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Research in Special Education: Scientific Methods and Evidence-Based Practices

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ABSTRACT: *This article sets the context for the development of research quality indicators and guidelines for evidence of effective practices provided by different methodologies. The current conceptualization of scientific research in education and the complexity of conducting research in special education settings underlie the development of quality indicators. Programs of research in special education may be viewed as occurring in stages: moving from initial descriptive research, to experimental causal research, to finally research that examines the processes that might affect wide-scale adoption and use of a practice. At each stage, different research questions are relevant, and different research methodologies to address the research questions are needed.*

Should science guide practice in special education? Most individuals would say "Yes." However, the "devil is in the details." Major initiatives in other disciplines such as medicine, the allied health professions, and psychology are attempting to identify and disseminate practices that have scientific evidence of effectiveness. In education, national policies such as the No Child Left Behind Act (NCLB) require that teachers use scientifically proven practices in their classrooms. Yet, there is concern about the quality of scientific research in the field of education and disagreement

about the type of scientific information that is acceptable as evidence (White & Smith, 2002). An oft-cited report from the National Research Council (NRC) states that science in education consists of different types of questions and that different methodologies are needed to address these questions (Shavelson & Towne, 2002). In contrast, other agencies and research synthesis organizations (e.g., the What Works Clearinghouse [WWC]) have focused primarily on the question of whether a practice is effective and proposed that the "gold standard" for addressing this question is a single type of research methodology—randomized experimental group designs (also called randomized clinical trials or RCTs; WWC, 2003b).

In January 2003, the Council for Exceptional Children's (CEC) Division for Research established a task force to address these devilish details as they apply to special education. The operating assumptions of this task force were that different types of research questions are important for building and documenting the effectiveness of practices, and that different types of methodologies are essential in order to address these questions. The task force identified four types of research methodologies in special education: (a) experimental group, (b) correlational, (c) single subject, and (d) qualitative designs. The task force was to establish quality indicators for each methodology and to propose how evidence from each methodology could be used to identify and understand effective practices in special education. The subsequent four articles in this issue of *Exceptional Children* will describe the quality indicators and provide guidelines for how each methodology contributes evidence for the effectiveness of practices in special education.

This article provides a context and rationale for this endeavor. We begin with a discussion of the importance of multiple scientific methodologies in special education research. Next, we examine efforts to identify high-quality research methodology and then examine initiatives in the fields of medicine and education to identify evidence-based practice. In conclusion, we propose that research and development on effective practices in special education exists on a continuum, with each methodology matched to questions arising from different points of the continuum. Also, it is important to acknowledge that although basic research serves as the foundation for the development of effective practices and is critically important for our work in special education, the issues addressed in this article will be most relevant for applied research.

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RATIONALE FOR MULTIPLE SCIENTIFIC RESEARCH METHODOLOGIES IN SPECIAL EDUCATION

The rationale for having different research methodologies in special education is based on the current conceptualization of research in education and the complexity of special education as a field. The history and tradition of special education research, when employing multiple methodologies, has resulted in the identification of effective practices.

Current Conceptualization of Research in Education

A primary emphasis in education policy today is to improve the quality of education for all of America's children. This policy, exemplified by NCLB, compels educators to use "teaching practices that have been proven to work" (U.S. Department of Education, 2003). However, a general concern has been voiced about the quality of research in education (Levin & O'Donnell, 1999; Mosteller & Boruch, 2002). To address this concern, the National Academy of Sciences (NAS) created a committee to examine the status of scientific research in education. An operating assumption of this committee was that research questions must guide researchers' selections of scientific methods. The NAS committee proposed that most research questions in education could be grouped into three types (Shavelson & Towne, 2002, p. 99): (a) description (what is happening?); (b) cause (is there a systematic effect?); and

(c) process or mechanism (why or how is it happening?). The committee conveyed two important points about these types of research and their associated questions. First, each type of question is scientific. Second, the different types of questions require different types of methodologies. It follows that each type of methodology that empirically, rigorously, and appropriately addresses these questions is also legitimately scientific. Scientists and social philosophers as diverse as B. F. Skinner (1972), John Dewey (1938), and J. Habermas (1971) have emphasized that the appropriate match between question and methodology is an essential feature of scientific research.

Complexity of Special Education as a Field

In his commentary on the NAS report on scientific research in education and the policy emphasizing use of RCTs implied by NCLB, Berliner (2002) noted that such a conceptualization of science is based on hard sciences, such as physics, chemistry, and biology. He proposed that science in education is not a hard science but it is the "hardest-to-do science." Berliner stated,

> We [educational researchers] do our science under conditions that physical scientists find intolerable. We face particular problems and must deal with local conditions that limit generalizations and theory building—problems that are different from those faced by the easier-to-do sciences [chemistry, biology, medicine]. (p. 18)

Special education research, because of its complexity, may be the hardest of the hardest-to-do science. One feature of special education research that makes it more complex is the variability of the participants. The Individuals with Disabilities Education Act (IDEA) identifies 12 eligibility (or disability) categories in special education (Office of Special Education and Rehabilitation Services [OSERS], 1997), and within these categories are several different identifiable conditions. For example, in addition to "typical" learning disabilities, attention deficit/hyperactive disorder is often subsumed under the Specific Learning Disabilities category. Autism is now widely conceptualized as a spectrum consisting of four disorders. Mental retardation varies on the range of severity. Emotional and behavioral disorders consist of externalizing and internalizing disorders. Visual and hearing impairments range in severity from mildly impaired to totally blind or profoundly deaf. Physical impairment can be exhibited as hypotonia or hypertonia. Other health impaired may incorporate health conditions as distinct and diverse as asthma, epilepsy, and diabetes. Adding to this variability is the greater ethnic and linguistic diversity that, unfortunately, occurs in special education because of overrepresentation of some minority groups (Donovan & Cross, 2002).

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A second dimension of complexity is the educational context. Special education extends beyond the traditional conceptualization of "schooling" for typical students. Certainly many students with disabilities attend general education classes. However, the continuum of special education contexts is broader than general education. At one end of the chronological continuum, infants, toddlers, and many preschoolers receive services in their home or in an inclusive child care setting outside of the public school settings (e.g., Head Start Centers). For school-age students with disabilities, placement sometimes occurs in special education classes or a combination of special education and general education classes. For adolescents and young adults with disabilities, special education may take place in community living or vocational settings in preparation for the transition out of high school and into the workplace.

Complexity in special education has several implications for research. Researchers cannot just address a simple question about whether a practice in special education is effective; they must specify clearly for whom the practice is effective and in what context (Guralnick, 1999). The heterogeneity of participant characteristics poses a significant challenge to research designs based on establishing equivalent groups, even when ran-

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domization and stratification is possible. Certain disabilities have a low prevalence, so methodologies that require a relatively large number of participants to build the power of the analysis may be very difficult or not feasible. In addition, because IDEA ensures the right to a free appropriate public education, some research and policy questions (e.g., Are IEPs effective in promoting student progress?) may not be addressable through research methodologies that require random assignment to a "nontreatment" group or condition. Last, in special education, students with disabilities are often "clustered" in classrooms, and in experimental group design, the classroom rather than the student becomes the unit on which researchers base random assignment, data analysis, and power estimates (see Gersten et al., 2004).

History of Special Education Research

Special education research has a long history in which different methodologies have been employed. In the early 19th century beginning with Itard's (1962) foundational work, *The Wild Boy of Aveyron,* there was a tradition of discovery, development, experimentation, and verification. Initially, the research methods employed in the field that was to become special education research were derived from medicine. Many of the early pioneers in services for individuals with disabilities (Itard, Seguin, Montessori, Fernald, Goldstein) were physicians. Similarly, early services for individuals with disabilities occurred in residential facilities and training schools, which were based on the medical tradition of care (Scheerenberger, 1983).

As psychology, sociology, and anthropology became academic disciplines, they provided methodological tools for research in special education. For example, Skeels's (Skeels & Dye, 1939) and Kirk's (1958) works, respectively, on early experiences and preschool education for infants and young children with mental retardation employed experimental and quasi-experimental group designs prominent in psychology. Edgerton's (1967) research on individuals with mental retardation who left institutions and moved to the community, drew from methods in sociology and anthropology. In academic instructional studies, Lovitt and Haring based their methodology on the then newly created single-subject design methodology of the time (see Lovitt, 1976). Farber's (1960) important early work on families of children with disabilities and continuing through work by Blacher (2001) and Dunst (2000) had its roots in family sociology. Many of the current special education research tools now frequently employed, such as sophisticated multivariate designs, qualitative research designs, and program evaluation designs, have their roots in general education and educational psychology. Today a range of methodological approaches are available to researchers in special education (Martella, Nelson, & Marchand-Martella, 1999) as a result of this rich history.

More Than One Research Methodology Is Important in Special Education Research

A current initiative of the U.S. Department of Education is to improve the quality of research in the field of education (Whitehurst, 2003), with the rationale that improved research will lead to improved practice. A major effort to improve quality has come through the establishment in 2003 of the Institute of Education Sciences (IES), whose mission is to expand fundamental knowledge about education (Institute of Education Sciences, 2004). A central theme advocated by IES is to focus research on the questions of effectiveness and to employ high-quality research methods to address these questions (Whitehurst). The gold standard for research methodology that addresses these issues is the use of RCT methodology (Mosteller & Boruch, 2002; WWC, 2003b). The IES acknowledges that different methodologies are important for addressing different questions.

The increased use of RCT methodology, when conducted well, will undoubtedly enhance the quality of research in education and special education. Rigorously conducted RCT studies have greater capacity to control for threats to internal validity than do quasi-experimental designs

that are often used in special education. Because of this greater experimental control, Gersten et al. (2004) propose that random assignment to experimental groups is one indicator of high-quality group design research. The IES and Department of Education policy of encouraging RCT studies may well move the field closer to the goal of identifying evidence-based special education practices. But again, there are devilish details that challenge the near exclusive use of this methodology for investigating effective practices in special education.

In special education, other methodologies, such as single-subject designs, are experimental and may be a better fit for some research contexts and participant characteristics (see Horner et al., 2004). Powerful correlational methodologies may suggest causal relationships by statistically controlling for competing hypotheses and may be essential for addressing causal-like questions when researchers are not able to conduct experimental group or single-subject design studies (see Thompson, Diamond, McWilliam, Snyder, & Snyder, 2004). The discovery and development of new effective practices may require researchers to work in naturalistic contexts where they may not be able to exert experimental control and/or in design experiments (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003), or where they have the flexibility of changing certain elements of an intervention based on students' responses. Such descriptive and process-oriented research may require the use of qualitative methods (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2004). Educational researchers have acknowledged the value of mixing methodologies to provide a complementary set of information that would more effectively (than a single method) inform practice (Greene, Caracelli & Graham, 1989; Li, Marquart, & Zercher, 2000).

QUALITY INDICATORS OF RESEARCH METHODOLOGY

Quality indicators are the feature of research that represents rigorous application of methodology to questions of interest. They may serve as guidelines for (a) researchers who design and conduct research, (b) reviewers who evaluate the "believability" of research findings, and (c) consumers who need to determine the "usability" of research findings. High-quality research is designed to rule out alternative explanations for both the results of the study and the conclusions that researchers draw. The higher the quality of research methodology, the more confidence the researcher and readers will have in the findings of the study.

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Textbooks on educational research describe the methodology that investigators should follow, but they usually do not provide a succinct or understandable set of indicators that are useful for individuals who lack graduate training on research methodology. Several professional organizations have developed standards for describing and, in some cases, evaluating research. Division 16 of the American Psychological Association (APA) and the Society for the Study of School Psychology have established criteria for evaluating group design, single-subject design, and qualitative methodology used in research on practices in school psychology (Kratochwill & Stoiber, in press). Similarly, APA Division 12 Task Force on Psychological Interventions has established criteria primarily for experimental group designs studies used to provide support for therapies in clinical psychology (Chambless & Hollon, 1998) and clinical child psychology (Lonigan, Elbert, & Johnson, 1998). The CEC Division for Early Childhood (DEC) created procedures for describing research methodology for studies using group, single-subject, and qualitative research methodology (Smith et al., 2002), which they used to determine recommended practices for early intervention/early childhood special education. These standards have been used to determine the quality of research methods employed (Odom & Strain, 2002; Snyder, Thompson, McLean, & Smith, 2002); however, they have not been published as quality indicators that other researchers could use.

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In their work on summarizing evidence for effective practices, which will be described in the next section, some research synthesis organizations have established evaluation criteria and methods for determining the quality of research. For example, the WWC created an evaluation instrument, called the Design and Implementation Assessment Device (DIAD), with which a rater could conduct an extremely detailed evaluation of a research article. At this writing, a DIAD has only been created for experimental and quasi-experimental group design, but the WWC reports that DIADs are also being constructed for single-subject and qualitative group designs (WWC, 2003b). Other research synthesis organizations, such as the Campbell Collaboration (2003) and the Evidence for Policy and Practice Information Centre (EPPIC; 2003), have somewhat similar research evaluation procedures.

Efforts described here illustrate the progress that professional and governmental organizations have made toward establishing standards for quality in research. To date, however, such quality indicators have not been identified specifically for research in special education. As noted, the purpose of the work conducted by this task force was to establish a set of quality indicators that were clearly stated, understandable, and readily available for use as guides for identifying high-quality research in special education. These quality indicators are presented in the articles appearing in this special issue.

EVIDENCE-BASED PRACTICE

The type and magnitude of evidence needed to verify a practice as evidence-based is a prominent issue in the discussion of scientific research and effective educational practices. These devilish details are critical for policymakers, practitioners, educational researchers, and consumers. Current endeavors to establish standards for evidence-based practice as well as to identify the evidence-based practices themselves, are occurring through two different, but related, initiatives. In this section, we describe briefly the history of identifying effective practices first in medicine and then other social science fields, efforts by professional organizations to identify effective practices, and similar efforts being conducted by research synthesis organizations.

Identifying Evidence-Based Practice

Like the evolution of special education research methods noted previously, the search for evidence-based practice originated in the field of medicine. Although the practice of evidence-based medicine extends back to the mid-19th century, the modern era of evidence-based practice emerged in the early 1970s and 1980s (Bennett et al., 1987) and came into fruition in Great Britain in the early 1990s (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). Cutspec (2003) tracked the evolution of evidence-based medicine from a movement that began with the intent to address the gap between research and practitioners' provision of medical care, moved to the use of the literature to inform practice decisions, and then became an approach to practicing medicine. Evidence-based practice is now a central part of medical education (Grad, Macaulay, & Warner, 2001), education in allied health professions such as nursing (Newell, 2002), and counselor education (Sexton, 2000).

General and special education have followed suit in adopting scientific evidence as the appropriate basis for selecting teaching practices (Carnine, 1999; Davies, 1999; Oakley, 2002). The impetus for the current evidence-based movement in education is similar to that in medicine: A concern that effective educational practices, as proven by research, are not being used in schools. This current concern reflects a long-standing discussion in the field of special education regarding the distance between research and practice (Gersten & Smith-Jones, 2001; Greenwood & Abbott, 2001). In response, a large number of initiatives have been established to identify practices that will generate positive outcomes for children (Dunst, Trivette, & Cutspec, 2002). Two types of groups are sponsoring these initiatives: research synthesis organizations and

professional associations that propose standards for practice.

Research Synthesis Organizations. Research synthesis organizations systematically evaluate and aggregate findings from the research literature in order to inform practitioners. Perhaps the largest and longest standing synthesis organization is the Cochrane Collaboration (www.cochrane.org), located in Great Britain and founded in 1963. This organization, which focuses on medical and health research, consists of over 50 collaborative review groups and has completed over 1,300 reviews. Following this model, the Campbell Collaboration (http://www.campbellcollaboration.org/FraAbout.html) was established in the United States in 1999 to assist individuals in education and the social sciences to make informed decisions about what works based on high-quality research and reviews. In Great Britain, EPPIC at the University of London Institute of Education (http://www.researchtopractice.info/) was created in 1993 to conduct systematic reviews of research on social interventions. This organization was recently funded to conduct reviews specifically on educational practices, which it plans to make available through their Research Evidence in Education Library (http://eppi.ioe.ac.uk/EPPIWeb/home.aspx?page=/reel/intro.htm).

In the United States, the IES has established the WWC (http://w-w-c.org/about.html), which is jointly managed by the Campbell Collaboration and the American Institutes for Research. WWC conducts reviews of educational practices supported by high-quality research and makes this information available to practitioners through Web-based databases. The U.S. Department of Education funds the Research and Training Center on Early Childhood Development (CED; www.puckett.org), which is conducting a set of practice-sensitive research syntheses on the effectiveness (and ineffectiveness) of practices for infants and young children with disabilities and their families. Whereas other organizational efforts primarily provide evidence that a practice is effective, the CED has created a more functional operational definition by stating that evidence-based practices are "informed by research, in which the characteristics and consequences of environmental variables are empirically established and the relationship directly informs what a practitioner can do to produce the desired outcome (Dunst et al., 2002, p. 3).

To examine the effectiveness of programs for children with autism, a committee formed by NAS established guidelines for the strength of evidence provided by individual studies (Committee on Educational Interventions for Children with Autism, 2001). The dimensions of the studies evaluated were internal validity, external validity, and generalization, with strength of evidence (i.e., from I to IV) evaluated for each.

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A key feature in these research synthesis initiatives is the methodological criteria established to select or exclude research studies for the synthesis. Most organizations confined evidence of effectiveness to research studies that have employed RCT methodology or rigorously constructed quasi-experimental designs. The CED researchers took a broader view of the empirical linkage between a practice and an outcome and looked for descriptions of the process of the intervention practices that led to the outcome. The leadership of the WWC has noted that qualitative research may provide information about the ways in which interventions work and can be used to substantiate "promising practices" in education, although they proposed that clearly efficacious practices would require verification through RCTs (WWC, 2003b). For the EPPIC, Oakley (2002) reported that they incorporated qualitative research in their reviews, but they had encountered multiple problems in their evaluation of qualitative studies.

Professional Associations. Professional associations and groups have also examined the literature to determine effective practices. These groups have often established the level of evidence

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needed to identify a practice as effective. For example, the Child-Clinical Section of Division 12 of the APA established the Task Force on Empirically Supported Psychosocial Interventions for Children (Lonigan et al., 1998). They proposed the types and amount of evidence needed to identify a practice as (a) well-established (i.e., two well-conducted group design studies by different researchers or nine well-conducted single-subject designs); or (b) "probably efficacious" (i.e., two group design studies by same investigator or at least three single-subject design studies).

The Division for Early Childhood of CEC established a process for identifying recommended practices that incorporated evidence from the research literature (Smith et al., 2002). Mentioned previously, DEC conducted an extensive literature review to identify support for recommended practices and also to incorporate information from focus groups of experts, practitioners, and family members in the final identification of practices. The level or type of evidence needed to support a recommended practice was not identified.

The American Speech-Language-Hearing Association (ASHA; 2004) proposed that different types of evidence may be important for different clinical activities. For questions of treatment efficacy, they propose that different frameworks are available for evaluating the level of evidence that documents efficacy. They provide as an example one such framework developed by the Oxford Centre for Evidence-based Medicine (2001). This system could be used to classify practices according to four levels of evidence:

- Level I evidence derives from meta-analyses including at least one randomized experimental design or well-designed randomized control studies.
- Level II evidence includes controlled studies without randomization and quasi-experimental designs.
- Level III consists of well designed nonexperimental studies (i.e., correlational and case studies).
- Level IV includes expert committee report, consensus conference, and clinical experience of respected authorities.

The ASHA policy emphasizes that other frameworks are currently available or evolving and could be useful for specific questions related to treatment efficacy.

To date, the special education community has yet to develop systematic guidelines for specifying the types and levels of evidence needed to identify a practice as evidence-based and effective. The Division for Learning Disabilities (DLD) and the Division for Research (DR) jointly published a document entitled *Alerts*, in which an expert from the field reviews the literature relevant to a specific practice and describes the evidence or lack of evidence that underlies the practice. These alerts, however, have been based on individual authors' reviews of the literature and, although quite useful, different authors may well be using different criteria for the evidence they include. The second goal of the current DR Task Force, therefore, was to describe the types of results generated by each research methodology and to recommend guidelines for using the results as evidence of effectiveness, or lack of effectiveness, of practices in special education.

WHERE DO WE GO FROM HERE?

The Department of Education is under pressure to prove to Congress that there are educational practices that have evidence of effectiveness and that supporting educational research is a good investment of public funds. In specifying RCT methodology as the gold standard for research, the Department of Education is investing the bulk of research funding in addressing the question of effectiveness, which is clearly important. However, Berliner (2002) urges us to avoid confusing sci-

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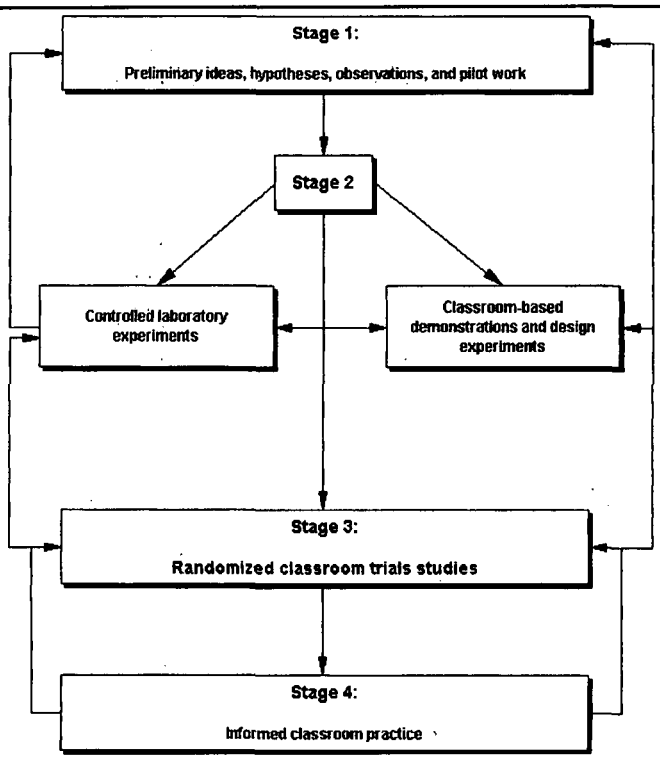
ence with a specific method or technique. It is more important to look at the broader goal of using science to improve education for all children.

To accomplish such a goal, educational science might be more appropriately seen as a continuum rather than a fixed point. Levin, O'Donnell, and Kratochwill (2003) suggest that a program of educational research might be thought of as occurring in four stages. (see Figure 1). The first stage would involve observational, focused exploration and flexible methodology, which qualitative and correlational methods allow. Stage 2 would involve controlled laboratory or classroom experiments, observational studies of classrooms, and teacher–researcher collaborative experiments. Design experimentation involving qualitative methodology, single-subject designs, quasi-experimental and/or RCT design could be useful at that stage. Stage 3 research would then incorporate knowledge generated from these previous stages to design well-documented interventions and "prove" their effectiveness through well-controlled RCT studies implemented in classroom or naturalistic settings by the natural participants (e.g., teachers) in the settings. We propose that single-subject design studies could also accomplish this purpose.

If research ended here, however, the movement of effective, evidence-based research into practices that teachers use on Monday morning

FIGURE 1
Stages of Programs of Research



From "Educational/psychological Intervention Research," by J. R. Levin, A. M. O'Donnell, & T. R. Kratochwill, 2003, in *Handbook of Psychology, Vol 7: Educational Psychology* (pp. 557-581), edited by W. Reynolds and G. Miller. Copyright 2003 by Wiley Publishers. Reprinted with permission.

would likely fail. A further step in the development process (Stage 4) would be to determine the factors that lead to adoption of effective practices in typical school systems under naturally existing conditions. That last step would require research into organizational factors that facilitate or impede adoption of innovation in local contexts (Fullan, 2001). The research methodologies that would generate this information are more likely qualitative, correlational, and mixed methods, as well as RCT and large-scale, single-case designs. Researchers may well draw from such disciplines as sociology, political science, economics, as well as education, in this research. Research at this stage may best occur though a partnership among researchers from education, researchers from other disciplines, local education agencies, and teachers. Indeed, an initiative is emerging from another panel convened by the NRC (Donovan, Wigdor, & Snow, 2003), which is proposing a broad federal initiative that would create just such a partnership.

CONCLUSION

If different methodologies are appropriate for addressing important questions in special education, then we, as a field, need to be clear about (a) the match between research questions and methodology, (b), the features of each methodology that represent high quality, (c) and the use of research findings for each methodology as scientific evidence for effective practices in special education. To date, we have numerous texts and papers that describe each methodology, but they are not a coordinated, clear index of how each contributes to the present research-to-practice challenge. The next four articles in this special issue identify quality indicators of research in special education and propose the use of research findings as evidence for practice. In the first article, Gersten et al. (2004) examine quality indicators for experimental and group experimental design and propose guidelines for using the results of group studies for evidence of effective practices. Horner et al. (2004) propose quality indicators and standards for evidence-based practice for single-subject design in the second article. Quality indicators for correlational design and ways in which results from correlational studies may contribute evidence of effective practices appear in the third article by Thompson and colleagues (2004). In the fourth article, Brantlinger and colleagues propose quality indicators for qualitative design and uses of qualitative research as evidence for effective practices in special education.

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