

DOCUMENT RESUME

ED 472 836

CS 511 231

AUTHOR Reyna, Valerie F.
TITLE The Logic of Scientific Research.
PUB DATE 2002-02-06
NOTE 6p.; Paper presented at the U.S. Department of Education "Use of Scientifically Based Research in Education" Working Group Conference (Washington, DC, February 6, 2002).
AVAILABLE FROM For full text: <http://www.ed.gov/offices/OESE/esea/research/reyna-paper.html>.
PUB TYPE Opinion Papers (120) -- Speeches/Meeting Papers (150)
EDRS PRICE EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS Educational Practices; *Educational Research; Research Methodology; Scientific Enterprise
IDENTIFIERS Empirical Research; *No Child Left Behind Act 2001; Randomized Experiments

ABSTRACT

This paper considers the case for scientifically based research. The paper presents the case in concise outline form, providing a rationale; an analogy to medicine; strength of evidence argument; and thoughts about educational sciences. It asks and answers the questions What is EBE? (Evidence Based Education); and What is empirical evidence? In discussing scientifically based research, the paper considers questions of quality; relevance; levels of evidence; randomized trials (asking why randomization is critical); where the research dollars flow; what the United States Department of Education will do; and goals. (NKA)

Reproductions supplied by EDRS are the best that can be made
from the original document.

Skip Navigation



My Profile | Add to My.ED.gov Bookmarks

Inside Scientifically Based Research

- [Scientifically Based Research Home](#)
- [Welcome and Introduction](#)
- [What Is Scientifically Based Evidence](#)
- [Logic and Basic Principles of Scientific Based Research](#)
- [Research](#)
- [Math Education and Achievement](#)
- [Reading and Scientific Based Evidence](#)
- [Safe and Drug-Free Schools](#)
- [Comprehensive School Reform](#)
- [Transcript in \(317K\)](#)
- [Transcript in \(134K\)](#)

No Child Left Behind

- [No Child Left Behind Home](#)
- [OESE Home](#)

Submitted Paper—The Logic of Scientific Research—Valerie F. Reyna

Scientifically Based Research

Rationale

- Why scientific research?
 - Research is the only defensible foundation for educational practice.
- If not scientific evidence, then what?
 - Tradition
 - Superstition
 - Anecdote

Related documents

- [Transcript](#)

Analogy to Medicine

- Traditions: Bleeding people.
 - Good intentions are not enough.
- Clinical trials are recent.
- Why isn't personal experience sufficient?
- Clinical trials: Only way to really be sure of what works. (Logic)
- Same rules apply to education: Brain surgery (NAS).

Strength of Evidence

- In the meantime, hierarchy of evidence.
 - Not all-or-none
 - Possibly true to probably true versus nothing (NCES example)
- Theory: Evidence-based
 - Knowing why and how something works
 - Key to generalization
 - Pitfalls of theory

Educational Sciences

- No conflict between science and values.
 - Some decisions made on values.
 - Evidence is necessary but not sufficient.
- Science with a human face.
- How do we support translation of research into practice?
 - Suggestions welcome.

What is EBE?

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it.
- Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

- Best available empirical evidence in making decisions about how to deliver instruction
- Gaps in scientific evidence: Human judgment (bias and wisdom)

What is empirical evidence?

- Scientifically based research from fields such as psychology, sociology, economics, and neuroscience, and especially from research in educational settings
- Objective measures of performance used to compare, evaluate, and monitor progress

Scientifically Based Research

- Quality
 - Measures and Methods
 - Scientific merit (double helix)
- Relevance and Significance
 - Trivial
 - Number affected and severity
- Two criteria of NSF

Quality: Levels of evidence

- All evidence is **NOT** created equal
 - Randomized trial
 - Quasi-experiment, including before & after
 - Correlational study with statistical controls
 - Correlational study w/o statistical controls (class size, high expectations)
 - Case studies

Randomized Trials: The gold standard

- Claim about the effects of an educational intervention on outcomes
- Two or more conditions that differ in levels of exposure to the educational intervention
- Random assignment to conditions
- Tests for differences in outcomes

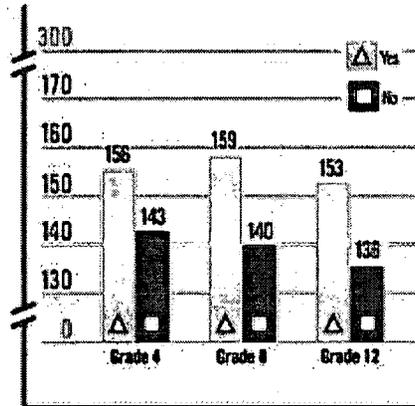
Why is randomization critical?

- Assures that the participants being compared have the same characteristics across the conditions
- Rules of chance mean that the smart, motivated, experienced, etc. have the same probability of being in condition 1 as in condition 2
- Without randomization, differences between two conditions may result from pre-existing difference in the participants, e.g., more smart ones in condition 1

Why is randomization critical?

Without randomization, simple associations such as between

Internet use and science grades have many different interpretations



Relevance

- Does the study involve a similar intervention and outcome to those of interest?
- Were the participants and settings representative of those of interest?
- Were enough participants involved to justify generalization? (statistical inference)

EBE: How to use existing science

- Search literature (Campbell Collaboration, PsychInfo, etc.)
- Screen literature
 - Relevance
 - Quality
- Search for pre-digested evidence
 - Narrative reviews (ERIC digests)
 - Systematic reviews (meta-analysis)

Screening research—Cautions

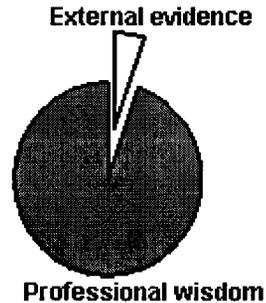
- Unconditional conclusions
- Conclusions involving hypotheticals
- Conclusions that diverge from evidence
- Strong calls to action
- Mixtures of opinions with evidence
- Low prestige publication outlet
- Publication outlet with ideological agenda

EBE: How to use objective measures

- Find or develop local data
 - measure and measure frequently
- Search state and national databases for benchmarks
 - www.edtrust.org
 - www.greatschools.net
 - www.ses.standardandpoors.com

- o www.just4kids.org
- Be skeptical

Evidence-Based Education—Where are we?



Where the Research Dollars Flow

- Of 84 program evaluations and studies planned by the Department of Education for fiscal year 2000, just one involved a randomized field trial
- 51 were a survey of need
- 49 had as their purpose program implementation/monitoring,
- 15 were non-randomized impact evaluations.
- Note: studies could have more than one purpose.
- Source: Robert Boruch, Dorthy de Moya, and Brooke Synder in Robert Boruch and Frederick Mosteller, eds., *Evidence Matters* (Brookings, 2001).

What ED will do

- The What Works Clearinghouse
 - o Interventions linked to evidentiary support
 - o Systematic reviews
 - o Standards for & providers of evaluations
- Preschool Curriculum Evaluation Research
- Explanatory Research: Why and How
- Funding for evaluations of promising innovations in the field
- Build capacity internally and externally

Goals

- ED will provide the tools, information, research, and training to support the development of evidence-based education
- Education across the nation will be continuously improved
- Wide variation in performance across schools and classrooms will be eliminated

The practice of evidence-based education will become routine

[< Previous page](#)

This page last modified—April 2, 2002 (pjk).

Technical questions about the Web site: webmaster@inet.ed.gov
Other inquiries/comments: customerservice@inet.ed.gov



U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)



NOTICE

REPRODUCTION BASIS

- This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

- This document is Federally-funded; or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").