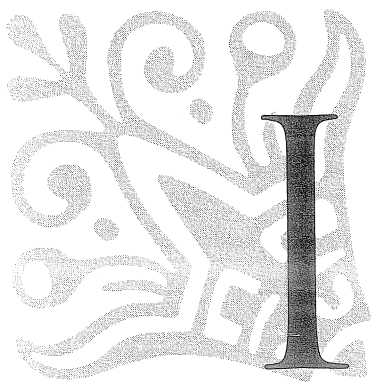
CHAPTER 12

Inquiry-Based Learning and Teaching



In inquiry-based learning, the student plays a major role in defining the content through curiosity-driven questions and in defining the pedagogy needed to actively pursue the answers to these questions. Unfortunately, neither teachers nor students have sufficient experience with authentic inquiry-based learning to make it a common reality in either general education classrooms or specialized experiences for talented students. Well-implemented, inquiry-based learning is applicable to a broad range of students, but the expectations for talented students' accomplishments can be suitably differentiated. The skills involved may best be directly taught and practiced.

What We Know

The majority of empirical research on inquiry-based learning has been at the classroom level, but only occasionally with specific attention to students with high ability. For example,

DiGisi and Willett (1995) surveyed 184 high school biology teachers about their use of text readings with regular and Advanced Placement (AP) students. They then interviewed a representative sample of 16 of these teachers in greater depth. Teachers responded that AP students were more often given texts for independent reading and that they had more independent responsibility for learning from their texts. On the matter of inquiry, however, only the AP students were also shown how to construct new knowledge from the texts. Raudenbush, Rowan, and Cheong (1993) had also noted this differential adaptation by teachers. They sent questionnaires to 303 teachers of 1,205 classes in 16 secondary schools located in Michigan and California. The questionnaires probed the teaching of higher order thinking skills in those classes. Teachers set a greater number of higher order thinking goals for college-bound classes.

Studies of students, rather than teachers, reveal similar results. Moar and Taylor (1995) made an important general point, based on studies of two 11th-grade classrooms in Western Australia having teachers with diverse epistemologies: The teacher whose pedagogical approach promoted inquiry through both personal and social processes of constructing knowledge, in contrast to a direct teaching approach, more successfully engaged students in inquiry. How the two teachers came to differ on this important variable was not discussed, nor is it clear if the students' abilities were directly comparable. Shepardson (1996) examined much younger students, two randomly selected groups of four first-grade children in the same rural Indiana school. Each group of four was teacher-selected to vary by gender, as well as academic and verbal ability. Shepardson showed that teachers taught for understanding in individual children rather than promoting interaction or collaboration among the children, that negotiating and sharing of materials contributed to science learning, and that the heterogeneity of the groups (an icon in some models of cooperative learning) did not result in the negotiation of meaning. In contrast, a very detailed qualitative study of eight highly able fifth-grade students working in groups of four, but more closely matched for ability and comprising two pairs of more assertive and docile children, clearly engaged in both cognitive and social moves related to their cognitive gains (Barfurth, 1994). Barfurth's relatively open-ended task, to design a Lego-LOGO machine that demonstrates the principle of mechanical advantage, may have been more appropriate than the more limited goals set for the younger children. Teachers do, however, clearly establish the academically and socially expected and accepted ways for pupils to interact in learning groups. Student ability differences seem to play a role, but this role is not fully discernible as a result of the designs used.

Similar outcomes have been reported at the college level. King (1995) examined and taught critical thinking skills in her own psychology courses at California State University, San Marcos. Compared to experts in their discipline, college students ask questions that call upon relatively low levels of knowledge and factual understanding unless they are specifically trained to ask thoughtful questions. This training includes two key components: good examples and feedback while practicing. Wineburg (1991) used protocol anal-

ysis to examine the process of historical inquiry in eight historians and eight high school students as they evaluated documentary and pictorial evidence. He also concluded that the high school students were able to learn many facts as well as the experts, but did not wonder about discrepancies or attempt to match different kinds of evidence, and sometimes extrapolated beyond the evidence; they did not understand how new historical knowledge is constructed. Unlike King, who demonstrated that training could change the performance, Wineburg only speculated about the impact of training in asking questions.

Inquiry With Talented Learners

The gifted education literature has begun to pose similar questions. The best-known example of an inquiry-based learning context in gifted education is probably a Type III Enrichment Triad Model activity as enunciated and developed by Renzulli (1977). The literature on Type III activities is extensive, and it is dominated by prescriptive and descriptive studies. As a corpus of work, however, it shows rather convincingly that highly able students exposed to such curricular options enjoy them and produce some remarkable products (cf. Baum, Renzulli, & Hébert, 1995). Lest anyone anticipate, however, that Type III forms of inquiry experiences abound in schools, it needs to be recalled that a massive national survey of nearly 3,400 regular classroom teachers conducted by the National Research Center on the Gifted and Talented found that, at best, only minor changes to the regular curriculum were occasionally made to accommodate the needs of highly able pupils (Archambault et al., 1993), and Type III adaptations are much rarer than Type I or other general enrichment activities.

Nonetheless, when given the opportunity, gifted students are able to engage in inquiry-driven learning in a variety of subjects ranging from art (Kay, 1994) to social studies, as well as the more often studied science cited in the general literature. In Cramond, Martin, and Shaw (1990), two groups of school-identified gifted children were trained either in a Creative Problem Solving control group (n = 28) in which memory training skills were added, or in which specific transfer skills were incorporated (n = 25). The inquiry-related transfer skills generalized across domains. Kaniel and Reichenberg (1992) worked with 140 talented and culturally disadvantaged 10- to 12-year-old children in Israel, all of whom were academically underachieving. Half received training in Feuerstein's Instrumental Enrichment (IE), plus metacognition and other thinking training. Half learned only the IE programming. The group that also received higher order thinking skills training generalized these skills to verbal and nonverbal tasks, but, strangely, not immediately to school performance. Four years later, this group's school performance was also enhanced. The reasons for the delay were not explored, but this does suggest the need for patience in awaiting educational benefits. Gallagher and Stepien (1996) countered a frequently expressed fear that children who engage in inquiry will miss basic

content. Their study of 167 sophomores at an Illinois state residential secondary school for mathematically and scientifically gifted students found that students whose instruction was initiated with an ill-structured problem and continued with significant student control of the content and pace of instruction did just as well on basic information as gifted pupils in more conventional, expository programs. Friedman and Lee (1996) studied seven small-city Kansas teachers of 137 children in grades 4 and 5. None of the teachers had more than a single-day workshop exposure to gifted education as such, but all had been assigned identified gifted children to their classrooms. The teachers were given further coaching in three gifted education models (including the Enrichment Triad), but the differences among these were overshadowed by the importance of specific, focused instruction on how to pose high-level questions in order to develop students' questioning techniques. These studies, and others like them, clearly demonstrated that talented learners can be directly equipped with component skills that favor inquiry-based leaning. None of these studies, however, explicitly included a nongifted control group nor investigated if or how this situation might be different for children of average ability.

In a larger study with a similar sample, Hansen and Feldhusen (1994) found results similar to those reported in the general education literature for the importance of training. They compared 54 gifted education teachers who had three to five courses in gifted education to those without such training but who also had responsibility for gifted pupils. Trained teachers created more opportunities for gifted children to determine their learning activities and to exercise self-direction. Because the teachers were included in the study on the basis of their having been trained in gifted education or not, there is a risk that teachers predisposed to inquiry-favorable relationships with pupils may seek gifted education training. It seems fair to agree that teachers make a difference, but the impact of specific independent variables needs more controlled examination. The same applies to the study by Baum et al. (1995) that closely followed the work of 12 Enrichment Triad trained teachers with 17 gifted underachieving students aged 8–13 who were doing Type III projects. Once again, the students developed worthy projects, but it is not possible to conclude whether the positive outcome is the result of their ability, their having been congregated for instruction, the specific actions of the teachers, or the content of the instruction; the authors fully acknowledged this limitation. It was also not clear how much explicit training the students had in asking questions.

A key unanswered question remains whether or not inquiry-based learning is in any way uniquely appropriate to high-ability students. Two empirical studies gave contradictory preliminary answers to this question. Meador (1994) found that training in synectics, using analogies to make original connections among apparently unrelated ideas, and helping students to value their own ideas (as opposed to textbooks or teachers as primary authorities—cf. Gabella, 1994, who has examined this authority question among older pupils) helped 107 gifted and nongifted Texas kindergarten pupils to ask higher level questions. From this, we might expect the evidence to swing toward a nonspecific

outcome with respect to ability. On the other hand, Roberts, Ingram, and Harris (1992) showed that higher order cognitive processes were most enhanced in gifted Utah pupils in grades 3–5 who received special programming consisting of the Schoolwide Enrichment Model (cf. Renzulli & Reis, 1985), Triad activity Types I and II, creative problem solving, and independent research. The contrasts included less able pupils (n = 56) in both of the special programs and high-ability pupils (n = 30) in regular schools. Roberts et al. acknowledged the still partly unexplained contribution of merely bringing the more able pupils together. An issue they did not address was the appropriateness of the special programming. Renzulli Type I and II activities are generally given to the whole class (as noted explicitly by Friedman & Lee, 1996), and unmodified creative problem solving, without additional transfer components, was not effective for Cramond et al. (1990). The remaining element of their program was training in independent research. The conclusion then returns to a very straightforward one implied elsewhere: In order to get students to do independent research, teach them to do independent research; this objective may be especially appropriate to highly able pupils. The remaining uncertainty arises from the Roberts et al. criterion measure, the Ross Test of Higher Cognitive Processes, rather than a performance outcome with higher ecological validity, such as an independent research project as used by Baum et al. (1995).

In addition, no study to date fully answers the important "chicken and egg" question. Do the students respond differently because they are taught differently, or are they taught differently because they perform differently? And, where they are taught differently, how has this come about? This dilemma may require study of inquiry in a general education setting where the teacher and program are blind to the abilities of the children, and these abilities should then be examined in retrospect. One hint, but just a hint, comes from a study by Moss (1990), who found that mothers of 2- and 3-year-olds who scored high on a preschool intelligence test were more likely to guide and question their children through puzzle and construction tasks (e.g., asking what they'd like to build or asking how the child might decide that pieces fit together) than to prompt them directly toward solutions (e.g., suggesting what to build, or saying to look for matching colored edges). Cause and effect are thoroughly entwined, but the prospect that the shape of early parental interaction could create precursors for inquiry is ideal for a longitudinal follow-up study.

WHAT WE CAN DO

Research on inquiry-based learning so far points to its being effective in classrooms across ability levels to varying degrees, and that it can be taught by teachers experienced in teaching students to ask inquiry-related questions and facilitating their small group interaction. Inquiry-driven learning is not the unique domain of gifted pupils, but it is likely that there will be qualitative differences in the outcomes, and that inquiry can be given special expression

in differentiated programming for highly able pupils. The precise nature of this differentiation remains to be determined.

At Home

❧ None of the research so far published connects inquiry-based learning at school in relation to home experience. The fact that some of the studies found differences as young as kindergarten, however, suggests that home experiences can play an important preparatory role. At this point, it is a matter for research waiting to be done, but children who are given the opportunity to make choices in daily events in their lives, who are asked for input on family decisions, and whose inquisitiveness is encouraged rather than suppressed may, at home and in school, be at an advantage in an inquiry-based curriculum.

In the Classroom

❧ A defensible hypothesis at this point may well be that students need to be directly taught the specific components of inquiry-based learning—from asking high-level and interesting questions, to valuing their own judgments, to criticizing arguments, to presenting reports—and given practice in bringing these components together.

❧ Research reported to date has not adequately addressed the extent to which teachers need specific training and experience in inquiry-based learning before they can engage effectively in inquiry-based teaching. The success of Type III activities, however small in relative numbers, points to the possibility of eventually bringing closure to this question. Working in a computer environment for data presentation with students in grades 5, 6, and 8, as well as their teachers, Hancock, Kaput, and Goldsmith (1992) have identified a need for both teachers and students to acquire and practice defining problems, negotiating priorities, synthesizing findings, resolving contradictions, and monitoring data for relevance, and surmised that it may take years to master these skills. Such an outcome would not be a surprise to university doctoral program supervisors.

At School

❧ Schoolwide decisions can clearly affect the opportunity for inquiry-based learning in the classroom, but this too is more an issue of educated guessing than the outcome of specific study. Many schools adopt educational missions that affect the overall curriculum, and nearly every major curricular reform initiative in the past decade, from mathematics, to social studies and language arts, to science, has stressed the central nature of inquiry. The same is true

across levels from the youngest learners to university students. It is not generally happening, and very few teachers-in-training, not alone among other university students, have experienced a true inquiry experience in their educational histories (Aulls & Luconi, 1997). The role of educational leadership and teachers' prior experience is only beginning to be explored. The general and gifted literatures show a high concordance on what works when it is implemented, but so far it is rarely implemented.

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