Research in Special Education: Scientific Methods And Evidence-based Practices

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Abstract

The purpose of this paper is to set 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.

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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 insist(s) 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 [see special issue of *Educational Researcher,* 2002, *31(8)*]. An oft-cited report from the National Research Council stated that science in education consists of different types of questions and 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) have focused primarily on the practice effectiveness question 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) (What Works Clearinghouse, 2003).

In January, 2003, the CEC Division of Research established a task force to address these devilish details, as they apply to special education. The operating assumption of this task force was that different types of research questions are important for building and documenting the effectiveness of practices, and to address these questions, different types of methodologies are essential. The task force

identified four types of research methodologies in special education: experimental group, correlational, single subject, and qualitative designs. The first purpose of the task force was to establish quality indicators for each methodology. The second task of this task force was to propose how evidence from each methodology could be used to identify and understand effective practices in special education.

The purpose of this paper is to provide a context and rationale for this endeavor. We will begin with a discussion of the importance of multiple scientific methodologies in special education research. Next, we will 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 will 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 while 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 paper will be most relevant for applied research.

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, the complexity of special education as a field, and the history and tradition of special education research that has resulted in the identification of effective practices.

Current Conceptualization of Research in Education

A primary emphasis in education today is to improve the quality of education for all of America's children. This policy emphasizes that educators employ "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 (Mosteller & Boruch, 2002; Levin & O'Donnell, 1999). To address this concern the National Academy of Sciences 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 questions 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 research question and research 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 the No Child Left Behind Act, 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. The variability of the participants is one feature of special education research that makes it more complex. The Individuals with Disabilities Education Act (IDEA) identifies 12 eligibility (or disability) categories in special education (Office of Special Education and Rehabilitation Services, 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(s) 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; and 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 over-representation of some minority groups (Donovan & Cross, 2002).

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 regular 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 regular 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 randomization 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, since 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 upon which researchers base random assignment, data analysis, and power estimates (see Gersten et al. this volume).

History of Special Education Research

Special education research has a long history in which different methodologies have been employed. Beginning with Itard's (1962) foundational work with Victor, the Wild Boy of Avyeron, in the early 19th century, there has been 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.

As psychology, sociology, and anthropology became academic disciplines, they provided methodological tools for research in special education. For example, Skeels' (Skeels & Dye, 1938) 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 the lives of individuals with mental retardation, leaving institutions and moving to the community, drew from methods in sociology and anthropology. Academic instructional studies by Lovitt and Haring

based their methodology on the then newly created single subject design methodology of the time (see Lovitt, 1976). Important early work on families of children with disabilities by Farber (1960) and continuing through 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. As a result of this rich history, today a range of methodological approaches are available to researchers in special education (Martella, Nelson, & Marchant, 1999).

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 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 of the Institute of Education Sciences (IES), whose motto is "building evidence-based education" (Retrieved from http://www.ed.gov/offices/IES/ on May 29, 2003). 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, 2003). The "gold standard" for research methodology addressing these issues is the use of RCT methodology (Mosteller & Boruch, 2002; What Works Clearinghouse, 2003). Importantly, the IES acknowledges that different methodologies are important for addressing different questions.

By advocating for the increased use of RCT methodology, the quality of research in Education and Special Education is likely to be enhanced. 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. (this volume) 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., this volume). Powerful correlational methodologies may suggest causal relationships by statistically controlling for competing hypothesis 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 et al., this volume). The discovery and development of new effective practices may require researchers to work in naturalistic contexts where they do not exert experimental control and/or in design experiments (Cobb, Confrey, diSessa, Lehrer, & Schable, 2003), 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 this volume). 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 (Green, Carselli, & 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 designing and conducting research, b) reviewers evaluating 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 the results of the study and conclusions the researchers draw. The higher the quality of research methodology, the more confident the researcher and readers may be in the findings of the study.

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 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; Synder et al., 2002), however, they have not been published as quality indicators that other researchers could use.

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 What Works Clearinghouse (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 (What Works Clearinghouse, 2003b). Other research synthesis organizations, such as the Campbell Collaboration (2003) and the Evidence for Policy and Practice Information Center (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 subsequent papers.

Evidence-Based Practice

An issue prominent in the discussion of scientific research and effective educational practices is the type of evidence and the magnitude of evidence needed to verify a practice as evidence-based. These devilish details are critical for policy makers, practitioners, educational researchers, and consumers. Current endeavors to identify standards for evidence-based practice, and the 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 of addressing the gap between research and practitioners' provision of medical care, moved to use

of the literature to inform practice decisions, and 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 more long standing discussion in the field of special education about 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, 2003). Two types of groups are sponsoring these initiatives: research synthesis organizations and professional associations that propose standards for practice.

Research synthesis organizations. The purpose of research synthesis organizations is to 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 the UK and founded in 1963. This organization, which focuses on medical and health research, consists of over 50 collaborative review groups and has completed over 1300 reviews. Following this model, the Campbell Collaboration

(http://www.campbellcollaboration.org/FraAbout.html) was established in the US 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 the UK, the Evidence for Policy and Practice Information Center (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 US, 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. The purpose of the WWC is to conduct reviews of educational practices supported by high quality research and make 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 to children with autism, a committee formed by the National Academy of Science 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.

In these research synthesis initiatives, a key feature 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 (What Works Clearinghouse, 2003s). For the EPPIC-Centre, 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. Often these groups have established the level of evidences needed to identify a practice as effective. For example, the Child-Clinical Section of Division 12 of the American Psychological

Association established the Task Force on Empirically Supported Psychosocial Interventions for Children (Lonigan, Elbert, & Johnson, 1998). They proposed the types and amount of evidence needed to identify a practice as "well-established" (i.e., two well-conducted group design studies by different researchers or nine well conducted single subject designs) or "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 they also incorporated 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, and Hearing Association (ASHA) have developed standards and guidelines for practice using different "classes" of evidence. Class 1 evidence consists of at least one randomized controlled clinical trial study; Class 2 evidence consists of one well-designed, observational, clinical study with concurrent controls, and Class 3 evidence is expert opinion, case studies, and studies with historical controls. *Standards* for practices are based on Class 1 evidence or strong Class 2 evidence, *Guidelines* for practice are based on Class 2 evidence (American Speech-Language-Hearing Association, date http://professional.asha.org/community/slp/evidence_levels.cfm). The ASHA criteria specify that for some disorders, it is difficult or impossible to obtain Class 1 evidence

because the disorder may have a low prevalence. In such cases, they recommend following a set of questions established by APA for evaluating evidence and determining the linkage between an intervention and its effects: a) How well are the subjects described? b) How well is the treatment described? c) What measures of control are imposed in the study? d) Are the consequences of the intervention well described?

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 and the Division for Research have jointly published *Alerts* that have proposed the degree of evidence or lack of evidence that underlies certain practices, but these alerts have been based on individual authors' reviews of the literature. The second goal of the current DR Task Force, therefore, was to describe the types of evidence generated by each research methodology and how the evidence may substantiate the effectiveness, or lack of effectiveness, of practices in special education.

Where Do We Go From Here?

The Department of Education is "under the gun" to prove to Congress that there are educational practices which 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 avoid confusing science

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. 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. 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 designs 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 would likely fail. A further step in the development process (Stage 4) would be to determine the factors that would lead to adoption of effective practices in typical school systems under naturally existing conditions. That last step, which could be called Stage 4, 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 between researchers from education, researchers from other disciplines, local education agencies, and teachers. Indeed, an initiative is emerging from another panel convened by the National Research Council (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 as a field we 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 describing each methodology, but not coordinated, clear index of how each contributes to the present "research-to-practice" challenge. The next four papers in this issue identify quality indicators of research in special education and propose the use of research findings as evidence for practice.

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Figure 1. Stages of Programs of Research (Levin, O'Donnell, & Kratochwill, 2003)