



Rejoinder to Geelan:
Dancing and Playing Around While Science Education and
Science Education Research Goes Up in Romantic Flames

James Carifio
University of Massachusetts-Lowell

Rocco J. Perla
Health Alliance Hospital

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Geelan's choice of the "dance" metaphor and the "playing" metaphor to frame his response to our critical review of his work could not be more apt, appropriate, or telling, nor could his various allusions to his being some kind of romantic anti-hero, celebrating the medieval, the emotional, and the creative, who was and is misunderstood by the public and his critics and unjustly excoriated, pilloried, and pursued with torches and pitch by those who claim to be proffering more classic and "enlightened" views (a popular allusion and stance among science educators as well as many other educators today). As Piaget pointed out, one of the hallmarks of a particular stage of development is the claim that people misunderstand you, rather than the fact that people understand you perfectly well, and the issue is that they disagree with you, and do so because your views and claims are severely defective and problematic if not flat out wrong. We do and did not misunderstand Geelan (but we do understand that we are lowly shepherds). How could we misunderstand him?

Geelan has labeled us as logical and cold (as well as remote and detached) as opposed to emotional, human, and up-close-and-warmly-personal. We do not and did not misunderstand Geelan (and in fact understand him fairly well, we believe); we disagree with him and not on minor and insignificant things or points in a few inconsequential and quibbling (or pedantic) ways, but rather with his entire framework, epistemology and philosophy, and his cavalier dancing and playing around with exceedingly important and

serious issues (like the proverbial missing person from the village), which have immediate practical and long term consequences, regardless of the spin (and self-justifying claims) Geelan (and others) tries to put on these things and these key and core issues. But to understand our disagreement and many of its particulars, and to get to our central points in this rejoinder, we must first say a word about humor, and then later humor's many children and cousins and how and why they come about and occur as a response to unilateral and covert attempts to alter the classic rules of engagement and dispute resolution that are the essence of normal modern science and intellectual discourse.

Cartoons, Playfulness and Humor

Essentially, our difficulty with Geelan and those science educators and science education professors who support his views can be succinctly summarized by two of Sidney Harris' famous Science Cartoons (Harris, 2007). The first of these two cartoons states "then a miracle occurs" as step two of a professor's proof (set of arguments) on a blackboard with the caption "I think you should be more explicit here in step two" said by the peer (obviously Harris) doing a critical review of the alleged proof, which is essentially what we said concerning over a dozen of Geelan's very exaggerated, completely vague and erroneous claims about research, theory, constructivism and John and Jane Doe death notices of various kinds (see Perla and Carifio, 2006b). Geelan clarified none of the "step two's" we pointed out in his response to us, essentially leaving all of the many important questions we raised unanswered still (and thus miracles), while at the same time raising a whole new set of "step two's" in his response to our review of his work. The second Harris cartoon is a response to a proof (set or arguments) offered by the professor who did the critical peer review in the first cartoon (again obviously Harris) by a colleague who could be Geelan or one of his proponents with the caption, "[Yes], it's an excellent proof, but it lacks warmth and feeling," with the hubristic assumptions that "warmth and feeling" (i.e., romantic rhetoric and dancing) are higher order epistemological, evaluative, and critical criteria than either excellence or proof, as well as the assumption that our critical review of Geelan's work did not have "warmth and feeling" of a particular kind, which it most certainly and undeniably did.

We empathize with Harris, as we most certainly know how he feels about life in science and science education today, which he expresses through humor that more than occasionally bites scientific soft tissues as he "playfully" explores various critical issues.

Like others, we are trying to redress an overgrown imbalance in science education today and help work this "excess exuberance" out of the marketplace of science education and current science education discourse and research. We are certainly not the first in this endeavor (see, for example, Matthews, 1992, 1993, and 1997; Fensham, 2004; and Schulman et al., 2006), but those who came before us were not heeded and, in fact, were and have been summarily ignored. We, therefore, are and have been far more "up front and personal" in our views and criticism than our predecessors, and actually take umbrage with being accused of being otherwise, and the warmth and feeling of our views have been such that we have *drawn responses* both here and elsewhere from Geelan and others, unlike many of the critical reviews of our predecessors. Geelan's 3,000 word response to our 3,600 word book review empirically

indicates to us, at least, that we are not being summarily ignored like many of our predecessors (and that critical reviews are indeed important), or that we missed the mark on the many points we made, even if our critical style seemed to step on many toes and to be less than civil or well-mannered. However, we believe that we have extremely good reasons, causes and justifications for employing the style and form of criticism we are now and have been employing.

Self-Evisceration

Specifically, it was not just Geelan's romanticism and excessive focus on the context of discovery *only* that brought about this rejoinder to his response to our critique of his work, but rather it was a few of the self-proclaimed discoveries he asserts he made as a result of reading our review. Geelan states in his response to our review that he teaches research and research methodology courses, and that he "discovered" Campbell and Stanley's classic work *Experimental and Quasi-experimental Designs for Research* through reading our critical review, which he had never read before, but became enamored with, as he read this slim but incredible thick and rich classic work. There is no better exemplar of most of the points we made in our original review, and of the deep and incredibly serious problems in science education and among science education researchers today than Geelan's self-proclaimed and self-eviscerating deficiency and discovery relative to the fundamental and absolute basics of research methodology and scientific methods. We simply are more than stunned, dismayed and chagrined that there are professors of science education today teaching research and research methodology courses who have never read and are unfamiliar with the contents of Campbell and Stanley's classic work, and who see such a lack as in no way being untoward or problematic or an egregious deficiency of any kind, and particularly so relative to evaluating research, research methodology, theory and the state of research knowledge as it relates to educational practice as well as making incredibly exaggerated, vague and unwarranted claims about each of the aforementioned elements.

Geelan asserts that he is deep into (romantic) folk methodology and folk knowledge and this fact we cannot dispute when we read his words. Nor does Geelan, who is not atypical of science educators or professors of science education today, seem to be aware that Campbell and Stanley's classic monograph was a work specially commissioned by the United States government in the 1960's to deal with the lack of knowledge about research methodology and scientific method of the educational researchers and educators of that era, and that despite this fact, we have come full circle 50 years later and need to familiarize science educators and professors of science education once again with this basic work and text.

Even more disconcerting and surprising, Geelan next proclaimed in his response to our critical review of his work that his claims about research, research methodology and theory arose from and were based upon some teacher training studies he was reading at the time (no details or numbers provided). Forgetting the issues of wild and inappropriate extrapolation and generalizations and unwarranted claims, and other external and ecological validity considerations, it is fairly widely known and agreed upon that teaching and teacher training studies are not exemplar of award winning research or exemplary research (in part due to the difficulties in doing this kind of research and the research sophistication, knowledge and experience these types of studies require). It is

also fairly well know that, according to Pat Hutchings of the Carnegie Foundation for the Advancement of Scholarship and Research on Teaching, that one of the very major weaknesses of current (and past) research on teaching, teacher training and teacher practice, is the lack of (appropriate and robust) theory that is modern in character and that can be falsified, as well as theory driven research and designs (Hutchings, 2007).

As Hutchings points out and documents in her article, *The Elephant in the Room*, research on teaching, teacher training and teaching practices is well known to be “seriously undertheorized” (Hutchings, 2007, p. 1) and thus out-of-date blind and shot gun empiricism, whether it is in the quantitative or qualitative mode; namely, turn-of-the-last century scientific method or/and alternative epistemologies or modes of inquiry. Even confining the discussion to this one narrow area that is Geelan’s focus for his broad and exaggerated claims in his book (and elsewhere), the point of critical importance here is that *theory is not dead in this area, it has yet to be born*, which is a point that is even more substantial and accurate than the original points we made about Geelan’s unwarranted and inaccurate claims about (still unspecified) dead and undead theories, and theory in general. We addressed and handled the “theory-yet-to-be-born” situation under the rubric of proto-theory and the processes by which proto-theory becomes modern scientific theory as is it goes through certain evolutions and meets specific criteria (see Perla and Carifio, 2005 for details).

The points made here are in no way made to denigrate or disparage teacher training (or applied or instructional) research and its importance. Rather the points made are to elucidate the (current) narrowness and atypicality of this kind of research and the nature, characteristics, and consequences of inferences, claims and generalizations based on this unrepresentative sub-sample to all research, research methodology, theory, and theorizing and that doing so is the “sound of one hand clapping.” In our review, we were very careful, in fact, to both outline and summarize Campbell and Stanley’s views, insights and wisdoms about the difficulties and importance of doing this particular kind of research, and the dispositions and methodological sophistication researchers who do this kind of inquiry need to have. The irony, as Campbell and Stanley point out, is that researchers who do this type of inquiry need very broad and very sophisticated research and theorizing skills rather than the opposite, and they need to master several different research traditions and cultures. But these points are not our chief concerns here. Our chief concerns here are the excessively parochial, insular, over-focused, and excessively romantic character of science education and science educators in the main currently, and the current sound of “one hand clapping” in science education, science education research and the training and preparation of science educators and science education researchers, as well as the number of “great and brilliant works” that seems to have fallen off syllabi and into oblivion in the past twenty years (e.g., Lakatos, 1970 and Suppe, 1974), and that are only available to be discovered in second hand books stalls or (accidentally) through critical reviews.

One Hand Clapping

Almost everyone in science education today is a philosopher and epistemologist with an eclectic (and usually hodge-podge and internally contradictory) framework (see Carifio, 2005 for details); almost no one is a (modern) theorist, (modern) experimental researcher or intellectual (or educational) historian who knows with some

old-fashion sophistication the foundational areas and traditions requisite to being a competent and literate educator, educational researcher and professor of education today. Everyone also is a reporter, journalist, and (narrative) story teller with expository and scholarly critical writing being a long lost and forgotten art (never mind science). As we point out in our review of Geelan's book, one simply cannot live on the Galapagos Islands or on the shores of Loch Ness (exclusively) any longer. One must work at and achieve composite literacy (see Dagostino and Carifio, 1992) to be a complete professional in today's world.

The modern world, according to a wide variety of research in several different fields, is "deskilling," "uneducating" and even socially and intellectually de-evolving the modern worker (and modern knowledge worker as well); one simply cannot allow these same phenomena to occur in the education profession or in the preparation of educational professionals, which has and is happening according to a number of expert and long time observers (e.g., Fensham, 2004, and Shulman et al., 2006). Such romanticism and arguments for and celebrations of such romanticism (and unskilled and irresponsible eclecticism) almost always lead to decay and "the fall of the House of Dalcastle," and Brave New Worlds and dystopias. Recall, please, that Chairman Mao called himself a philosopher, and that he called his writings and little books, particularly on education and re-education of recalcitrant and field-independent scholars and scientists, philosophical works. Every educational professional today must be highly knowledgeable about and highly skilled in C. P. Snow's two cultures (The Scientific, and The Arts and the Humanities) and broadly and in-depth, and three of four more "cultures" as well. To be less than minimally literate in one and only one culture and tradition (or form of research) today is the sound of one hand clapping, which is one of the major problems in the current "culture" and "research" wars, as well as the education professions today. Attempting to mandate (via an "innocuous" passive-aggressive "invitation") that others dance to the beat and sound of one hand clapping (and requiring at the same time that one forsakes all other hands, helping or otherwise), as Geelan does in his response to our critical review of his work, is a sure-fire recipe for creating Babel, fatwas, and dungeons, in our opinion. In this respect, Geelan is not alone or atypical but rather is typical and exemplary of the current state of both science education and the education professions as well.

That someone claims to be a science educator and research methods instructor, and has never heard of Campbell and Stanley (let alone mastered the content in this slim but brilliant basic work) is similar to claiming to be a philosopher of science and to have never heard of Kuhn and Popper and to find their work interesting and informative after having been introduced to it by someone from another area and specialty altogether. In a word, you would not be an educational researcher or have developed the associated tacit knowledge and experience needed to be one, other than in the self-proclaimed and self-professed sense, without knowing about and having mastered the basic content in Campbell and Stanley *and the research tradition and lineage it established*. New is not necessary progress or exemplary, and old not only can be very good but both wonderful and excellent. The problem is science educators, professors of science education, and (alleged) science education researchers who cannot do scientific research of the modern kind, as it is not part of their training or experience,

which was the implicit thrust of Shulman et al.'s (2006) article and arguments recently, which we discussed in our original review of Geelan's book.

We believe that Geelan's self-descriptions and self-admissions make it "point, set, and match" in our "differing views volley" of the issues and questions at hand, but there is a related point of importance that also needs to be made here concerning taking horses of any kind out for gallops before proceeding to even more important issues and concerns.

We would like to point out that when speaking of Tristram Shandy and Hobby Horses, as well as little old ladies of both sexes, and using them as rhetorical devices to make and attempt to win points, one needs to remember that Tristram's wounds, problems and short-comings were *self-inflicted* and that stream of consciousness is neither science nor philosophy but may be the beginnings of both with judicious weeding and hard work as we (and Voltaire) have elaborated elsewhere (see Perla and Carifio, 2005). In a word, discourse analysis requires very careful and close reading of works and metaphors and allusions in particular, if they are not going to become suicidal and self-eviscerating rhetorical devices.

Metaphoric and Logical Operativity

As we have pointed out in many works, metaphor is one of the basic fundamental units of intellectual, emotional and social discovery (and communication) similar to the ways in which the joke (i.e., humor and all of its variants) is the prototype of modern scientific method and the classic rules of engagement and dispute resolution. Metaphor is also a prototype for a particular mode of discourse and inquiry, and thus a particular kind of research methodology and tradition. Metaphor, therefore, is important, and important in science, even though it has many inherent and often high risk difficulties and dangers, as any practicing or theoretical scientist will attest, particularly if this scientist is at the fuzzy cutting edge of her or his science.

We are no strangers to metaphor and their various functions and uses and can construct and deconstruct them with both nuanced and experienced skill. One of us, in fact, coined and successively developed the concept of metaphoric operativity (see Carifio, 1973) and its various essential functions in cognition and cognitive development as well as in inquiry, thought, exploration and discovery processes and particularly so in cutting edge science. Further, we have written extensively on these concepts and issues in terms of theory, theory change, epistemology and the nature of science, scientific knowledge and scientific change, and particularly in terms of how metaphoric operativity is to some degree the "dark matter" of cognition and science (see Perla and Carifio, 2005, and 2006a).

But we have also outlined in detail how metaphoric operativity cannot be separated or disengaged from logical operativity, for very long or in the end, without serious risks and a very high probability of undesirable and highly problematic consequences, which is one of the problems we found with Geelan's work as well as his response to our critical review of it and his self-admission that logic was not something to be considered in his work or used in the evaluation of it. In our model, theory, and view both metaphorical and logical operativity must be managed and used together along with high quality empirical data and approximately true experiments to arrive at new and synthetic knowledge and truths in the manner and by the processes described by Kemeny

(1959). In fact, we are also the first to have asserted that what Frankfurt (2006) calls bullshit is not *always* bad or subversive to the truth; rather it is *often* a highly dynamic and necessary matrix for the *development* of expressive, creative, critical and higher order thinking and representations (including metaphors) that gives birth to the truth or/and new truths (see Perla and Carifio, 2006a for details). So we believe that it is difficult to say or imply that we do not appreciate or are unknowledgeable about romances and romance methodology (rhetorical or otherwise), or the romantics in science and science education. We are well versed and well practiced in these areas and forms of inquiry which gives us critical insight into them as well as caution about using them and particularly so as an exclusive inquiry strategy.

We do not reject, demote, nor dismiss metaphor or metaphoric operativity and all that is associated with it, and, in fact, include it and give it strong weighting in all of our work and views. However, we also do not reject, demote or dismiss logic, logical operativity, modern views of theory as well as inquiry, nor the scientific and experimental methods of science like Geelan and numerous others in science education both do and have done. Further, we consider such rejections ‘excessive and exaggerated exuberance’ and, like Keyes and Greenspan, a psychological phenomenon and something that needs to be “flushed out of the marketplace” of discourse, research and inquiry. This particular point is a subject and an area where the sound of one hand clapping is not sufficient. Further, doing critical reviews of issues, views and advocated models and theories in science education and science education research currently is not a “hobby” or a “hobby horse” for us, but rather an absolute professional necessity given the current state of affairs in science education and among science educators, as noted by many others than just us as Geelan claims (see Mathews, 1993, 1994 and 1997; Fensham, 2004; and Schulman et al, 2006). Thus the need for us to reply to Geelan’s response, and somewhat more explicitly than in our original critical review, as none of the points we raised regarding theory (dead or otherwise), eclecticism (as opposed to syncretism), educational constructivism (as opposed to psychological constructivism) and modern scientific method (and most particularly falsification) and research were addressed (let alone countered) by Geelan who only succeeded in raising a whole new set of issues and problems in his response. Our view is that one must both develop and judiciously use and manage both logical and metaphoric operativity in all contexts; however, metaphoric operativity in particular must be disciplined and bounded for a variety of reasons and constantly connected and reconnected to logical operativity, because metaphoric operativity does not have, and perhaps cannot have any rough algorithmic precision or metrics, or established rules of engagement and dispute resolution, which is its most fundamental of flaws and Achilles heel that must be well protected. This very characteristic, moreover, leads to other critical problems.

Eclecticism

Eclecticism (as opposed to Syncretism) has a long philosophical (and non-philosophical) tradition and waxes and wanes as a “framework of choice.” The waxing and waning is a function of many factors including the development of the area or discipline, the development of the person, or the person embedded in a particular pragmatic context or situation. In a very loose and very misleading way, most scientific disciplines could be said to be “eclectic,” as they are or tend to be a collection or family

of different theories, with some of the theories being to some degree contradictory or incommensurate with each other (e.g., relativity and quantum theory) for some period of time *significantly less* than “forever” or “always.” The key and critical differences and characteristics here, however, are (1) the collections of theories that are a discipline are a macro set of entities or elements, (2) all of the entities (i.e., theories) in the set are internally consistent to some minimal degree, or there is an acute, explicit, and specific awareness of exactly how they are not, and (3) this same acute, specific and explicit awareness criterion and demand is applied to the internal relationship and consistencies of all of the theories (elements) in the macro set to each other.

Scientists, and those who are scientifically minded in all fields of study (including education and educational research), work very consciously and very assiduously to ensure that each theory in the set is internally consistent, does not have self-contradiction claims or predictions, has a parsimonious and generative explanatory “inner belt and core,” and is falsifiable and thus testable to some degree. These unglamorous and unromantic activities are the routine maintenance and housework that practicing scientists do not leave undone or ignore for very long, or see if they can hire someone to come in and do for them (or outsource). And they also do this “routine maintenance and housework” (i.e., “weeding”) at the macro level between theories in the set, trying to insure that they are working on and making progress towards a “grand unified (macro) theory of everything” in their area, on an on-going and daily basis, typically using standard models to indicate and describe where they currently are and are not successful in these discipline and framework maintenance tasks and responsibilities. Scientists take Voltaire seriously and to heart, and they *tend their own gardens assiduously* (if only to prevent Jonathan Swift from showing up and doing it for them), and because they do so consciously and assiduously not only do all of the theories in a given discipline fit together to some known (and usually very high) degree, but so do all of the different scientific disciplines themselves allowing all of those now much prized interdisciplinary endeavors in science today. These endeavors are due to scientific disciplines and scientific theories being *syncretic* as opposed to *eclectic*, as these two terms are in fact polar and logical opposites of each other.

Syncretism (as opposed to eclecticism) imposes the criteria on any framework or theory that the parts being brought together and bracketed as a framework or theory are consistent and not logically contradictory or logically contradictory with other core postulates and tenets within the framework, or outside of the framework in the macro framework of which the framework is part. Syncretism also has the further requirement that the parts brought together are not forced or slammed together to “make” a coherent whole. Syncretism also imposes the responsibility and accountability that these conditions are met on the creator and proponents of the framework or theory in question, who are not allowed to celebrate at all or to be out romantically playing and dancing around like medieval minstrels until they have done the hard scut-work of assiduously tending their gardens. As this is such a hard task, and as creators and disciples are human (despite reports and claims to the contrary), the importance of help on these tasks from colleagues and critics becomes both obvious and transparent, particularly as housework and routine (intellectual) maintenance is so unpopular and unfashionable today, and something that busy modern practitioners and professors claim that they have no time for, particularly if the efforts required are too demanding or

rigorous. It is far, far easier to just move on to the next problem, speech, discourse, framework, theory or village like the Sophists of old and leave all of the inconsistencies, contradictions and problems created behind you or out on various hillsides to die.

Eclecticism and eclectic framework and philosophies (as they are not theories) historically have tended to be or become a hodge-podge of inconsistent, contradictories and irreconcilable elements and views. Eclecticism (discipline or otherwise) is a model and view that is essentially and inherently incommensurate with moderns views of (scientific) theory and the principle and doctrine of falsification. For example, how does one falsify a metaphor or an inconsistent and (internally) contradictory eclectic theory or framework, and how would one know or be sure logically or in fact that one had done so, as the falsification might be a confirmatory test for other elements and principles in the eclectic theory or framework. *Old* psychoanalytical theory is an exemplar of this particular and critical point, and the incessant critical comments it drew of “could you be a little more specific about step 2 please” and its “here a miracle occurs” claims. Further, if an eclectic theory was really disciplined (i.e., all of inconsistencies and contradictions weeded out), it would begin to be transformed into modern scientific theory, as it became more and more disciplined and testable, which, as we have pointed out, is both hard and difficult work, which a great many people, particularly in educational disciplines, do not want to do today. So Geelan’s assertion in his book and his response to our critical review that he espouses ‘disciplined eclecticism’ is, in our view, saying that he does espouse modern scientific theory by the back door under another name, sort of, but without all of the hard and difficult work required to actually bring it into being, which he could do, however, if he were actually required to do so, or so he claims. In these respects, Geelan is not atypical to those in science education and education today, in our view.

Science education, as we point out in our review, is rife with “core contradictions” today, which must be addressed quickly. These core contradictions are a fairly wholesale rejection of modern scientific theory, modern learning theory, and modern scientific research methodology by science educators, science educator researchers and professors of science education, as well as a seemingly lack of awareness of (or stonewalling of) these core contradictions, never mind a broad and sophisticated understanding of them by many who most loudly claims these kinds of knowledge and expertise, based upon, what seems to be (from Geelan’s self-admissions) very little first hand experience or knowledge of history or “the classics” of various research traditions. Our central point has consistently been that this state of affairs, as well as not doing something about it quickly and significantly, is simply not going to get science educators or science education to the “Big Dance” now or in the future. Further, it is for these reasons that we have focused on the current preparation and competencies of science educators and science education researchers currently, and, like many others, are concerned with the training and education that they are receiving. Our concerns also extend to mathematics educators and other educators who we are equally if not more concerned about in terms of all we have had to say here and elsewhere.

Theory Revisited

It is unfortunate in our view, that Geelan (and his supporters) never seem to save the last dance for theory or consistency or the experiment (as he and they should) unless forced too (by a review such as ours) before packing it in for the night and eventually finding their way home. Consequently, we are sorely tempted to end this rejoinder by quoting Robert Frost's poem *Revelation*, and its focus on "light words that tease and flout," but will not, as science and science education are simply too important and far too deep in very serious difficulties right now to just dance around and play rhetorical games, particularly for the fun of it and in the village square. It may take awhile and be currently very unpopular and unromantic, but fortunately, in the end, the Context of Justification will "speak and tell us all exactly where [we] are."

We are asserting the need for science education and education in general to focus strongly and resolutely on the Context of Justification as opposed to the Context of Discovery (or Justified Sinning) *alone* in order to re-establish needed balance and tamp down and tame the excessive exuberance in science education and education in general today. To achieve this goal will require becoming more academically and intellectually sober and serious (but not tee-totaling!), and mastering and practicing modern scientific, theory-driven, falsification-incorporating experimental research and criticism to the standards of current practicing scientists, which will require learning all of the steps, including the sophisticated ones, and having the appropriate first hand experiences to appropriately dance with both quantitative and qualitative data as well as to use critical reviews (anonymous or otherwise) to alter and improve one's routines and dance game (see Mayer, 2007 for further details).

Achieving this goal will also require asserting as well as mastering the classic rules (and logic) of engagement and dispute resolution in science (once again) and actually practicing them. It will also require better neutralizing various power games and plays that attempt to hijack and/or commodore these classic rules (and logic) of engagement and dispute resolution and a better understanding of the signs, process, and nuances of these attempts as well as the strategies and devices that have classically been successful in both short-circuiting and clearly characterizing them. When it comes to metaphors, allusions, and conceits and deconstructing them, as well as discourse, critical and deconstruction analysis of text, views, policies, conclusions, inferences or recommendation, one needs to remember that both a complete and full analysis, and processes that constrain and weed the results, are needed to avoid self-eviscerations, suicides, and the propagation of critical (and often unconscious) misconceptions, misunderstanding, and unintended claims. There are a plethora of exemplary models, methods and exemplars for doing this type of inquiry, research and criticism in a variety of areas outside of what one sees as exemplars in education currently.

Similarly, we pointed out that logical and metaphoric operativity are not mutually exclusive and independent phenomena or processes and that they are two sides of a single (research) coin or anchoring ends of a non-linear (research) continuum with one side of the coin or end of the continuum weighted more strongly in certain "exploratory or confirmatory" contexts and situations, but that never get "shut off" in any given situation other than pathological ones. This same point holds for "thoughts and feelings," as well as "logic and rhetoric," and "qualitative and quantitative," which we have elaborated on elsewhere (see Perla and Carifio, 2005). We additionally indicated that eclecticism (as opposed to syncretism) waxes and wanes in education and is

currently in the waxing phase (in our opinion), but that eclecticism historically has tended to be or become a hodge-podge of inconsistent, contradictory and irreconcilable elements and views, which in turn spawn decay due to a lack of assiduously tending to the garden and doing all of the maintenance and nurturing needed. This thoroughly modern problem not only creates many problems and dis-functionalities, but actually creates and escalates external pressures and problems. We also outlined in detailed how eclecticism is a model and view that is essentially and inherently incommensurate with modern views of (scientific) theory and the principle and doctrine of falsification. As we said, how does one falsify a metaphor or an inconsistent and (internally) contradictory eclectic theory or framework? We also outlined how “disciplined eclecticism” is a contradiction in terms, and if executed in the required number of successive iterations how (logical) weeding would transform the disciplined eclecticism in question into to modern scientific theory that could be falsified and thus tested.

As we have said above and in our original review, we do not believe that word play, rhetoric, romanticism and eclectically playing around is going to get science education and science educators to the Big Dance, which is exactly where we believe science education and science educators need to get to and be today because of the importance of science in the modern world and to modern economies. It is also our view that the only way science education and science educators are going to get to the Big Dance is through serious and hard work, redressing excessive exuberances, declining misleading and diversionary (passive-aggressive) dance invitations that attempt to sweet-talk and romance them into situations and contexts that are not only self-contradictory and not consonant with their basic character and values, but also fundamentally risky and unhealthy, and, even more importantly, by not saving the last dance for modern scientific theory but rather making it the first and last dance on one’s dance card. It is our view that it is time for science education and science educators to sober up, get serious, learn the requisite intellectual, academic and disciplinary traditions, and to stop playing and dancing around in the village square while science education goes up in romantic flames, and particularly so when it comes to theory, research, learning, instruction, science and scientific rules of engagement and rules of dispute resolution, and the future of everyone’s children worldwide.

Note. This work is a collaborative work to which each author has contributed equally.

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About the Authors

James Carifio

Graduate School of Education
Dept. Leadership in Schooling
University of Massachusetts Lowell
61 Wilder Street
Lowell, MA 01854 USA

James_Carifio@uml.edu

James Carifio is a Professor in the Graduate School of Education at the University of Massachusetts Lowell. His interests include measurement, cognition, mathematics and science education, and complex problem solving. Dr. Carifio teaches courses in research design and data analysis, cognitive psychology and learning theories. His current research

projects focus on developing and validating an integrated standard information processing model (and theory) of learning.

Rocco J. Perla

UMass Memorial—HealthAlliance Hospital
Mount Wachusett Community College

Rocco J. Perla is a biological scientist and science educator who has done basic research in medicine and epidemiology over the past decade. He teaches and mentors graduate and undergraduate students in the life sciences. Dr. Perla's research in science education is interdisciplinary and focuses on scientific, cognitive, and philosophic literacy as well as developing models of scientific change, progress, and decision-making.



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Editors

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