*Comments on Bulterman-Bos*

# What Should Education Research Do, and How Should It Do It?

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In this article, three theoretical perspectives are used to extend Bulterman-Bos's (2008) argument regarding a clinical approach to education research. First, three intellectual virtues identified by Aristotle—*episteme*, *techne*, and *phronesis*—are related to the requirements of the "pure" education researcher, the skilled practitioner, and the clinical researcher, respectively. Second, Churchman's typology of inquiry systems—based on whether the primary source of evidence is logic, observation, representation, dialectic, or values—is offered as a way of conceptualizing different kinds of inquiry in education. Third, recognizing that much practitioner knowledge is tacit, Nonaka and Takeuchi's model of knowledge conversion is suggested as a tool with which knowledge gained through different methods of inquiry might be brought into productive dialogue.

**Keywords:** education research; epistemology; inquiry systems; Nicomachean ethics

In the article that provides the focus for this dialogue, "Will a Clinical Approach Make Education Research More Relevant for Practice?" (this issue of *Educational Researcher,* pp. 412–420), Jacquelien A. Bulterman-Bos raises two central questions about education research: What should education research seek to do, and how should it go about doing it?

Stokes (1997) suggests that two issues are crucial in the conduct of research: whether the research is conducted with a concern for how the results of the research will be used, and whether the research is conducted with a concern for fundamental understanding (Table 1). Where neither of these is a concern, the result is applied research unmotivated by applications, which Stokes suggests is exemplified by the Danish astronomer Tycho Brahe. Where use is a concern, but fundamental understanding is not, the result is pure applied research, exemplified by the work of Thomas Edison. Conversely, where fundamental understanding is a concern, but application is not, we have pure basic research, exemplified by the work of the Danish physicist Niels Bohr. Finally, where considerations of use and fundamental understanding both are important, we have "Pasteur's quadrant"—use-inspired basic research.

**Table 1**
***Quadrant Model of Scientific Research***

| Quest for fundamental understanding? | Considerations of Use? | |
|---|---|---|
| | **No** | **Yes** |
| Yes | Pure basic research (Bohr) | Use-inspired basic research (Pasteur) |
| No | Applied research unmotivated by applications (Brahe) | Pure applied research (Edison) |

*Source:* Stokes (1997).

Almost from its emergence as a field of inquiry, education research has been criticized for its lack of relevance to practice—and in particular for emphasizing a quest for fundamental understanding at the expense of considerations of use. In 1945, J. Cayce Morrison, assistant commissioner for research in the State Education Department in New York, lamented that there was "too wide a gap between research at its best and much of its practice in education" (p. 243).

The frustration appears to be caused, at least in part, by an expectation that although it was easy to accept that problems in nuclear physics and rocket science might be difficult to solve, educational problems should be much more tractable. As early as 1917, H. L. Mencken pointed out that problems in the social sciences were generally far more complex than they appeared: "There is always an easy solution to every human problem—neat, plausible, and wrong" (Mencken, 1917/1949, p. 443).

A similar perception appears to have driven Robert F. Kennedy, in the hearings of the Senate Subcommittee on Education in 1966, to ask the commissioner of the U.S. Office of Education, Harold "Doc" Howe II, "What happened to the children? Do you mean you spent a billion dollars and you don't know whether they can read or not?" (cited in McLaughlin, 1975).

Implicit in such criticism is often an underlying belief that education researchers make things complicated because they enjoy or value the complexity. Although there may be a small element of truth in such criticism, in most cases researchers make things complicated because they are complicated; they have

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learned that approaches that elide—or refuse to acknowledge—the complexities have not been successful in addressing the challenges of improving educational outcomes. Consider the issue of class-size reduction policies (CSRPs).

CSRPs are an attractive route to improving educational achievement, being popular with both parents and teachers. However, given the high cost of implementation, it would seem advisable to get some clear evidence of the likely benefits before embarking on such a program, especially given the political difficulties of reversing such reforms.

The issue of class-size reduction would seem to be an ideal candidate for rigorous, high-quality research, and indeed there is no shortage of well-designed studies on the effects of CSRPs. Perhaps the best known of these is the Tennessee Student–Teacher Achievement Ratio (STAR) study, described by Mosteller (1995) as "one of the greatest education experiments in United States history." Teachers and students in kindergarten and first grade were assigned at random to small classes (13–17 students), large classes (22–26 students), or large classes with a teacher's aide. By the end of third grade, student achievement in the smaller classes was significantly higher, especially in reading, and the gains were most marked for socioeconomically disadvantaged students and those from minority ethnic communities. More important, when the students returned to larger classes, although some of the advantage of the smaller classes diminished (Krueger & Whitmore, 2001), students who had experienced smaller classes had a lower rate of grade retention (Pate-Bain, Boyd-Zaharias, Cain, Word, & Binkley, 1997) and higher aspirations to continue education beyond secondary school, evidenced by an increased tendency to take the SAT (Krueger & Whitmore, 2001). The fact that the improvements were maintained over such a long period of time is significant because so many educational interventions have yielded initially promising effects that disappear when a program is ended (e.g., Head Start; see Brody, 1992, pp. 174–178).

The size of the impact found in the STAR study was equivalent to an extra 3 or 4 months of learning per year for the students in the smaller classes, with effects up to twice as great for minority students. So far, so good. Except, of course, it is not as simple as that. First, the STAR study appeared to have no difficulty in recruiting additional teachers without a reduction in average teacher quality, which is unlikely to be the case when such a program is implemented on a statewide or national basis (what economists call equilibrium effects). In evaluating a CSRP in California, Jepsen and Rivkin (2002) found that the decline in teacher quality reduced, and in some cases completely negated, the effect of smaller classes. Second, the STAR study found that the smaller classes made faster progress in kindergarten and first grade, and thereafter the gap between the smaller and larger classes stayed constant. The fact that the earlier gains were maintained is important, but so is the fact that smaller classes appeared to confer little benefit in second grade and beyond. Indeed, a finding across much of the research literature on CSRPs is that effects are strongest in Grades K to 3, weaker in Grades 4 to 8, and practically nonexistent in Grades 9 to 12. These two points suggest that the benefits of CSRPs as systemwide reforms are likely to be significantly smaller than those found in the STAR study and that the money might be spent more profitably in other ways. The researcher working in Bohr's quadrant, concerned only with fundamental understanding, might be content to stop here, but the fundamental limitation of this analysis is that it tells us only about what did happen in the STAR study rather than what *might be* possible with reduced class sizes. One of the most intriguing findings of the study is that the teachers in the study did not appear to have changed their teaching approaches very much. Clearly, some teaching approaches that are feasible with 15 students are more difficult with classes of 22 and may be impossible for the average teacher with a class of 30 students. It is possible, therefore, that the *potential* effects of CSRPs may be significantly greater than has been found to date, because few studies have systematically investigated class-size reduction combined with in-service training for teachers on how they can best make use of smaller classes (although there are significant exceptions, such as Blatchford, Basset, Goldstein, & Martin, 2003).

The lesson I wish to draw from this brief example is that in education what we can learn from the scientifically detached approach—in the terminology used by Labaree (2003), an approach that emphasizes the analytic, the theoretical, the universal, and the intellectual—provides only a part of the story, and the scientifically detached account is partial in both senses of the word. It provides only a partial picture, and more important, it is a picture that is actually misleading. As the work of Blatchford et al. (2003) shows, class-size reduction programs do offer significant possibilities for improving educational outcomes at scale but only when they are combined with well-designed programs of in-service support for teachers.

So what seemed at the outset to be a very clear, simple question does not have a clear, simple answer. Given the equilibrium effects and the age specificity found in most CSRPs, it seems that the costs may well not justify the benefits, and other uses of the money could well produce better returns. If, however, the question is changed from "By how much have class-size reduction programs improved student outcomes in the past?" to "By how much *can* class-size reduction programs improve student outcomes?" then we may get very different answers, but only if we are prepared to tangle with the messy reality of the contingent and the variable.

The relationship between physics and engineering may be an instructive parallel here. To design a bridge that will be safe in operation, it is necessary to know the physical properties of the materials to be used, such as knowing that stone is a reliable material to use in compression but behaves unpredictably in tension, whereas steel and, to a lesser extent, wood are relatively predictable in their behavior in both tension and compression. However, precise knowledge of these kinds of properties does not provide any guidance about what the bridge should look like. The detailed knowledge of the physical properties of the materials will indicate whether a particular design is likely to be effective, but they do not, by themselves, provide guidance about how to generate the design. Designing a bridge requires knowledge of the properties of the materials, to be sure, but at its heart is a creative process, substantially underdetermined by the physics.

In the same way, the challenge of "engineering" effective learning environments requires knowledge of the findings of education research, but this research, no matter how well it is

done, underdetermines what is possible. Rather than limiting the enterprise of education research to the pursuit of "knowledge" (in the sense of collections of items of generally agreed on information) and the development of theories, it seems therefore that a more appropriate focus would be that of actually moving people—teachers, teacher educators, school administrators, policy makers, and so on—to action (Wiliam & Lester, 2008).

This is the heart of the argument made by Bulterman-Bos—a call for a change in focus in education research from what is *correct* to what is *good,* echoing the arguments made by Bent Flyvbjerg (2001) in his book *Making Social Science Matter*. Flyvbjerg argues that social inquiry is at its least successful when it attempts to emulate the natural sciences, adopting as its central criterion analytic rationality. In contrast, social inquiry is at its most successful when it focuses instead on value rationality (Weber, 1914/1978).

In framing this argument, Flyvbjerg (2001) draws on the three principal intellectual virtues proposed by Aristotle (2000) in the *Nicomachean Ethics: episteme*, *techne,* and *phronesis*. *Episteme* (ἐπιστήμη) concerns knowledge of eternal and universal truths, such as the fact that the base angles of an isosceles triangle are equal. Once one has established, for example by reasoning from Euclid's postulates, that the base angles of an isosceles triangle are, indeed, equal, there is no need to reverify that it remains the case on another occasion. As *episteme*, it will be true for all time and all (Euclidean) space. *Episteme* equates to what we call scientific knowledge, and according to Aristotle,

> is a state by which we demonstrate, and has all the other distinguishing characteristics we add in the *Analytics*. For it is when a person believes in a certain way and understands the first principles that he has scientific knowledge: if he fails to understand the first principles better than the conclusion, he will have scientific knowledge only in an incidental way. Let this, then, be our definition of scientific knowledge. (Aristotle, 2000, p. 105, 1139b)[1]

*Episteme* therefore embodies the notion of scientific detachment. The privileging of scientific detachment is not necessarily a philosophical choice—it could be driven simply by a concern for parsimony. On the grounds that, all other things being equal, parsimonious explanations are to be preferred to more complex and convoluted explanations, then the attraction of scientific detachment is clear. If we can establish that something is always the case, then once this has been done, we can rely on the same truth forever and in all contexts. However, scientific detachment delivers the goods only where such timeless universal truths exist. Where they do not, different intellectual virtues are required.

*Techne* (τεχνη), in contrast, is the virtue of being able to bring into being those things that are contingent and variable. *Techne* is variously translated as art, craft, or skill. It differs from *episteme* in that *episteme* is concerned with things that are the way they are of necessity (otherwise they would not be eternal truths), whereas *techne* deals with things that could be different from what they, in fact, are.

> Included within the class of what can be otherwise are what is produced and what is done. Production and action are different (we can rely here also on our popular accounts). So the practical state involving reason is different from the productive state involving reason. Neither is therefore included in the other, since action is not production, nor production action.
>
> Since building is one of the skills [*techne*] and is essentially a productive state involving reason, and since there is neither any skill that is not a productive state involving reason, nor any such state that is not a skill, skill is the same as a productive state involving true reason.
>
> Every skill is to do with coming into being, and the exercise of the skill lies in considering how something that is capable of being or of not being, and the first principle of which is in the producer and not the product, may come into being; for skill is not concerned with things that are or come into being by necessity [this would be the domain of *episteme*], or with things that are by nature (since they have their first principles within themselves). Since production and action are different, skill must be a matter of production, not action. (Aristotle, 2000, p. 106, 1140a)

Although Aristotle discussed *techne* in terms of the ability to make things such as tables and buildings, the ability to bring into being, for example, an effective tax regime, would also be regarded as *techne*. It is the ability to bring into being those things that need not be the way they are. By itself, however, *techne* is no guarantee that the building, the table, or the tax regime will be fit for the purpose for which it was created.

Aristotle's third principal intellectual virtue, *phronesis* (φρόνησις)—"prudence" or "practical wisdom"—in some senses transcends both *episteme* and *techne* because it concerns the problem of acting rationally (literally, "along with reason") in situations that are contingent and variable. According to Aristotle, *phronesis* is a person's ability "to deliberate nobly about what is good and beneficial to himself" (Aristotle, 2000, p. 107, 1140a). Aristotle points out that this is quite different from *episteme* because there is no point in deliberating about things that are universally true—*phronesis* requires knowledge of particular (variable and contingent) circumstances. *Phronesis* is also different from *techne* because it is designed to move people to action rather than to production. Aristotle's point here is that *techne* is product oriented because the aim of the production is not the production itself but the product, whereas action is process oriented—the end is doing *well*.

Because *episteme* deals with universal truths, it is independent of individual experience. Those with different experiences should be able to agree on the extent to which a particular claim is universally true (the "view from nowhere" supposedly secured with scientific detachment). With *phronesis*, however, individual experience is crucial:

> What I have said is supported by the fact that, though the young become proficient in geometry and mathematics, and wise in matters like these, they do not seem to become practically wise. The reason is that practical wisdom is concerned also with particular facts, and particulars become known from experience; and a young person is not experienced, since some experience takes a long time to produce. (Aristotle, 2000, p. 111, 1142a)

Although *phronesis* is relevant only when there is no universal truth, that does not mean there are no general principles involved. *Phronesis* is the practical wisdom to act well by the successful integration of general principles with detailed consideration of the specificities of the particular case in question. From this perspective, the notion of clinical research practice involves, for the practitioner, a move from *techne* to *phronesis*. Although the primary intellectual virtue required of the traditional education researcher is closest to *episteme*, and the expert practitioner demonstrates *techne*, the teacher–researcher envisaged by Bulterman-Bos transcends these by the acquisition of *phronesis*. It requires the knowledge of the general findings from the education research literature but also requires the ability to interpret these general principles in the light of a specific context of practice.

The physical sciences have succeeded because they have focused on *episteme*. And there are some aspects of the social sciences that are fruitfully explored with *episteme*. But in the main, in the social sciences and specifically in education, there are few universal truths because successful action will always require the integration of general principles and specific contextual details. In this context, it is important to note that although some authors have likened the distinction between *episteme* and *phronesis* to the distinction between quantitative and qualitative approaches to inquiry (e.g., Laitin, 2003), this is emphatically not the case, as Flyvbjerg (2001) notes:

> Phronetic social science is opposed to an either/or and stands for a both/and on the question of qualitative versus quantitative methods. Phronetic social science is problem-driven and not methodology-driven, in the sense that it employs those methods which for a given problematic best help answer the four value-rational questions [Where are we going? Who gains and who loses, and by which mechanisms of power? Is this development desirable? What, if anything, should we do about it?]. More often than not, a combination of qualitative and quantitative methods will do the task and do it best. (p. 196)

Although Aristotle's account is useful for thinking about the kinds of expertise that might be required of different roles in the educational enterprise, this formulation provides little advice about how the expertise might be acquired or developed (apart from simple accumulation of experience). For this, the classification of different kinds of systems of inquiry proposed by Churchman (1971) provides a useful organizing principle.

Churchman (1971) proposed a classification of inquiry systems based on what was the primary or most salient form of evidence, and he labeled each category of the inquiry system with the name of a philosopher whose own stance, according to Churchman, typified the category: Leibniz, Locke, Kant, Hegel, and Singer.

In the *Leibnizian* inquiry system, certain fundamental assumptions are made from which deductions are drawn by the use of formal reasoning. In a Leibnizian inquiry system, the most important form of evidence is rationality—whether the conclusions follow logically from the assumptions. The obvious example of a Lebnizian inquiry system is pure mathematics. Although there may conceivably be occasions in education research when such methods are appropriate, they are generally inadequate—typically, inquiries into educational phenomena require some sort of empirical data from the situation under study.

In what Churchman called a *Lockean* inquiry system, the main source of evidence is observation of the world. Empirical data are collected and then an attempt is made to build a theory that accounts for the data; or conversely, multiple theories are developed that generate testable hypotheses that can then form the basis of a "crucial experiment," which will indicate which of the theories is correct. This is the standard method of inquiry for the physical, life, and earth sciences. The major difficulty with a Lockean approach is that, because observations are central, it is necessary for all observers to agree on what they have observed, leading to the need for the "scientific detachment" described by Bulterman-Bos. If observers disagree on what they have observed, if the evidence is in doubt, then the Lockean inquirer cannot begin.

Philosophers of science have long recognized that all observations are theory dependent. As Werner von Heisenberg observed, "What we learn about is not nature itself, but nature exposed to our methods of questioning" (quoted in Johnson, 1996, p. 147). Nevertheless, there are many situations, even in the social sciences, where considerable progress can be made because the relevant data are sufficiently widely agreed on to provide a fruitful starting point for the Lockean inquirer.

Where there is no such sufficient agreement about what the relevant data are, then a *Kantian* inquiry system is more appropriate. The Kantian inquirer accepts that there can be no such thing as "scientific detachment." What is generated by any theory will inevitably be, to an extent, a consequence of the assumptions made by the inquirer about what constitutes the relevant set of data. Kantian inquiry involves the deliberate framing of multiple alternative perspectives on both theory and data (thus incorporating both Leibnizian and Lockean systems). This could be done by building different theories on the basis of the same set of data; alternatively, two (or more) theories related to the problem might be generated. For each theory, appropriate data would be collected, and it is entirely possible that different kinds of data might be collected for each theory.

In practice, this might mean that researchers would construct competing explanations on the basis of the same set of data. These perspectives would result in part from their engagement in serious reflection about their underlying assumptions and in part from submitting their data to the scrutiny of other persons who might have a stake in the research. It may not be immediately apparent where these theories overlap and where they conflict, and indeed, these questions may not be meaningful, in that the inquiries might be incommensurable (Kuhn, 1962). However, by analyzing the inquiries in more detail, it may be possible to begin a process of theory building that incorporates the different representations of the situation under study.

This idea of reconciling rival theories is more fully developed in a *Hegelian* inquiry system, where antithetical and mutually inconsistent theories are developed. Not content with building plausible theories, the Hegelian inquirer takes a plausible theory and then investigates what would have to be different about the world for the *exact opposite* of the most plausible theory itself to be plausible. A crucial question for the Hegelian inquirer is, "What would have to be different about the world for the exact

opposite of my conclusion to be plausible?" If the answer is "not very much," then this suggests that the available data underdetermine to a significant degree the interpretations that are made of them.

The tension produced by confrontation between conflicting theories forces the assumptions of each theory to be questioned, which might then result in sufficient clarification of the issues to make possible a coordination, or even a synthesis, of the different perspectives, at a higher level of abstraction. The differences between Lockean, Kantian, and Hegelian inquiry systems were summed up by Churchman (1971) as follows:

> The Lockean inquirer displays the "fundamental" data that all experts agree are accurate and relevant, and then builds a consistent story out of these. The Kantian inquirer displays the same story from different points of view, emphasizing thereby that what is put into the story by the internal mode of representation is not given from the outside. But the Hegelian inquirer, using the same data, tells two stories, one supporting the most prominent policy on one side, the other supporting the most promising story on the other side. (p. 177)

It is tempting to view these four inquiry systems as a hierarchy, and in one sense, there undoubtedly is a logical order relation. The Hegelian inquiry system is a special case of a Kantian inquiry system, where the multiple representations are constrained to create a dialectic. The Lockean inquiry system (which clearly subsumes the Leibnizian inquiry system) is also a special kind of Kantian inquiry, where one representation is singled out as privileged. However, this does not mean that Kantian inquiry systems are always to be preferred, because this may produce such complexity that progress is impossible—the most complex representation of a problem is not necessarily the most useful. There is a trade-off between parsimony and completeness, and therefore there is a choice to be made. In other words, we can inquire about inquiry systems, questioning the values and ethical assumptions that these inquiry systems embody.

This inquiry into inquiry systems is itself, of course, an inquiry system, which is termed *Singerian* by Churchman (1971) after the philosopher E. A. Singer (see Singer, 1959). Such an approach requires a constant questioning of the assumptions of inquiry systems. Tenets, no matter how fundamental they appear to be, are themselves open to challenge in an effort to cast a new light on the situation under investigation. This questioning leads directly and naturally to examination of the values and ethical considerations inherent in theory building.

In a Singerian inquiry, there is no solid foundation. Instead of asking what "is," we ask what the implications and consequences are of different assumptions about what "is taken to be."

> The "is taken to be" is a self-imposed imperative of the community. Taken in the context of the whole Singerian theory of inquiry and progress, the imperative has the status of an ethical judgment. That is, the community judges that to accept its instruction is to bring about a suitable tactic or strategy. . . . The acceptance may lead to social actions outside of inquiry, or to new kinds of inquiry, or whatever. Part of the community's judgement is concerned with the appropriateness of these actions from an ethical point of view. Hence the linguistic puzzle which bothered some empiricists—how the inquiring system can pass linguistically from "is" statements to "ought" statements—is no puzzle at all in the Singerian inquirer: the inquiring system speaks exclusively in the "ought," the "is" being only a convenient *façon de parler* when one wants to block out the uncertainty in the discourse. (Churchman, 1971 p. 202)

Within a Singerian inquiry system, one can never separate out the meanings of a piece of research from its consequences. Education research is a process of *representing* educational processes, and the representations are never right or wrong, merely more or less appropriate for a particular purpose, and it is perfectly fair to expect the researcher to defend the appropriateness of the representations. Greeno (1997) suggests that education researchers should assess the relative worth of competing perspectives by determining which perspective will contribute most to the improvement of educational practice; of course, as Greeno notes, this evaluation must take into account the constraints of the available resources (both human and financial), the political and social contexts in which education takes place, and the likelihood of success. Although the Lockean, Kantian, and Hegelian inquirers can claim to be producing knowledge for its own sake, Singerian inquirers are required to defend to the community not just their methods of research but which research they choose to undertake.

Singerian inquiry provides a framework for debating the issues raised by Bulterman-Bos about the nature of education research. At one extreme, should all education research be undertaken only by those with substantial practical experience as educators? Or at the other extreme, should we value as knowledge only that produced by studies designed from the outset to be widely generalizable? In a Singerian framework, both are defensible, but researchers should be prepared to defend their decisions. The fact that the results of action research are often limited to the classrooms in which the studies are conducted is often regarded as a weakness in traditional studies. In a Singerian framework, however, radical improvements on a small scale may be regarded as a greater benefit than a more widely distributed but less substantial improvement.

To sum up the argument so far, I have suggested that education research should be broadened by an acceptance that a complete reliance on "scientific detachment" results in such limitations about what can be said that the whole enterprise becomes irrelevant, somewhat along the lines of Wittgenstein's (1921/1961) closing line in the *Tractatus Logico-Philosophicus:* "That of which one cannot speak, one must pass over in silence" (my translation). If we accept that education research should speak about those things where we cannot pronounce with certainty and scientific detachment, we must accept that other intellectual virtues, and specifically, practical wisdom—"a true and practical state involving reason, concerned with what is good and bad for a human being" (Aristotle, 2000, p. 107, 1140b)—become part of the requirements for an effective research practice. For this to occur, we must broaden the basis for what counts as evidence in education research, including multiple representations of educational settings, and we must acknowledge that values, as well as data and theories, have a role to play.

This shift from a sole reliance on scientific detachment also has implications for how the findings of research are to be communicated, shared, and "disseminated." Shotter (1993) proposes

that the shift can be characterized as a shift from scientific rationalism to communicative rationalism, which differs from scientific rationalism in three important ways. First, for the communicative rationalist, the social world is not "out there waiting to be discovered" but can be studied only from a position of involvement within it (in the same way that Polanyi insists that knowledge is rooted in an engagement with, rather than a detachment from, the object of study). Second, "knowledge of [the] world is practical–moral knowledge and does not depend upon justification or proof for its practical efficacy" (Shotter, 1993, p. 166). Third, "we are not in an 'ownership' relation to such knowledge, but we embody it as part of who and what we are" (p. 166).

Embracing communicative rationalism involves changes not only in how knowledge is warranted but also in what is to count as knowledge. The practical knowledge that teachers possess about their classrooms—and in particular about how to make complex, nuanced judgments in the face of considerable complexity and in the absence of complete information—is to be counted as knowledge even though such knowledge may be tacit and cannot be reduced to the explicit formulations of the decontextualized, transcendent, but often difficult-to-apply "truths" of scientific rationalism.

The complementary roles of tacit and explicit knowledge are brought out clearly in the model developed by Nonaka and Takeuchi (1995) of knowledge creation in organizations. The fact that knowledge can exist as either explicit or tacit knowledge results in four different modes of knowledge conversion, as shown in Figure 1. The process of socialization can be viewed as one in which one person's tacit knowledge comes to be shared by others, whereas externalization involves making previously tacit knowledge explicit. Developing new explicit knowledge from existing explicit knowledge is a process of combination, and internalization consists of making explicit knowledge "one's own." Nonaka and Takeuchi propose that these four processes typically occur in the following sequence:

> First, the socialization mode usually starts with building a "field" of interaction. This field facilitates the sharing of members' experiences and mental models. Second, the externalization mode is triggered by meaningful "dialogue or collective reflection," in which using appropriate metaphor or analogy helps team members to articulate hidden tacit knowledge that is otherwise hard to communicate. Third, the combination mode is triggered by "networking" newly created knowledge and existing knowledge from other sections of the organization, thereby crystallizing them into a new product, service or managerial system. Finally, "learning by doing" triggers internalization. (pp. 70–71)

What this analysis makes clear is that scientific rationalism is concerned only with those situations in which one person's explicit knowledge is transmitted to others as explicit knowledge (bottom-right cell of Figure 1). Communicative rationalism, on the other hand, involves all the kinds of knowledge conversion and knowledge creation shown in Figure 1.

The framework offered by Nonaka and Takeuchi (1995) allows us to regard the knowledge that is generated in a clinical approach to education research alongside that generated by more

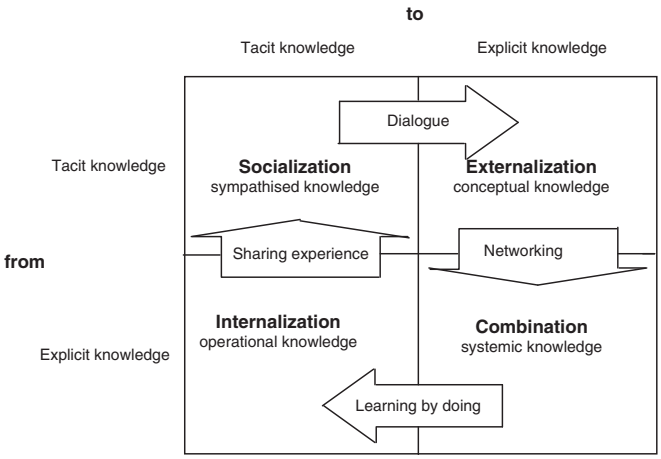


FIGURE 1. *The four modes of knowledge conversion and the knowledge spiral (Nonaka & Takeuchi, 1995).*

traditional forms of inquiry. More important, it offers a way of thinking about how we might move beyond these dualities to a more integrated approach to knowledge management. The systemic knowledge generated as a result of "traditional" research can become operational knowledge through "learning by doing." This operational knowledge becomes sympathized knowledge when the experience of practitioners is shared and when dialogue between teachers supports the creation of conceptual knowledge in practice. Networking with other professionals produces new systemic knowledge, and so the cycle can repeat.

## Conclusion

In this response I have used three theoretical perspectives in an attempt to illuminate, and to deepen, the argument made by Bulterman-Bos about the contributions that a clinical approach might make to education research.

First I suggested that the three main intellectual virtues identified by Aristotle—*episteme*, *techne*, and *phronesis*—exemplify the skills required by the "pure" education researcher, the skilled classroom practitioner, and the clinical researcher, respectively. Second I proposed that the framework of inquiry systems proposed by Churchman (1971)—based on whether logic, observation, representation, dialectic, or values are regarded as the main source of evidence—provides a useful way of thinking about different kinds of inquiry in education. Specifically, I suggested that although the *phronetic* researcher may be, at any one time, operating in Leibnizian, Lockean, Kantian, or Hegelian mode, these are always moral choices that the researcher is prepared to defend, because the primary aim is to do good. Third, I suggested that the framework for knowledge transfer proposed by Nonaka and Takeuchi (1995) indicates a way in which knowledge gained through different methods of inquiry might be developed in parallel, and perhaps even be integrated, so that education research can become a powerful force for acting well in the world.

## NOTE

[1]References to passages in Aristotle's *Nicomachean Ethics* are conventionally given as a four-digit number followed by a letter, referring to the

pages and columns of Immanuel Bekker's Greek text of 1831. I provide these, as well as the page numbers of the Cambridge University Press (CUP) edition published in 2000. Text in parentheses is from the CUP edition; my additions are enclosed in square brackets.

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