# Six Criteria for Scientific Based Research

Critical Issue: Using Scientifically Based Research to Guide Educational Decisions

1. ***Research that employs systematic, empirical methods that draw on observation or experiment.*** Empiricism is "watching the world," relying on careful observation of events to make conclusions. Systematic empiricism requires doing those observations in a careful manner in order to answer a specific question. In the realm of educational research, systematic empiricism requires an exact definition of the intervention and program being studied, and careful measurement of its outcomes. In order to know if one method truly caused an improvement, it is necessary to quantify the improvement in student performance…It all comes down to…without data, it's just an opinion…

2. ***Research that involves rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn.*** It is necessary to analyze data from a study using appropriate statistical procedures that can support the conclusions. Failure to apply the appropriate statistical procedures call the results into question. Reputable research does not issue strong claims for the effectiveness of a program or practice based on modest differences or gains in student achievement. It is necessary to use statistics to determine whether the results were significant and important. A great deal of technical expertise is necessary to understand whether statistical procedures have been performed and reported adequately. Quality research reports basic statistical information such as:

a) Sample size and representativeness: This refers to the selection of participants in the study. Does it represent the population of people about whom the researchers wish to learn.

b) Statistical procedures to interpret data: Research that compares the effectiveness of an intervention almost always reports statistical test such as t-tests or analyses of variance (ANOVAs). A study lacking such information is unlikely to provide convincing proof of effectiveness.

c) Supplementary descriptive statistics: Quality research provides numbers that describe the results, such as means and standard deviations.

d) Significance: this is expressed as the probability that the observed differences could have happened by chance. When this is very low (.05 or less) the results are deemed statistically significant.

e) Effect size: this is the description of how large an effect the treatment had. It should be reported in real-world terms, such as percentages.

3. ***Research that relies on measurements or observational methods that provide reliable and valid data across evaluators and observers, across multiple measurements and observations, and across studies by the same or different investigators.*** Research needs to be reliable. A reliable testing instrument will give you the same result each time you use it on the same person or situation. When testing a student in a manner that relies on human judgment, such as a writing ability, it is essential for the research to report interrater reliability, and index of how closely the different raters agree. Studies that rely on testing instruments typically establish test-retest reliability by administering it to the same group of people twice. The main point is that SBR documents the reliability of its procedures for data collection.

4. ***Research that is evaluated using experimental or quasi-experimental designs in which individuals, entities, programs, or activities are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest, with a preference for random-assignment experiments, or other designs to the extent that those designs contain within-conditions or across-condition controls.*** Experimental design. This criterion specifies that in order to be deemed scientific by the NCLB Act, research needs to conform to an experimental or quasi-experimental design. The reasoning is that it is difficult to understand the effectiveness of any educational approach without comparing it to a different approach. The effectiveness of any practice needs to include a comparison group to show what would happen if that practice had not been used.

5. ***Research that ensures that experimental studies are presented in sufficient detail and clarity to allow for replication or, at a minimum, offer the opportunity to build systematically on their findings.*** Scientific research is open to the public. A person who claims to have discovered an effective teaching technique needs to submit evidence for its effectiveness to public scrutiny. If the results are sound, and the practice is truly effective, other people should be able to get the same results. For this reason, SBR must be reported in sufficient detail to allow for replication of the intervention and the scientific findings.

6. ***Research that has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review.*** The process to peer review is essential to SBR. The purpose of peer review is to submit research to public criticism-to shine the light of objectivity generated by independent minds. This process helps to screen out poor quality research, especially research that has serious problems in any of the areas discussed. In summary, SBR is submitted to public scrutiny through peer review, and is replicated by independent researcher. Educators should therefore be wary of programs or practices whose support comes only from unpublished "in-house" studies conducted by its commercial vendors.