Chapter 1

Designed to Fit

Educational Implications of Gifted Adolescents' Cognitive Development

BY
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ALL OF A SUDDEN John eats like a horse, Dwight brings new friends home, Tanya discovers existentialism, while Sarah discovers—and then loses—her temper. Welcome to adolescence. Although the external transformations capture our attention, the genesis of adolescent change is internal: an influx of hormones stimulates physical growth, moods shift as the body adjusts, and even the brain is expanding, opening the door to whole new vistas of understanding. The changes of adolescence are so numerous and far-reaching it is a wonder we try to teach these students at all, yet many secondary educators feel a sense of urgency about their instruction. The need to prepare students for college contributes to the urgency, as does the need to prepare them for work in the Information Age. The sense of urgency also is fed by the knowledge that in some way, the clock is running out on compulsory education for these adolescents, and before that happens, they must acquire enough dedication to seek the education they need independent of laws or parents. Ideally, they will have some vision of their future to guide their way.

All this urgency sometimes convinces teachers that there is too much at stake to take time to differentiate for their gifted students. Yet, adolescence is also the time when it is most likely that gifted students will abandon their gift because of a desire to be popular, of boredom with simple schooling, or of disenchantment with the lack of significance of their curriculum. How do we sustain gifted students' desire to learn while still preparing them for college and life? At the very least, how can we keep them from skipping class? The answers to these questions lie in the qualitative differences gifted students bring into the classroom. New research on the brain may well provide us with new ways to map and describe these differences (see Figure 1). Even now, evidence of qualitative differences from both psychology and education provide a strong rationale for modifying content, emphasizing thinking strategies, and using student perspective to create a meaningful differentiation: goals that are respectful and consistent with secondary instruction.

A Rationale for Multidimensional Content Differentiation

Copious Challenging Content

Gifted students' sponge-like absorption of new information is a defining trait. Cognitive scientists have isolated at least three skills related to IQ that combine to create an advantage in acquiring information. According to Steiner and Carr (2003), infants who: (1) react to new information quickly; (2) accommodate new information, or "habituate" quickly; and (3) leave "habituated" information to seek out new stimuli quickly, grow into children with high IQs. These same factors—rapid information processing, habituation, and preference for novelty—also are crucial to adult expert performance.

Between high-IQ children and the expert adults are gifted adolescents who also (1) learn better when taught two to three times faster than average (rapid response to stimuli); (2) remember better with fewer repetitions (Larson & Richards, 1991), which suggests habituation; and (3) respond better to open-ended, inquiry-oriented instruction (novelty seeking; Sak, 2004), preferring to learn something new even more than typically popular hands-on activities. Although it is impossible to make causal or developmental ties based on these separate bodies of research, the similarities are clear.

As gifted adolescents engage in the cycle of seeking, responding to, and accommodating new information, they acquire an extensive knowledge base, which contributes to academic success. Helping gifted students acquire a substantial knowledge base is the first essential component of an effective secondary program.

Should differentiation then focus on intensive memorization of facts? No. Gifted students consistently report that the dominant emphasis on factual learning leads to their disenchantment with school (Csikszentmihalyi, Rathunde, & Whalen, 1993; Gallagher, Harradine, & Coleman, 1997; Kanevsky & Keighley, 2003; Plucker & McIntire, 1996). The extensive knowledge base gifted students

Adults often wonder what happened to the mind of a new adolescent, as it often seems to have disappeared. Ironically, adolescents don't suffer from a lack of grey matter; rather, they have a surfeit. A decade of research using Magnetic Resonance Imaging (MRI) technology has revealed that brain development is much more dynamic than once thought, particularly during adolescence. Key findings include:

1. Just before the teenage years, the brain acquires a mass of new grey matter. Grabner, Neubauer, and Stern (2006) reported this new brain growth peaks at around 11 for girls and 12 for boys.
2. The new grey matter is deposited in the prefrontal cortex, which controls executive functions: impulse control, decision-making, reasoning, and planning.
3. Myelinization of an early adolescent's prefrontal cortex is significantly less developed than an adult's. Myelin, the insulation, helps make strong, efficient connections between neurons; the neural connections manifest as thought or action. Myelin develops as a result of exercising an area of the brain much as muscle develops as a result of exercising an arm or leg. New and unexercised, an adolescent's new prefrontal cortex—the area that controls executive function—is relatively flabby and in need of a workout (Sowell et al., 2003).
4. Unable to efficiently use their flabby prefrontal cortex, young teens rely on other regions of the brain, including the amygdala, which sends out impulsive gut reactions to respond to certain stimuli like facial expressions. Adults use their prefrontal cortex to respond to the same stimuli. Only in later adolescence does the teen brain begin to respond like an adult's (Yurgelun-Todd & Kilgore, 2006).
5. Individuals with high measured IQ also tend to have more grey matter in the prefrontal cortex than individuals whose IQ is average or below (Haier, Jung, Yeo, Head, & Alkire, 2004), suggesting the opportunity to develop more or stronger executive control function.
6. The preadolescent influx of grey matter is followed by attrition throughout adolescence. Grabner and colleagues (2006) called this a "pruning" process that weeds out weak neural connections and retains stronger connections.

For decades, the assumption has been that secondary educators have been adding to a work in progress, helping to mold a brain that has been around since a child's birth. Current research replaces this picture with another: 12-year-olds hurrying down crowded hallways, each carrying a mass of untrained brain. This image might serve as a call to action for any teacher, but it is particularly important for gifted educators, because the prefrontal cortex regions are "critical for essentially all higher order cognitive functions" (Grabner et al., 2006, p. 436). Grabner et al. noted the observed efficiency of prefrontal cortex activity in intelligent individuals suggests that they are malleable and responsive to training.

The key to changing an unpredictable, impulsive 12-year-old into a more self-possessed 22-year-old lies at least in part on the effective development of executive control processes. Given the relationship between prefrontal matter and intelligence, gifted students may well have more potential for executive control skill to develop—or waste. Because the adolescent brain also will engage in winnowing out unused or ineffective neural connections, it seems incumbent upon gifted educators to pay special attention to this area during the secondary years.

Figure 1. Neurological changes at adolescence.

develop is significant because "more leads to different" (Berliner, 1986, as cited in Shiever & Maker, 1997). With more content at their disposal, gifted students can make more connections and see more original relationships, for ". . . a strong knowledge base . . . facilitates and is facilitated by the development of advanced, domain-specific strategies and metacognitive knowledge" (Carr & Alexander, 1996, p. 214). Over time, these strategies accumulate and create an impetus toward complex and abstract levels of understanding.

Abstract, Complex Content

Another form of differentiation, particularly appropriate for gifted students, is exposure to abstract, conceptual ideas. Abstract reasoning creates its own form of new content to understand, encompassing intangible notions such as hypothesis posing, theorizing, and analogous reasoning. By implication, students must have access to abstract reasoning before they can succeed with curriculum that requires designing experiments, interpreting symbolic meaning, or comparing policy initiatives.

Students are generally thought to have access to abstract thought with the onset of adolescence and the acquisition of formal operational reasoning (Inhelder & Piaget, 1958). Systematic differences between groups in the acquisition of formal operational reasoning would provide compelling reasons to differentiate in order to capitalize on the early opportunity to begin honing these essential skills. Berninger and Yates (1993) present a thorough review of the literature on gifted students and formal operations, demonstrating that:

1. Children move through the Piagetian stages in the same order, but not on the same timeline. Gifted students acquire formal operational reasoning around ages 12–13; most other students are still in the transition to formal operations at age 15.
2. Gifted boys tend to enter formal operations earlier than gifted girls. The effect size of this difference is small, and the male advantage diminishes by late adolescence.
3. Gifted adolescents progress through substages of formal operations more quickly than their age-mates.

Gifted students have the capacity for abstract, conceptual reasoning as many as 3 years ahead of their peers—*the equivalent of their entire middle school careers.* Naturally, variability exists in both the gifted and average populations, but still the implications are clear: Gifted students are ready to grapple with qualitatively different content years ahead of their classmates. Once formal operations are achieved, instruction should be designed toward mastering this new form of content, as it is critical for success in secondary academics (Bitner, 1991; Gipson, Abraham, & Renner, 1989; Hurst & Milkent, 1996; Matthews & McLaughlin, 1994; McDonald, 1989; Niaz & Robinson, 1992; Wavering, 1989). Incorporating conceptual content with a plentiful factual base also provides a means of ensuring that learning will not fall into drill and rote memorization. Concepts help organize facts, resulting in more meaningful connections and expert-like thinking (Shore & Irving, 2005).

Disciplinary or Interdisciplinary Content?

Understanding the need for a deep, concept-centered knowledge base is only partly useful; it also is necessary to know how to focus the knowledge. Compelling arguments can be made in two directions. On one hand, opportunity for early specialization is essential for students with exemplary talent (Jarvin & Subotnik, 2006). Early specialization also makes sense for many students whose chosen career may require many years of schooling. On the other hand, the modern age is marked by unique combinations of traditional disciplines into new fields (Klein, 1993), and innovation is often the result of cross-disciplinary application, similar to the use of linguistics to decode the DNA sequence (Young, 2001). Ultimately, the most effective programs for gifted adolescents provide the choice to either go wide or deep while ensuring some exposure to deep disciplinary thinking and original interdisciplinary connections, regardless of the direction students take.

In sum, gifted students are capable of learning substantially more content than their peers. They also have early capacity for abstract thought, which both adds a layer of content and helps organize factual information. Building a gifted student's knowledge base makes sense, especially because this knowledge base is a predictor of academic success. Ensuring that gifted students, fond as they are of novelty, remain engaged in learning requires the presentation of content that:

- presents information using instructional models that facilitate identification and creation of meaningful connections,
- allows for inductive and deductive connections between facts and abstract ideas,
- incorporates time specifically for cultivation of abstract reasoning, and
- encourages either deep exploration of one discipline (with exposure to interdisciplinary thought) or wide exploration of several disciplines (with exposure to deep exploration in one field)—or both!

Frequent Opportunities for Higher Order Thinking

The knowledge base gifted students acquire may be impressive, but it is ultimately fairly useless unless they put that knowledge to work with the help of thinking strategies. Surprisingly, the research base on gifted adolescents' unique thinking attributes is thin in both gifted education and cognitive science; research on how cognitive differences *develop* is virtually nonexistent (Steiner & Carr, 2003). The research that is available tends to focus on three interrelated areas: (1) strategic thinking, (2) metacognition, and (3) expert thinking.

Strategic Thinking: Speeding up to Slow Down. Gifted students generally use the same set of strategies that other students use, so in terms of sheer number of strategies employed, they do not seem different from other students (Hong, 1999). However, gifted students learn more quickly, and when faced with a challenging task, they use more complex forms of strategies and often select sophisticated strategies (Steiner & Carr, 2006). Having more content at their disposal, they have the capacity to use thinking strategies to more original ends. As obvious as it may seem, however, it bears emphasizing that there is a difference between knowing a strategy and using a strategy. Evidence suggests that gifted students only use their critical thinking strategies when they perceive a need; that is, when the challenge of a task merits their use (Hong, 1999).

Gifted students' advantage with thinking strategies is especially apparent when they are engaged in problem solving. Gifted students tend to show a greater explicit knowledge of problem-solving stages, know more problem-solving strategies, and are more adept in selecting strategies to use when faced by an open-ended problem. They also are more inclined to switch from one strategy to another when necessary (Kanevsky, 1992). The strengrh gifted students demonstrate is evident even in the absence of direct instruction in problem solving; gifted students seem to "invent" strategies when needed (Montague, 1991). While they are problem solving, fast-learning gifted students slow down, taking more time to plan and strategize (Davidson & Sternberg, 1984; Shore & Lazar, 1996). In addition, they show early tendencies toward expert-like behavior when problem solving; content knowledge may strengthen this tendency (Cherney, Winter, & Cherney, 2005).

In summary, gifted students demonstrate superior performance in a wide range of thinking skills, which they use well and selectively. However, gifted students use these skills only when faced with meaningful challenges. Ensuring that gifted students develop their skills in critical thinking requires:

- constant exposure to challenging content;
- tasks more challenging than average, requiring the use of critical thinking;
- reflective time to engage in problem finding, planning, and conceptual reasoning; and
- an overall pace of curriculum and instruction in which time saved as a result of rapid content learning is spent on more difficult complex thinking.

Metacognition. In the early 1980s, Sternberg (1982) proposed that metacognition, the ability to oversee and manage thinking, is an important factor in gifted performance. After two decades of research, a more specific, but unexpected, picture has emerged of gifted students' use of metacognition. Although it is clear that metacognition is a component of exemplary performance, gifted students do not show a clear-cut performance advantage. In fact, there are only two areas of metacognition where gifted students consistently show superior performance: (1) gifted students' knowledge about specific learning strategies, and (2) their inclination to use a skill in a new, usual setting, also known as "far transfer" (Carr & Alexander, 1996; Robinson & Clinkenbeard, 1998; Span & Overtoom-Corsmit, 1986). Other studies of metacognition show only a slight advantage for gifted students;

some show inferior performance among gifted youth (Dresel & Haugwitz, 2005; Ludlow & Woodrum, 1982).

At first glance, these findings seem counterintuitive: Why wouldn't gifted students show the same advantage in metacognition that they have in learning content and using thinking skills? Carr and Alexander (1996) presented three plausible explanations. First, the tasks used in metacognitive research, especially research on near transfer, may be so easy that gifted students do well without monitoring their performance. This would explain why gifted students are similar to their peers in their use of metacognitive skills on near transfer tasks, but consistently perform better on far transfer tasks. Far transfer tasks offer a greater challenge, requiring gifted students to engage in self-monitoring. Dresel and Haugwitz (2005) conducted a classroom-based study that reinforces this notion, finding that gifted students did not use self-regulating behavior if they thought an assignment was easy. Based on their study, they concluded, ". . . the finding that students with high abilities use strategies less frequently in regular school lessons can be seen as an indication that their learning environment is inadequately low . . ." (p. 15). In order to provide gifted students with the same amount of practice in self-regulation as average students, they must work as frequently with tasks they find challenging. The alternative is to leave these skills undeveloped, underdeveloped, or poorly developed.

Second, the relationship between metacognition and IQ may have a "threshold effect": IQ may predict skilled use of metacognition up to a point. Once the threshold is crossed, IQ ". . . does not guarantee that children will acquire or use cognitive skills, such as metacognition, believed to promote high achievement. These cognitive skills appear to develop, instead, out of emerging expertise" (Carr & Alexander, 1996, p. 214).

Third, the generic, content-free nature of research tasks may be both unrealistic and unlikely to reveal gifted performance differences. Research on expert performance suggests that cognitive monitoring really is only necessary after the student develops a deep and significant body of discipline-based content (Chi, Glaser, & Farr, 1988; Rabinowitz & Glaser, 1985).

In sum, gifted students have access to self-regulatory behaviors but use them inconsistently. Effective self-regulation is related both to academic success and to adult expert performance. Ensuring that gifted students have adequate practice with a wide range of metacognitive skills requires

- constant exposure to challenging content,
- learning tasks sufficiently difficult to require self-regulation, and
- immersion in disciplinary-based content.

Expertise and Giftedness. Insight into expert performance provides a guidepost for planning programs for gifted adolescents because we aspire for them to become experts or innovators in their chosen field. Research findings continue to strengthen the tie between gifted students' thought processes and that of domain-specific experts (Gorodetsky & Klavir, 2003; Kaufman, Gentile, & Baer, 2005; Shore, 2000). Common characteristics already discussed include rapid acquisition of content, skill and flexibility in critical thinking, and self-regulation. Gifted students seem to intuitively have some expert-like skills (Kaufman et al., 2005), while others are only acquired through training (Cherney et al., 2005).

Reviewing the literature on expertise, Carr and Alexander (1996) pointed out that it takes more than skill and ability to be an expert: "Although experts need sufficient general ability (IQ) to perform at a high level, other factors such as task commitment, a strong knowledge base and social support are more important for developing expertise and promoting achievement through expertise. . . ." (p. 214). The list of requirements for expertise also includes perspective, forward problem solving, persistence, risk taking, and tacit knowledge (e.g., professional language and behaviors; Jarvin & Subotnik, 2006; Shore, 2000; Sternberg, 2003). Expertise in this larger sense can be developed using curriculum and instruction that emphasize problem solving, open-ended questions, construction of ideas, multiple perspectives, and exposure to disciplinary experts (Gallagher, 2006; Shore & Irving, 2005; Sternberg, 2003; Subotnik, 2003).

In sum, gifted students' cognitive characteristics parallel those of adult experts. Ensuring that gifted students continue to develop expert-like skills requires

- exposure to explicit and tacit disciplinary knowledge;
- time to engage in flexible thinking with disciplinary and interdisciplinary content;
- curriculum and instruction that incorporate inquiry, conceptual learning, and authentic contexts; and
- opportunities for problem solving and mentorships.

The Role of Student Perspective: Epistemology

Still missing is perhaps the most important factor about the education of gifted adolescents. Efforts to design effective programs and promote new kinds of practice will be for naught if the students themselves do not recognize the significance or value in the tasks assigned.

The form of perspective in question is *epistemology*, one's belief about the nature of knowledge. Perry (1970) presented a developmental scheme that made direct and pragmatic application to the classroom, for it described both how students' views of knowledge change over time and also the powerful effect differing views have in the classroom. Perry's scheme presents nine distinct "positions" that can be collapsed into four broad stages, as summarized by Gallagher (2006):

> **Dualism**: Marked by a black-and-white perspective, students at this stage believe all legitimate questions have certain answers. So-called questions without answers are just nonsense questions, pointless.
> **Multiplicity**: Students acknowledge that there are a few unanswered questions, but believe that in the absence of an answer, all opinions on the matter are equally valid.

> **Contextual Relativism**: Unanswered questions are investigated using the tools provided by each discipline; each discipline approaches questions in a different way. Certain answers are unlikely, but a "best answer" can be achieved using the proper tools.
> **Commitment/Dialectic**: Theories are used to set directions for important questions, most of which have no right or wrong answers. Gaining understanding requires building upon the possibilities presented by data as interpreted by a consciously selected point of view, but with willingness to change perspective if the need arises. (p. 436)

Table 1 presents the four stages aligned with the beliefs about learning that accompany each stage.

For a more concrete example, consider Carl and Cedric, two students waiting for class to begin. Carl believes that knowledge means facts, and being knowledgeable means remembering lots of facts. Cedric, on the other hand, thinks that knowledge is the ability to combine facts to create ideas. For Cedric, being knowledgeable isn't about the number of facts he knows, it's about how the facts can form and reform to create different ideas. Their teacher, Ms. Morgan, starts her lecture on the Trail of Tears, focusing on the sequence of events, detailing what, who, and when. Carl picks up his pen and starts studiously taking notes; Cedric slumps down in his desk, grumbling, "factoids." The two boys hear the same lecture from the same teacher, but their different beliefs about knowledge affect how willing they are to accept the information as meaningful or valid.

A number of theories now attempt to describe aspects of epistemological development (Baxter Magolda, 1987; King & Kitchener, 1994; Schommer, 1994). Each theory describes sequential, developmental movement from a low or "naïve" stance in which knowledge is equated with factual information and memorization, to a high or "mature" stance in which facts are used to build theories from ". . . a consciously selected point of view, but with willingness to change perspective if the need arises" (Gallagher, 2006, p. 436). In the example above, Carl holds a naïve stance and thus is happy to gather up a list of facts from the lecture; Cedric's stance is more mature, and he wishes the facts had been embedded in more meaningful ideas.

The Comprehensive Impact of Epistemology. At one level, the impact of Carl's and Cedric's differing beliefs is immediately apparent: Students are not likely to learn what they do not believe to be meaningful—or at least, they won't learn it for long. After two decades of research into the effect of epistemology on learning, it is clear that the impact extends beyond whether students like what they learn to a number of other important academic outcomes.

Epistemological stance affects academic achievement. Using a structural equation analysis, Cano (2005) found that high school students' epistemological stance had both direct and indirect effects on academic achievement. Similar results have been

TABLE 1

Perry's Stages/Positions of Epistemological Reasoning and Related Instructional Strategies

Stages of Epistemological Development	Dualism	Multiplicity	Relativism	Commitment/Dialectic
Beliefs Associated With the Position	Knowledge is certain (right or wrong) and unambiguous. Authorities (teachers) know "The Truth."	Some questions have no certain answers; in these cases, knowledge and "truth" are subjective, so everyone's opinion is equally valid.	Knowledge is interpreted in context; distinguishing better from worse answers requires selecting theories that best fit the question.	Knowledge, theories, and methods are imperfect and uncertain. Choices require analysis and values.
Instruction That Matches Epistemological Stage	Activities that help students develop skill in memorization and recall: mnemonics, etc.	Practice in comparing hypotheses and theories; acknowledging all possibilities.	Practice in creating, comparing, and selecting preferable theoretical models; practice in expert behaviors.	Mentorship.
Instruction That Encourages Movement to a Higher Stage	Exposure to problems with more than one right answer and/or more than one approach to a solution.	Exposure to the tools used in different disciplines to conduct research, construct theories, and make decisions.	Exposure to models of paradigm shifts (chaos theory), personal choice (Gandhi's personal commitment to nonviolence), interdisciplinary problem solving.	

Earlier Positions → Later Positions

Range of Typical High School Senior

Range of Gifted High School Senior

found with middle school students (Schommer-Aikins, Duell, & Hutter, 2005). Students at lower levels may have trouble correcting misconceptions, and draw only fact-based information from inquiry-oriented environments (Ryan, 1984).

Epistemological stance affects advanced academic performance. Students with more advanced beliefs have an easier time building logical arguments (Weinstock, Neuman, & Tabak, 2004); they tend to choose thinking strategies that support deep, rather than surface, learning (Cano, 2005; Zhang & Watkins, 2001). Kitchener (1983) also suggested that students' selection of metacognitive strategies can be affected by their epistemological beliefs. Support for this idea comes from a study by Ruban and Reis (2006), who found that high-achieving students tended to select "enhancement" oriented learning strategies while lower achieving students selected "survival" oriented strategies.

Instruction can encourage movement to higher epistemological levels. Teachers can affect changes in students' epistemological thinking through intentionally structured learning experiences (Kloss, 1994; Kronholm, 1993). Strategies recommended to develop epistemological thinking include using ill-structured problems and instructional strategies that allow students to examine their assumptions; analyze data that present different, conflicting perspectives; and then make decisions (King & Kitchener, 2004). Devoting some time to direct instruction about the nature of the discipline helps develop higher levels of reasoning (Bell, 2004).

Mismatch between instruction and epistemological stance (perspective) contributes to frustration and disillusionment. Cedric didn't respond well when Ms. Martin started a fact-based lecture. Over time he will simply decide that school is trivial, or worse, meaningless. Had Ms. Martin started instead with a discussion of the violation of Native Americans' sense of personhood, Cedric would have been thrilled and Carl would have been lost. This kind of disparity creates barriers to learning (Nelson, 1996; Perry, 1970). Neber and Schommer-Aikins (2002) found that a mismatch between instruction and stance caused work avoidance among some high school physics students. Lovell and Nunnery (2004) found that students even found small-group work more satisfying when they were grouped according to stance (perspective).

Gifted students tend to be ahead in epistemological development. Studies of adolescents document that epistemological beliefs mature in a predictable developmental sequence (Cano, 2005; Zhang & Watkins, 2001). In parallel to formal operational reasoning, gifted adolescents move through epistemological stages in the same sequence (Thomas, 2008), but tend to be a stage or two ahead of others the same age (Arlin & Levitt, 1998; Goldberger, 1981; Schommer & Dunnell, 1997; Thomas, 2008; Wilkinson & Maxwell, 1991; Wilkinson & Schwartz, 1987). Table 1 provides a general sense of the distribution of senior year students based on existing research.

Adult experts tend to hold advanced epistemological views. The epistemological framework also provides a connection to another aspect of expertise. Across the disciplines, the behaviors and attitudes associated with mature epistemology are considered essential for advanced, authentic work (Buehl & Alexander, 2005; Felder, 1997; Henderson, 1995; Kloss, 1994; Muis, 2004).

Connections With Gifted Education. Evidence that gifted students tend to be somewhat ahead of their age-mates in epistemological development follows naturally from the data on formal operations reported above. However, other interesting connections bring this theory into cohesion with existing knowledge of gifted students. For example, there is some indication that people who prefer Intuition on the Myers-Briggs Type Inventory tend to have higher epistemological stances (Zhang, 1999). Gifted students overwhelmingly report this preference (Sak, 2004), and the connection gives further evidence that gifted students will respond best to open-ended inquiry-oriented learning environments. Similarly, it explains gifted adolescents' positive response to mentor relationships. Like all adolescents, gifted teenagers want to see similarities between themselves and others; in mentors, they find kindred spirits who think about ideas from similar frames of mind.

Most exciting, perhaps, is the connection between epistemology and expertise. Not only do gifted students show early potential to achieve the experts' high levels of reasoning, but also, epistemological models provide a guide to help explain how to move all students closer to authentic higher order reasoning. Gallagher (1998) suggested that models such as these would make effective frameworks for designing high school curriculum, providing an organic model for differentiation. Based on his study of adolescent epistemological beliefs, Cano (2005) concurred:

> . . . it is necessary to take into account not only students' previous knowledge and learning strategies . . ., but also their learning approaches and epistemological beliefs. . . . Secondly, we should work directly to try to enhance the depth of learning approaches and the complexity of epistemological beliefs, as a way of improving academic achievement. (p. 217)

Finally, this framework reinforces the notion that the outcomes for ignoring students' beliefs are grave. Students have trouble accepting the relevance of instruction that is out of sync with their stage (Perry, 1970), a finding that is consonant with the well-established knowledge that gifted adolescents reject mundane, repetitive curriculum. Further, gifted students operating at higher levels than other students find instruction oriented towards the majority uninspiring, and communicate their feelings through underachievement. More seriously perhaps, Nelson (1989) cautioned that excessive time spent in low-level curriculum actively builds a wall of habits that blocks the path to higher level reasoning. Even rapid acceleration can have this damaging effect if students are only accelerated into new low-level content. To provide a climate ready for higher order thinking, educators must present content that is accelerated vertically as well as horizontally.

Complete Coherence: Evidence-Based Recommendations for Differentiation in Secondary School

Each of the perspectives considered in this rationale is championed by different researchers operating from different paradigms and using different research techniques. Even so, their respective findings are remarkably similar.

1. Gifted adolescents need exposure to a larger quantity of content that they find challenging. Beginning at least in middle school, abstract content should be a standard part of their curriculum. The importance of developing a plentiful, high-quality well of information is essential as it is a precursor to using higher order thinking, metacognitive thinking, and abstract thinking. Gifted students will not adequately develop their thinking skills without this knowledge base.
2. A quality knowledge base is necessary, but not sufficient, for developing thinking skills. Gifted students must be presented with learning experiences that require them to engage their critical thinking skills and metacognitive skills. If they do not find their assignments challenging, their brains will not engage their higher order functions. Together, content and strategy used along with metacognition predict academic performance, making the simultaneous development of these three paramount.
3. Gifted students show early promise for developing expertise. Capitalizing on that early promise requires instruction where students can practice the qualities of expertise including open-ended instruction, inquiry-based instruction, problem-oriented instruction, field experiences, and mentorships, all centered on high-quality disciplinary or interdisciplinary content. Gifted students are most likely to see this instruction as relevant and draw maximum value from it.
4. Expertise requires more than content and skill; habits of mind and advanced epistemological reasoning also are essential. If we aspire for gifted students—or for any student—to become creative, productive leaders in their chosen field, curriculum and instruction should be selected to develop these simultaneously, and include exposure to the philosophies and ethics of the disciplines.

The absence of a quality differentiated secondary program for gifted students is not a neutral position; it is a choice that will result in deficit skill development and student apathy. At worst, it will result in the disillusionment of some of the best minds in the country.

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