

In my proposed research project, I plan to investigate the effectiveness of different teaching strategies in science education. 

I hypothesize that students who are taught using inquiry-based learning will exhibit higher levels of critical thinking and problem-solving skills compared to those taught using traditional lecture-based methods. 

My research design will involve a randomized controlled trial, where students from different classrooms are randomly assigned to either the experimental or control group. 

The experimental group will be taught using inquiry-based learning, while the control group will follow the standard lecture-based curriculum. 

I will use pre- and post-assessments to measure students' understanding of scientific concepts. 

The results of this study will contribute to the literature on effective teaching strategies in science education and provide insights into how to improve student learning outcomes.
Although research on inquiry-based strategies has led to the design of feasible instructional approaches, the degree to which these results can be generalized to other domains remains a matter of debate. The potential of inquiry-oriented instruction to support learning and thinking is evident in a variety of educational contexts, but the extent to which these methods can be effectively implemented in practice for all students is not yet clear. In this section, we explore the potential of inquiry-oriented instruction to support the development of critical thinking and problem-solving skills, as well as the implications for educational practice.

First, the research of David Klahr, Samuel plunges into the heart of the inquiry-oriented approach to education. Klahr and his colleagues have studied the development of scientific inquiry skills in children, and their work has been influential in the field of science education.

Second, the research of Brenda Breslow and colleagues highlights the potential of inquiry-oriented instruction to support the development of critical thinking and problem-solving skills, as well as the implications for educational practice.

Third, the research of John Hattie and colleagues explores the potential of inquiry-oriented instruction to support the development of critical thinking and problem-solving skills, as well as the implications for educational practice.

In general, the research of Klahr and his colleagues has emphasized the importance of providing children with opportunities to engage in scientific inquiry, such as by designing and conducting experiments or investigating real-world problems. The potential of inquiry-oriented instruction to support the development of critical thinking and problem-solving skills, as well as the implications for educational practice, is evident in a variety of educational contexts, but the extent to which these methods can be effectively implemented in practice for all students is not yet clear.
Table 1. Linking Research, Instruction, and Assessment

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<thead>
<tr>
<th>Research (Klahr, 1999)</th>
<th>Instruction (NRC, 2006)</th>
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teaching methods for college juniors may not have great utility in predicting its value for 4th graders and vice-versa. 4. In enthusiasm for inquiry as the most effective approach to teaching science both to prospective scientists and the general student population, there has been general disregard for the outstanding success of traditional methods in producing the large generation of very capable and imaginative scientists who grew up in the ’50s through the ’70s, most of whom learned their science from didactic sages-on-a-stage, some inspiring, most not.

In his very thoroughly prepared response, Bybee does a better job than we did of documenting the wide variety of ideas that have appeared under the blanket term “inquiry.” However, by including so many approaches under the heading inquiry, the word becomes almost synonymous with “education,” and any argument over the superiority of inquiry versus direct instruction or vice versa becomes moot. For example, he proposes that the following quality be included as part of the definition of inquiry, “… inquiry includes understanding scientific inquiry and developing the cognitive abilities associated with the processes and methods of science.” A good conventional science lecturer using Socratic teaching methods can accomplish this, too.

We did not argue, as Bybee suggests, that inquiry strategies are ineffective because students are not developmentally prepared. To the contrary, we proposed that in studies where inquiry showed no clear edge over conventional teaching, these results may have been due to developmental factors, rather than a problem with inquiry itself. Further, we did not suggest that direct instruction is the viable alternative to inquiry. Rather, we posited that good direct instruction may be more effective than mediocre inquiry activities in a given population.

We are not inquiry opponents, and we do not believe our piece suggests this. In our collective 80 years of teaching high school and college science, we have regularly used (and still use) inquiry activities. However, we have discovered that inquiry does not produce positive results for all students all the time, and the teaching approach has to be tailored to the characteristics of the intended audience. One of our goals in offering this editorial was to suggest that in some circumstances, a good, well-prepared (and perhaps even inspiring) lecturer can be just as effective (or more so) as a pre-packaged inquiry activity in helping students understand the process of science, and to force all science teaching into the inquiry mold may well be counterproductive in specific cases.

Frank Heppner
Karen Kouftah
William Croasdale

Response

Our intent in this editorial was to provoke discussion on four points: 1. "Inquiry" is the dominant paradigm for the science education establishment today, but this one-size-fits-all approach may not produce beneficial results in all situations. 2. "Inquiry" has been so broadly defined that it is difficult to predict its usefulness in a given case because different research-based studies may have been testing different phenomena. 3. Where studies have shown less-than-stellar results for inquiry, developmental factors may have been a determining factor; intellectual development has been understudied in the applicability of inquiry. A study on effectiveness of