to be ways of signaling to a speaker that another wishes to participate – to take a turn of talk. Accordingly, when another signals a desire to begin a turn of talk the speaker can pass the baton, confident that s/he can contribute further a little later in the sequence of interactions. A mindful speaker should not assume that what s/he has to say is the most appropriate action in an interaction chain. On the contrary, if another wants to get involved, and it makes sense to do so, then a transfer in the turn of talk can and should occur expeditiously. Failure to transfer a turn of talk will create a breach in the flow because the signal of desire to talk can be interpreted as a contradiction or resistance to enacted culture. The conditions for fluency are that actions occur in a timely manner, are appropriate, and are anticipatory. In the circumstance of a person signaling a desire to assume a turn of talk, a mindful speaker could act synchronously by handing over the baton to the person who desires to speak.

The following characteristics are part of a mindfully speaking heuristic – When I participate in a conversation: I act to balance the amount of time I talk; when I have been speaking too long I wind up my talking turn; before speaking I pause to make sure the previous speaker has finished; as I speak I monitor others’ emotions; as I speak I monitor my emotions; when asynchronies occur I try to understand them; I try to make conversations with others successful; when breaches in fluency occur I try to repair them; I do not increase the loudness of my voice to continue my talking turn; I speak with a similar rhythm to previous speakers; I maintain the focus of previous speakers; I look for signs that others want to speak; I am aware of how long I speak; I create chances for others to speak; I act to balance my speaking turns; the loudness of my talk is appropriate; I do not speak to hurt others; and my talk shows respect for others’ perspectives.

Expanding horizons for science education

Our ongoing research on emotion has identified wellness related issues that might be considered central to science education. For example, when a person has excess emotions in a social setting, how can these be ameliorated? What about alleviating symptoms associated with allergies, and physical conditions such as high blood pressure, dizziness, headache, hot flushes, skin rashes, and nervous tension as it is represented in shortness of breath and speech irregularities such as stuttering? Knowing one’s body might involve identification of disharmonies and/or deviations from normal and knowing how to restore harmony/equilibria. Science educators might consider whether wellness, as I have described it here, is a reasonable goal for science education. In this section I provide insights into ways in which a particular framework, in this case Jin Shin Jyutsu (JSJ), can be used to provide different experiences and raise distinctive questions.

JSJ is a knowledge system that developed over a period of several thousand years, probably originating in India (Higgins 1988). Jiro Murai, a philosopher and Buddhist monk from Japan, documented the tenets of JSJ and tutored Mary Burmeister, who carefully further developed and disseminated JSJ throughout the world. JSJ can be used as a self-help system or can be administered by others to maintain wellness while treating symptoms of illness and addressing underlying causes. JSJ has flourished in the West, mainly due to Burmeister and her students. Even so, the art is not a mainstream practice and nor is it widely acknowledged as legitimate.

From a polysemic perspective, JSJ appeals as a knowledge system that is expansive and generative. Through the lenses of JSJ questions can be asked about everyday practices in all imaginable fields of the lifeworld. To what extent do JSJ-like holds occur naturally and what are their functions? In terms of the mainstream focus on teaching and learning in classrooms – in which emotions saturate all social interactions – there are possibilities for designing toolkits that can enhance the productivity of teaching and learning while educating a literate citizenry to use self-help procedures from JSJ to improve wellness.

JSJ as a framework for research in science education

JSJ postulates that revitalizing energy, which flows up the back and down the front of the body can become blocked at 26 pairs of Safety Energy Locks (SELs, Figure 1). Burmeister noted that: “as we abuse our bodies in our daily routines, mentally, emotionally, digestively, or physically, our locking system becomes activated.” There are twelve main energy pathways (known as flows) and these intersect with three major flows. When SELs block, one or more flows are disrupted and associated disharmonies manifest in symptoms or vulnerabilities to disease/injury.

Each flow can be restored, or harmonized, through a sequence of light touches using fingers, hands, and other parts of the bodies. It might be as simple as grasping a finger or toe. In this way individuals can improve their own health by synchronizing pulses on their own bodies by touching/holding SELs that can be reached. People who administer JSJ open SELs by touching or holding appropriate places of the body, enabling the flow of energy to be redirected, unblocked, and recharged along energy pathways. According

to Burmeister, we use JSJ routinely as we enact social life – holding hands, touching the chest, leaning on cheeks, and standing with hands on hips. But why do we do it and what do such holds and touches accomplish? We were interested to see to what extent individuals used JSJ touches/holds in different spheres of life and the circumstances in which touches/holds occurred. It is possible that when disharmonies arise a person unconsciously touches and holds SELs to restore synchronies.

I did not notice related touches/holds in day-to-day interactions until I

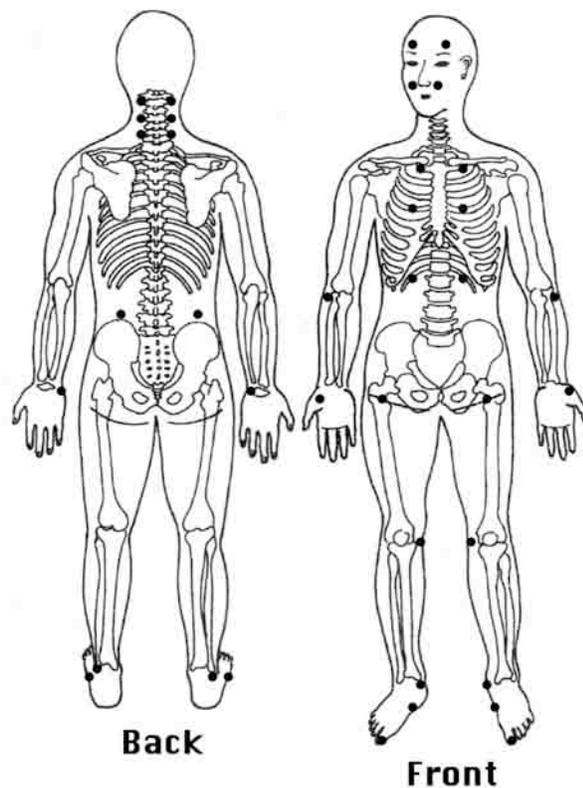


Figure 1. Safety energy locks referred to in this study.

began to practice JSJ as a self-treatment for health problems such as seasonal allergies, high blood pressure, and muscle and organ dysfunctions. However, during a recent professional meeting in Luxembourg, I was aware of individuals using JSJ as an implicit knowledge system as they touched/held themselves in ways that were identical with, or bore a family resemblance to, JSJ touches/holds. Because of my growing familiarity with JSJ and my infusion of its tenets into ongoing research on wellness, emotion, and mindfulness, I was sensitized to see and notice JSJ in people's practices. Just as Burmeister has noted, and so too have my JSJ teachers, Ian Harris and Sara Harper, touches/holds of the SELs are commonplace in every day life. For the most part these touches and holds appear to be unconscious ways of addressing physical discomforts and emotional disharmonies. In the following sub sections I address the occurrence of JSJ-like hold/touches in four contexts: a one-on-one cogen in a graduate urban education class; an oral defense associated with a doctoral degree in urban education; and a CSSE Forum in Luxembourg. Because of the interest in this paper on emotion, the interpretive aspect of these examples focuses on the use of JSJ to resolve emotional disharmonies.

One-on-one cogen with a graduate student

As part of her course assessment a graduate student elected to participate in a cogen with two professors who cotaught the course in which she was enrolled. I was one of the professors. The purpose of the cogen was to create a dialogue around an oral presentation from the student. The cogen allowed the professors to ascertain what the student learned in the course and the student to show what she knew, in a context of a project she completed as part of the course. A PowerPoint presentation and nine pages of written text containing prose/narrative, freestyle writing, poems, song lyrics, diagrams/sketches, and photographs of places, family members, and friends supported her oral text. The presentation covered aspects of everyday life in the United States (as a student, a worker, recreation, and home life), and Ecuador. Some of the text was in Spanish, but most of it was in English. To an unexpected extent the cogen was a roller coaster of emotions, which varied in type and intensity. Based on a video recording of the 20-minute cogen and recollections/reconstructions of what happened, the primary emotions represented by the student involved satisfactory-happiness, disappointment-sadness, and aversion-fear. Although there may have been instances in which frustration was an expressed emotion I did not consider the assertion-anger continuum to be salient.

JSJ-like hold/touches were commonplace, produced continuously throughout the cogen. Because the camera was focused on the student, the examples provided below primarily involve SELs on the front of the body and above the table on which the student accessed her computer and notes.

Touches/holds that approximated to SELs included the following:



In JSJ each finger connects into one or more distinctive flows of energy. Interlocking fingers from the left and right hands may be a way to harmonize the emotions throughout the body and, as necessary, return them to normal.



The palm side of the right hand rests on the back side of the left hand. As well as contact of the fingers from the left and right hand, the SEL near the wrist on the little finger back side of the left hand and the SEL at the base of the thumb on the palm side of the right-hand are being touched by the opposite hand. Holding or touching the SEL on the back of the hand affords intuition, helping to still the mind, relax, and become peaceful, assisting to calm nerves. Similarly, holding the SEL at the base of the thumb helps to relax the body, enhance mindfulness and free the body of thoughts and worries.



Using the fingers and/or palms to touch the SEL on the forehead above the left or right eye. Here the right hand may help to remember, focus, and clear a busy mind. It is possible that the touch initiates a calming effect.



The fingers and palm of the left hand touch a SEL at the bottom of the cheekbone and a finger-width to the side of the nostril. It is possible that holding this SEL can relieve a sense of fear (i.e., anxiety, uncertainty, doubt) and assist in unburdening the mind and overcoming senses of lethargy and apathy.



Folding arms with fingers extending into the inner elbow region of the arm. The hand may clutch the elbow in which case it makes strong contact between an area at the base of the thumb and the elbow. In other instances participants grasp one elbow while resting the other elbow on the back side of the other hand. In this case an SEL on the little finger side of the hand, close to the wrist, might make contact with the elbow.

Holding an SEL on the outer side of the elbow restores harmony, thereby affording confidence and authority, providing balance and control of destiny. If a person has a sense of losing control she may well touch or hold the SEL on the elbow in an effort to gain control, not necessarily over others, but of herself. In this image the right hand may be touching the left rib cage, also a site of an SEL.

JSJ-like holds exhibited during an oral dissertation defense

Like many doctoral oral examinations Gray opted to present what he had learned with a plethora of PowerPoint slides to support an oral presentation. Few were in attendance. The supervisory committee of three and a friend of the candidate, a professor from a nearby university, sat quietly as they listened to the unfolding narrative of what was accomplished in the dissertation research. Occasionally one of the committee punctuated lengthy sequences of listening with a question that sought clarification. For the most part the candidate gave a 45-minute oral presentation without interruption in an articulate and fluent manner. Understandably his emotions were running high, especially those situated on an aversion-fear continuum. It was impossible for me not to notice Gray's continuous flow of JSJ-like hold/touches. Accordingly, I decided to record them as they emerged in a 5-minute segment that occurred 20 minutes into the oral presentation.

- Held his right thumb with his left hand.
- Placed his left hand on his right shoulder, like a coat hanger hook, over his shoulder and angling toward the neck and spine.
- Placed his left hand, palms down, above his left breast.
- Placed right hand on right groin, more or less as an anchor as the left hand gestures and touched SELs.
- Place left fingers on the left cheek about a half-inch from the nostril.
- Interlocked fingers of his left and right hands occasionally elevating both middle fingers vertically (touching one another).
- Wrapped his left hand around left-hand side of neck, below skull.
- Slid his right hand back and forth from right groin to right kneecap (on the inside).

- Placed back of his left hand on the right arm, just below the elbow.
- Interlocked fingers of his left and right hands.
- Placed left palm on right palm, thereby engaging fingers and the base of the thumb on each hand.
- Placed left hand on neck to cover SELs at the base of skull and on the lower left side neck.
- Placed right hand (palm down) on the back of the right wrist, on the little finger (outer) side.
- Slid right hand back and forth on left hand and lower arm – from outer wrist to access side elbow on same side of the arm as the back of the hand.
- Place left hand on three SELs on the right neck and just below (just below skull, at nape of neck, and angling toward the spine from where the neck meets the shoulder. Gray then slid his fingers down to the front of the body into a cavity beneath the right clavicle.
- Placed fingertips of his left hand on fingertips of his right hand in a deliberative manner.
- Left thumb deliberately works the nail of his right thumb.
- Left thumb deliberately works on the nail on his right ring finger and then on all right hand fingers.

Although it is not an identified SEL Gray also spent time moving his fingers from his left ear down the underside of the jaw to the chin, touching that area with his fingers and the neck with his fingertips.

Common touches and holds during the CSSE Forum in Luxembourg

Photographs taken with my iPad during the CSSE Forum in Luxembourg showed that JSJ-like holds were enacted literally everywhere. Most participants touched and held SELs continuously, possibly to mediate the production of emotions – seeking to diminish excess emotions and increase emotions that may be useful in meeting goals. The JSJ framework afforded me experiencing emotions and proxemics in different ways. As the keynote speakers delivered their presentations they were standing, speaking from the front of the room using a PowerPoint presentation to support what they had to say. About 30 participants sat at benches arranged as the other three sides of a rectangle. The keynote speakers used gestures and at various times touched their faces, arms, and upper bodies in various places that were proximate to JSJ's SELs. Similarly, seated participants also touched SELs on the upper and lower parts of the body. The photographs in this section are of me to avoid the use of the pictures from the Luxembourg conference that I analyzed.



The SEL just above the breast can be harmonized by touches of the fingers or palms. When this SEL is out of harmony it may be associated with a sense of guilt and an assumption of responsibility. Holding this SEL can ameliorate these emotions while boosting the immune system, increasing resistance to catching something from others – such as a cold or flu.



Participants who stood up during the keynote address, including one speaker and several others, appeared to stretch and placed their hands on their backs, just above the hips. This point on the body corresponds with an SEL associated with energy flowing through the hip. Touches and holds of this SEL can relieve a sense of fatigue and minimize doubts, competitiveness, grief, and even desperation.



Seated participants were observed to place their hands and fingers close to an SEL on the groin, often moving the fingers toward another SEL located at the upper/inner side of the knee. In fact, while seated and listening, a number of participants had one hand on the groin SEL and the other on the top/inner knee.

Touching the SEL close to the groin in conjunction with a hold on the SEL on the upper knee, is common, especially when a person is seated. Touching the SEL near the groin can ameliorate intense negative emotions and produce happiness and a sense of fun. As the JSJ canon remarks, letting go of stress can be associated with laughter and joy.



As the presentations progressed several participants were seen placing one hand, like a coat hanger, diagonally across the body to clutch a SEL close to the spine, just below the neck (e.g., left hand over right shoulder while right hand is on the right upper/inner knee).

There are numerous SELs in the vicinity of the shoulder and neck. Reaching over the shoulder like a coat hanger grasps an SEL associated with worry, fear, and negative thinking. Holding the SEL can reduce negative emotions and foster positivity. In terms of physical wellbeing the SEL is associated with problems that include neck and wrist pain, headaches, and high blood pressure.



Two other common body orientations involved one leg crossing the other at the knees. In this case an SEL on the lower/outer side of the knee comes close to the SEL on the top/inner side of the other knee.

An SEL on the lower outside of the knee rests on an SEL on the top of the inner knee. Also, the right hand holds the SEL on the upper knee of the left leg. According to JSJ canon, it is possible that holding the SEL on the lower knee harmonizes anger and induces a higher level of tranquility. Similarly, holding the SEL on the upper knee can relieve stress, calm nerves and build self-confidence.



Similarly, legs were frequently crossed at the ankles allowing for an SEL on the outer (little toe side) ankle to come into contact with an SEL on the outer/top arch of the foot.

There is a SEL just below the ankle knob and the back on the little toe side rests on the right ankle. A common posture is to rest this on an SEL on the top of the outer side of the arch on the right foot, which is midway between the ankle and the little toe. Opening up the SEL under the ankle knob is associated with transformation and often catalyzes clearing of the mind and changing expressed emotions. By discarding entrenched emotions and thoughts (i.e., letting go) then fears and uncertainties can be resolved.

Research possibilities

Based on my analyses of the prevalence of JSJ holds in everyday life, they are pervasive in diverse contexts and appear to be used to ameliorate changes in emotion and physical disharmonies as they arise. For the most part the holds/touches are fleeting and appear to be enacted without cause-effect levels of awareness. This had me thinking immediately about all of the video resources we have for our ongoing research on emotions. I am curious about the landscape of JSJ holds in different classroom activities. Which JSJ holds occur and what are the contexts associated with their use? Consistent with the use of JSJ as a complementary system of medicine, it seems logical to hypothesize that tacit use of the holds would be associated with emotional and physiological changes – presumably benefits. Within a context of event-oriented, multilogical, multilevel research, the applications of JSJ in science education offer an opportunity for science education scholars to expand their interests to embrace wellness across the birth-death continuum and become central in research on wellness, a major issue of our time. If authentic inquiry is part of our methodological bricolage, it is evident that what is learned from ongoing research can educate all stakeholders, improve lifestyles for different communities within society, and address the needs of individuals who are not well-placed socially to take advantage of what we learned from research.

The occurrences of touches/holds that correspond with JSJ's SELs might be regarded as actions that are potentially transformative in regards to wellness. Many questions arise as I consider what might happen, based on my very limited experiences of studying the incidence of SEL touches/holds in classrooms. The following questions serve as an example of the generative potential of the JSJ framework for research in social settings, including classrooms.

- What is the relative occurrences of touches/holds for each of JSJ's 26 pairs of

SELs?

- How does the occurrence of SEL touches/holds and their nature relate to expressed emotions and emotional climate?
- To what extent do SEL touches/holds ameliorate the intensity and nature of expressed emotions?

From the perspectives of event-oriented inquiry and interpretive inquiry there are several ways to proceed. One way would be to identify one or more SEL holds that were noteworthy in the sense of being spikes in the curve, incidents that either transformed what was happening or had the potential to do so.

An event would then be situated in a social episode by identifying an appropriate beginning and end. For example, in the Luxembourg CSSE Forum a participant began to report what happened in his group during a small group breakout. I became aware of my mounting frustration as I listened to the report and then of tension in my right forearm. The tension was created by my left hand pulling on my right arm, about six inches below my elbow. My arms were almost folded with the left over the right and the back of my right hand resting underneath the left elbow. These details of posture were retrieved after I identified the event (the tension in my arm caused by tugging away from the right elbow), associating it with a vignette involving a colleague reporting back to a whole group in ways that frustrated me. Once the vignette was identified my next step as a researcher was to create short narratives about the conference, the small group breakout, the report back activity, and the selected vignette. Since I did not have video files to access I relied on my recollections to undertake an analysis of emotions in terms of their type, intensity, and characteristics of the emotional climate.

The analysis is highly subjective, but that is strength in that I can access thoughts and feelings that would not otherwise be available. The research is what it is, providing me with insights into ways in which an SEL hold is used in a social setting to ameliorate the intensity of an expressed "negative" emotion, thereby decreasing the possibility of an intervention that would have disrupted my colleague's report and probably would have catalyzed an unpleasant interaction. Furthermore, the analysis sets the stage for studies that examine similar holding/touching patterns relating to this SEL.

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Author Biography

Kenneth Tobin came to the Urban Education doctoral program at the Graduate Center of CUNY in the fall semester of 2003. Prior to that he had positions as tenured full professor at Florida State University (1987 to 1997) and the University of Pennsylvania (1997 to 2003). Also, he held university appointments at the Western Australian Institute of Technology (now Curtin University), Mount Lawley College and Graylands College (now Edith Cowan University).

Prior to becoming a university science educator in Australia in 1974, Tobin taught high school physics, chemistry, biology general science, and mathematics for 10 years.

He began a program of research in 1973 that continues to the present day – teaching and learning of science and learning to teach science.

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