

Scientifically Based Research



Congress passed the No Child Left Behind (NCLB) Act as a reauthorization of the Elementary and Secondary Education Act. Signed into law by President Bush in January 2002, NCLB brings many significant changes to schools nationwide. This QUICK KEY is designed to help school leaders identify scientifically based research, evaluate evidence of effectiveness, ask key questions about the research, and apply scientifically based research to school improvement efforts.

As a result of NCLB, schools and districts are seeking information to **identify, plan, and implement** federally funded programs and practices that have been proven to be **effective** through **scientifically based research**.

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Evidence of Effectiveness—Scientifically Based Research

When school leaders meet to address school improvement efforts, they should first determine their needs and then decide which intervention, program, or model may best address those needs. In order to receive funding under NCLB, schools must implement reform strategies informed by “scientifically based research,” which is defined in Title IX as having each of six specific components. The six components, including detailed explanations and examples, contain the following requirements:

- **Use empirical methods.**

Quality research is conducted in a systematic and consistent manner with great attention to detail. The methods are appropriate, and conclusions are based on systematic observation or experiment.

Practical example: You are the principal of an elementary school serving 500 students. In Grades 1–3, 70 percent of your students are bilingual and not achieving to grade-level standards. You are considering adopting a literacy model that claims to benefit all students, including bilingual students. Before adopting a new program, you should ask some questions about the research: Was this program tested under controlled circumstances in which some schools used the program and some did not? Was the sample size reasonable and relevant to the service provided?

- **Involve rigorous and adequate data analyses.**

Data collected in a high-quality study should be examined with appropriate statistical measurements to test the stated hypothesis and justify the conclusions drawn from the research. Failure to use proper statistical measurements could result in inaccurate or misleading results.

Practical example: You are reviewing a study related to the effectiveness of a Grades K–4 mathematics curriculum that claims significant increases in student achievement over a comparable program. Does the analysis account for students who have not stayed in the program for the length of the study? If yes, does it address how the data change as a result of students dropping out? Was the same measurement (test or assessment tool) used over time, and are comparisons and interpretations really possible given the tools used?

- **Rely on measurements or observational methods that provide reliable and valid data.**

Quality data produce accurate and credible findings. Scientifically based research utilizes measurements that provide reliable, valid data across multiple measurements and observations. Reliable instruments allow repeated measurements to produce similar results over time. Valid data will show that the assessment tool measures only what it is designed to measure. There must be a connection between the research question and the observed behavior; the research findings are based on that connection. Repeated measurements should yield identical or similar results from one evaluation to the next.

Practical example: You are an elementary school reading specialist looking to improve student reading comprehension. A professional development provider shows evidence that in a particular school that adopted its literacy approach, scores increased on a state assessment of third graders. You may reasonably have some concerns about bias because the service provider may only be presenting success stories. You might also have concerns about validity because the test measures several aspects of reading performance in addition to comprehension.

- **Use either an experimental or quasi-experimental design.**

Quality studies use experimental research designs in which there is random assignment into at least two equivalent groups. One group participates in the program (receives the treatment), and the other group does not. If random assignment is not an option, quasi-experimental designs allow researchers to match the experimental and control groups as closely as possible.

Practical example: You are a concerned parent and member of the school improvement planning team. An external provider's website reports the following: "In 20 schools that have used our mathematics approach, student performance on standardized tests increased by more than 15 percent in three years compared to national norms." Was there a control group? If so, were students assigned randomly? Did similar students in the area also make gains in mathematics performance during the same period?

- **Allow for replicability.**

Quality studies include a clear description of the method, instruments, and data used—a description sufficiently detailed to allow a different researcher to conduct the same study. Findings should be free from jargon to allow an informed lay reader to understand them.

Practical example: A research study in a popular journal looked at the achievement of at-risk students in a computer-mediated environment. Does the study allow the reader to actively "participate" in the research process? Can the research process be re-created in another classroom with the same setting? Does the study provide enough information to carry out the experiment?

- **Undergo expert scrutiny.**

Quality studies have been reviewed and approved by independent expert reviewers. A form of quality control has been executed through expert analysis through a rigorous, objective, and scientific review of the research.

Practical example: A teacher conducted a detailed case study of her experiences in implementing a new reading curriculum. The editor of a popular magazine that addresses a variety of educational issues decided that the case study was interesting and informative, so it was published. Would you consider this to be a highly scrutinized study?

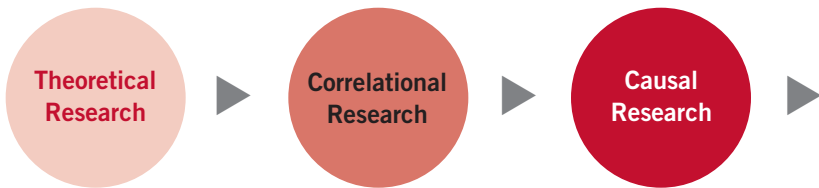
Evidence of Effectiveness—Cumulative Evidence Base

School leaders must make decisions based on the best available evidence as well as professional judgment when implementing their programs. School reform programs—and the strategies and methods that make up the programs—must reflect scientifically based research (as defined by the six components).

It is important to remember that one study, even if it meets all the scientifically based research criteria, is not enough to be considered sufficient evidence of effectiveness. In most cases, there exists a mix of research composed of numerous studies using various methodologies, including but not necessarily limited to experimental or quasi-experimental designs. If an experimental or quasi-experimental design has not been used, however, claims of causality are more tenuous and should be treated with caution. For a thorough but nontechnical guide to assessing the quality of research studies, check out *Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide* (www.ed.gov/rschstat/research/pubs/rigorousvid/index.html).

It might be helpful to note that research exists on a continuum—from research that is purely theoretical in nature to research that shows a correlation between variables to research that shows causation. As shown in Figure 1, an educational reform program typically starts out as a theoretical relationship between the variables of interest, is then subjected to correlational studies to understand the relationships of the variables, and finally is subjected to causal studies to examine whether the variables in question are actually causing, for example, changes in student achievement.

Figure 1. Progression From Theory to Scientifically Based Practice



While this process does not always happen in the “real world,” look for evidence of this process when you are examining research that purports to make causal claims. Because a program must adapt to meet the specific needs of a particular student population, it is important that clear evidence explains why and how a program works, not just that it does. For answers to the “why” or “how” questions, there must be a theory underlying the program, and evidence that previous research found that the theory successfully predicts certain outcomes. In order to meet NCLB criteria, school leaders must find ample research evidence for their reform program of choice. Finding scientifically based research and building a cumulative research base are certainly daunting tasks, but resources are available to help.

Key Resources

Comprehensive School Reform Practitioner's Guide to Scientifically Based Research

www.centerforcsri.org/pubs/pg/index.htm

Designed by the National Clearinghouse for Comprehensive School Reform, this guide is intended to help school leaders understand and respond to the new federal regulations regarding the quality of research supporting comprehensive school reform programs.

Education Commission of the States Website

www.ecs.org/html/issue.asp?issueid=195&subIssueID=114

This website contains resources and a Web-based summary of state policies and activities related to NCLB requirements and scientifically based research.

Guidance on the Comprehensive School Reform Program Website

www.ed.gov/programs/compreform/guidance/index.html

This website outlines the components and requirements for comprehensive school reform programs.

Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User Friendly Guide

www.ed.gov/rschstat/research/pubs/rigorousetid/index.html

This thorough but nontechnical guide helps school leaders assess the quality of research studies.

Iowa Professional Development Model

www.iowaccess.org/educate/ecese/tqt/tc/doc/ipdm05.pdf

This guide provides a framework intended to assist districts, schools, and individuals as they design professional development programs.

Making Good Choices: A Guide for Schools and Districts

www.centerforcsri.org/pubs/mgcSchoolsandDistricts.pdf

This publication from the North Central Regional Educational Laboratory at Learning Point Associates provides a process for examining school needs for reform and creating a reform initiative that will address those needs.

The No Child Left Behind Legislation: Educational Research and Federal Funding

www.infoagepub.com/products/series/titles/1-59311-188-6.html

This book provides a glimpse of the driving force behind federal funding of scientifically based research.

Proven Methods: Scientifically Based Research

www.ed.gov/nclb/methods/whatworks/research/index.html

Experts in both education and research discuss scientifically based research and its implications in this transcript of a 2002 U.S. Department of Education seminar.

Reporting the Results of Your Study: A User-Friendly Guide for Evaluators of Educational Programs and Practices

www.whatworks.ed.gov/technicalassistance/evaluator_guide.pdf

This report describes the requirements for acceptance of research studies by the What Works Clearinghouse and offers insight into what constitutes good research.

Scientifically Based Research and the Comprehensive School Reform (CSR) Program

www.ed.gov/programs/compreform/guidance/appencd.pdf

This booklet is designed to help school leaders understand educational research and assess the quality, relevance, and usefulness of the research.

Scientifically Based Research: ERIC Digest Website

www.ericdigests.org/2003-5/based.htm

This website offers the history and impetus behind scientifically based research in education and a basis for its current advocacy within the federal government.

Using Research and Reason in Education: How Teachers Can Use Scientifically Based Research to Make Curricular & Instructional Decisions

www.nifl.gov/partnershipforreading/publications/pdf/Standovich_Color.pdf

This publication presents methods for incorporating scientifically based research into instructional decision making.

Using Scientifically Based Research in Schools

www.centerforcsri.org/files/TheCenter_NL_Oct05.pdf

This newsletter from The Center for Comprehensive School Reform and Improvement provides practical suggestions for reading and understanding scientifically based research and for applying the principles of scientific inquiry to both teaching and student learning.

What Works Clearinghouse Website

www.whatworks.ed.gov

This website contains Web-based databases that provide a compendium of high-quality scientific research studies and reviews of scientific evidence of effectiveness for educational policies, practices, products, and programs.

What Works Clearinghouse: Evidence Standards for Reviewing Studies

www.whatworks.ed.gov/reviewprocess/study_standards_final.pdf

This document describes the three-stage review process that studies of interventions undergo before they are deemed to either not meet evidence standards, meet evidence standards, or meet evidence standards with reservations.

Glossary of Common Research Terms

case study: An extensive study of an individual unit, group, institution, organization, or program. It provides a thorough analysis of the object being studied.

causality: The relationship between the cause and the effect. Causality exists under three conditions: the intervention (e.g., a reform model) must come before the outcome (e.g., increased student achievement); there must be covariance (e.g., if the intervention increases slightly, the outcome will increase slightly); and there must not be extraneous explanations for the observed outcome.

control group: A group of individuals whose characteristics are similar to an experimental group but who do not receive any of the program services or products being evaluated.

correlation: A standardized measure of linear association between two variables. Its values range from -1 (strong negative association) through zero (no association) to +1 (strong positive association).

empirical research: Research conducted for the purpose of collecting measurable data in terms of attitudes, behavior, or performance. Designed to generate projectable, numerical data on a topic.

evidence of effectiveness: A term used in NCLB that programs must “prove evidence of effectiveness,” meaning a program must show—through student achievement data—that it improves achievement.

experimental group: A group in an experimental design that receives the treatment or program.

experimental research: A research design that involves random assignment of study participants to either an experimental or control group. This allows researchers to compare the outcome (e.g., test scores) of the experimental group to that of the control group and to assess the effect of the treatment. It is the strongest research design for establishing evidence of effectiveness.

qualitative research: Collection of nonnumerical data using interviews, observations, and open-ended questions to gather meaning from nonquantified narrative information.

quantitative research: Collection of numerical data in order to describe, explain, predict, and/or control phenomena of interest.

quasi-experimental research: A research design that includes some type of intervention or treatment and provides a comparison. Lacks the degree of control over all elements (environment, intervention, subject selection) found in experimental research design but may provide some evidence of effectiveness. Comparison groups are frequently used, but maximum controls are employed to minimize threats to validity; random selection is typically not possible or practical.

reliability: The degree to which an instrument consistently measures in the same way on repeated trials (e.g., a mathematics test given to a student one day would yield roughly the same score if given to the same student the next day).

theory: A comprehensive explanation of a given set of data that has been repeatedly confirmed by observation and experimentation; it has gained general acceptance within the scientific community but has not yet been decisively proven.

validity of an instrument: The degree to which a measure accurately assesses the specific concept it is designed to measure (e.g., whether a reading comprehension assessment focuses on students' understanding of a story or their ability to read the story).

validity of a research study: A study has internal validity when the possibility is minimal that other (confounding) variables are responsible for the effect in question. External validity is the extent to which the results of a study are generalizable and transferable to different populations, settings, and conditions.

The Quick Key Series

Learning Point Associates developed the *Quick Key* series to assist educators, policymakers, and other stakeholders in understanding and implementing the No Child Left Behind Act. The following *Quick Keys* are available online at www.learningpt.org/QuickKeys/.



Quick Key 1

Understanding the No Child Left Behind Act: Reading



Quick Key 2

Understanding the No Child Left Behind Act: Opportunities for Schools in Need of Improvement



Quick Key 3

Understanding the No Child Left Behind Act: Technology Integration



Quick Key 4

Understanding the No Child Left Behind Act: Mathematics and Science



Quick Key 5

Understanding the No Child Left Behind Act: English Proficiency



Quick Key 6

Understanding the No Child Left Behind Act: Teacher Quality



Quick Key 7

Understanding the No Child Left Behind Act: Scientifically Based Research



Quick Key 8 Action Guide

Implementing the No Child Left Behind Act: Teacher Quality Improves Student Achievement



Quick Key 9 Action Guide

Implementing the No Child Left Behind Act: Strategies to Improve High Schools



Quick Key 10 Action Guide

Implementing the No Child Left Behind Act: Using Student Engagement to Improve Adolescent Literacy

www.learningpt.org/QuickKeys/



1120 East Diehl Road, Suite 200
Naperville, Illinois 60563-1486
Phone: 800-356-2735
Fax: 630-649-6700
www.learningpt.org

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