Integrating INQUIRY Across the CURRICULUM

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PART I

Teaching and Learning Through Inquiry in the Content Areas

It is error only, and not truth, that shrinks from inquiry.

—Thomas Paine

Can you recall the first time you heard the term *inquiry* used to describe an approach to teaching and learning? For me (Richard Audet), the memory is still vivid. It was during the late 1960s, and I was part of a huge wave of eager new teachers determined to change the face of education. At this time, proponents of inquiry were at their ascendancy. Educators call this the alphabet soup era because of the explosion of innovative curriculum projects with acronyms such as MACOS, IPS, SCIS, and PSSC. My high school was caught up in this tide of reform and adopted textbooks produced by the Biological Sciences Curriculum Study (BSCS) project. BSCS was, and still is, among the leaders in developing instructional materials that feature an exploratory approach.

Despite their high quality and orientation toward investigation, such student-centered materials failed to gain a substantive and permanent foothold in most schools. My brief story, told from the

perspective of an unaccomplished novice from that time period, may explain why such materials failed to meet the original high and widely held expectations.

During the early stages of my development as a teacher, I was heavily dependent on BSCS's vision of effective biology instruction. Because of my lack of experience, I had few other choices. Never in my K–12 education, except for mandatory science fairs, was I offered challenging opportunities to learn through inquiry. Never in the 7 years spent obtaining my biology degrees had I heard the word *inquiry* used to describe this scientific way of knowing. Never in the early stages of my teaching career did I receive professional development to prepare me for this new style of instruction. Because I was forced to rely exclusively on my own naïve interpretation of the BSCS model, most of my instructional decisions were based solely on intuitive hunches. The unfortunate yet fully predictable ending of this tale was that several years later, my department abandoned BSCS curricula in favor of more traditional textbooks and approaches—another illustration of "the discrepancy between beliefs about the importance of inquiry teaching and actual school practice" (DeBoer, 1991, p. 109).

Surprisingly, these pioneering curriculum movements proved to have an enduring impact on the educational community. True believers of inquiry persevered, and, like fine wine, their ideas and understandings continued to improve and mature over time. Aided by formal research and considerable trial and error, more finely tuned approaches and deeply rooted personal philosophies about inquiry appeared in the literature. Eventually, national content standards emerged that included strong and clear statements about inquiry.

Today, an ever-increasing number of inquiry-based classrooms from all areas of study suggest that educators learned from these lessons of the past. Such settings are supported by rich curricula that incorporate cognitive research findings, research-based instructional models, strategies for differentiating among learners, and technologies that offer immediate access to information and data. Inquiry *teachers* possess an inquiry "stance" (Cochran-Smith & Lytle, 1999), a disposition toward teaching that assigns more value to a good question than a correct answer. Inquiry *learners* are curious and eager to search for explanations, and they accept responsibility for their learning. Inquiry-based *curriculum* materials incorporate open-ended invitations to explore and accommodate alternative explanations and

interpretations. Inquiry *assessment* is authentic and carefully aligned with the goals for student learning. Inquiry *classrooms* are noisy, semichaotic places populated by students and teachers wearing happy, quizzical, and satisfied expressions.

This book's major sections were shaped by the contributors' contemporary beliefs, ideas, and understandings about inquiry. Part I begins with an overview of inquiry as an overarching theme for teaching and learning that cuts across all areas of the K–12 curriculum. In the five chapters that follow, content area experts examine inquiry from the unique perspectives offered by geography, science, history, mathematics, and English language arts. This section's final chapter examines inquiry in terms of its potential for supporting seamless curriculum integration.

References

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IDEAS FROM THE FIELD

Alien Invaders

This is an inquiry-based middle school unit on invasive species. This problem is second only to habitat destruction in terms of its threat to biodiversity and economic impact. The problem of invasives is global in scope and expanding rapidly as the spatial and geographic boundaries that once separated natural populations continue to weaken and fall.

Invasion Ecology (Krasny, 2003) offers an outstanding set of activities that incorporates inquiry. The book's ecological approach offers a cross-disciplinary perspective that addresses all science areas. Many of the ideas in this 5E learning cycle (Bybee, 1997) were drawn from this book.

Portions of the unit can be adapted for elementary and secondary school students. The materials include both laboratory and field components. Fall is a great season to conduct these lessons because so many fruits and seeds ripen at this time of year. Our current awareness of this global problem makes this topic ideally suited for inclusion in wetland projects.

Alien Invaders

Engage: Hitchhikers Beware

A simple question like "How do seeds spread from place to place?" can serve as a great launching pad for guided student inquiry. Use a silent demonstration for this engagement. Students observe you displaying seed specimens and later describe the exact steps completed during your demonstration. Select fruits and seeds that have fairly obvious adaptations for spreading seeds. The maple samara, dandelion, touch-me-not, acorn, blueberry, and burdock are excellent examples. After the demonstration, a set of focusing questions can guide children to identify the salient elements of seed dispersal and generate ideas about how such features benefit plants. Students enter a summary statement in their science notebooks based on their prior understanding of seeds and insights triggered by this demonstration to consider the relationship between form and function.

Explore: Designer Seeds

In this guided discovery activity from the Access Excellence Web site, students use their prior knowledge to design, build, and test wind-dispersed "seeds." They test their seed's dispersal potential by dropping it in front of a fan and recording the distance traveled. Different design

features are evaluated and then compared with properties that contribute to seed spreading in nature. The complete lesson is available at http://www.accessexcellence.com/AE/AEC/AEF/1995/taylor_seeds.html.

Explain: Deadly Plant Invaders

Science teachers can draw from the following resources to prepare an inquiry-based instructional plan that targets the essential information needed to understand the invasive species problem.

- The National Park Service offers an interactive simulation called *The Deadly Plant Invaders Game* that enables student to grasp the fundamental ecological issues associated with nonnative plants (http://www.nps.gov/piro/lp05.htm).
- *America's Least Wanted: Alien Species Invasions of U.S. Ecosystems* (http://www.conserveonline.org/2001/06/s/amleast) is a terrific reading that gives a comprehensive overview of the problem.
- Two videos devoted to invasive species are available free to school libraries: Bill Nye's *Aquatic Invaders* (http://www.sgnis.org/av/video/aquatic.htm) and *Plants Out of Place* (ecoservices@dnr.state.mn.us).
- The Nature Conservancy offers a compendium of materials called *Invasives in Your Backyard* (http://nature.org/initiatives/invasivespecies/features/).

Extend: Invaders in Our Midst

The teacher searches the Internet for invasive plant lists for his or her state or region. Selected pictures are downloaded to prepare a laminated identification sheet (preferably in color) for each student (http://www.blm.gov/education/weeds/hall_of_shame.html has an example). Ask students to scour their neighborhoods for instances where alien plants have gained a foothold. Create a Local Invasive Species Sightings sheet in which students can record information about plant species, location, description of the site, approximate size of area affected, and so on. Have students describe their findings to the class and post their sightings on a community map in specific locations where they were discovered. After sufficient time has elapsed, have students summarize their findings in their science notebooks.

Another great extension activity, *Unwanted Travel Partners,* accompanies a program from the Scientific American Frontiers series called *The Silken Tree Eaters.* Students simulate an alien invasion by studying population changes that occur after an *Elodea* sprig is added to a tube of sterile water (http://www.pbs.org/saf/1204/teaching/menu.htm).

Evaluate: Let's Take Action

Ask the class to prepare a community awareness campaign aimed at reducing the incidence and local impact of invasive species. The performance assessment can involve preparing brochures, editorials, maps, videos for local cable programs, jingles, petitions, bumper stickers, wanted posters, commercials, and so on. A scoring guide with clear expectations for students should accompany the evaluation. Be sure that the guidelines for the task require that students provide evidence that demonstrates a clear understanding of the science content associated with this topic.

Literacy Connections

- *Kudzu: The Vine to Love or Hate* (Hoot & Baldwin, 1996) describes the impact of this nasty invader from Japan on the habitat of the southern United States.
- *Hawaii's Natural Forests* explains the threat to Hawaii posed by alien plants from around the world (Orr & Boynton, 2000).
- *When Animals and Plants Invade Other Ecosystems* (Batten, 2003) offers thought-provoking descriptions of how ecological balances are threatened by the accidental or intentional introduction of organisms such as the gypsy moth.

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