by Jann H. Leppien, Ph.D.



So What Makes Curriculum Different for Highly Capable Students? Recommendations Worth Considering

Early in my teaching career, I met a young man named Sam who possessed a great deal of mathematical expertise at a young age. He arrived at our school at the age of five and entered kindergarten, ready to learn with great intensity and enthusiasm. Mrs. McDonald, his kindergarten teacher, was eager to work with Sam and provide an educational setting that fostered his love of mathematics. Each and every day, Sam would use mathematical language to explain his observations. The mathematical content and skills that were of importance to most kindergarteners seemed more and more out of alignment with his mathematical knowledge and understanding. It was soon decided that we should administer pretests on Sam to determine a starting point for his mathematical instruction, and I was given the opportunity to help determine his level of proficiency. I soon realized that Sam not only had great expertise in mathematical understanding but also had an unusual way of learning new concepts.

First, Sam enjoyed the testing situation. For him, the test was a game of mathematical reasoning and inquiry. He delighted in arriving at the correct responses, and he pursued ideas that were unfamiliar by asking a series of questions that he soon answered for himself. What was of particular interest to me was how he approached what he did not know. For example, I can remember quite vividly how excited he became when faced with a fraction problem in the third-grade curriculum during the testing situation. The question asked Sam to look at two circles, one that was divided into three parts and one that was divided into four parts (one representing 1/3 and the other representing 1/4). He was asked to name the fraction that was largest, one-third or one-fourth.

As he looked at these circles he asked, "What is this thing called? Everything in math has a name, Mrs. Leppien, so what do you call these things?"

I replied that these visual representations are called fractions.

He then asked me, "Is this like a pie that is cut into several pieces? If it is, then my mother certainly can't cut straight lines like they do in this picture. My guess is that the question being asked of me is which of the pieces of pie would I prefer, either onethird or one-fourth?" As quickly as he asked this question, he announced, "But it would have been easier had they asked me to compare these pieces as twelfths or twentyfourths, or something that they share in common."

Sam's line of questioning stemmed from his curiosity to know and also from his ability to see patterns and make connections between mathematical ideas. Once he understood the structure of anything (its purpose, examples, and importance to his life), he then inquired about how to play out these ideas in various settings and under different conditions, similar to the way writers play with word choices when constructing sentences that express ideas. Sam would then move toward trying to see patterns or connections between concepts and ideas in order to generate laws or what he referred to as "mathematical rules to live by." Sam considered himself to be a mathematician, and this became the lens through which he viewed the world.

What We Learned About Sam's Advanced Level of Expertise

I learned many things from working with Sam. I learned that the questions teachers ask are like the questions Sam posed to himself and others. These questions can provide rich invitations for developing student engagement and for promoting understanding of a discipline's structure, its connectivity to other disciplines or ideas, its modes of inquiry, and how it shapes or affects an individual's life. Sam's pace of learning far exceeded that of other advanced level students. What became an appropriate curricular match for Sam was not necessarily appropriate for other students who had been identified for our program. Therefore, as we identified other students for our highly capable program, we carefully had to adjust curricular options based on the advancement in the subject area(s) in which talent manifested, with a careful eye to the type of pacing that was most appropriate to the learner.

The other thing that we learned from Sam was that his strengths varied greatly

mom other students we served. mus, ms academic needs would dictate a different type of program service than what we offered to other advanced students whose characteristics varied from Sam's. It was readily apparent that Sam required advancement of content and skills that could be arranged through subject acceleration rather than a teacher being able to differentiate the content for him within the regular classroom. He also needed the interaction with and expertise of an educator and other peers who could share with him the beauty found in mathematical principles and ideas he so readily craved as a learner. What we learned is that the strengths and profiles of advanced learners vary widely which warrant different types of services that a school should provide for students' continuous growth.

What the Field of Gifted Education Realizes About Advanced Learners and High Quality Curriculum

What the field of gifted education has come to realize is that there is no single profile for highly able students. There are students whose abilities are so apparent that no one can miss them, like Sam's, and then there are students who are highly able and experience learning challenges and disabilities that can actually mask their abilities. There are students who are advanced in one or more areas of study, and students who are so acutely advanced in their abilities as to make the challenge even greater for teachers who try to differentiate their curriculum. There are also students who are just learning

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now to speak English as wen as students who experience poverty and are equally talented, yet they have been denied the opportunity to experience a curriculum that is appropriately challenging to unveil their potential for advancement. Those of us who have worked with students who are advanced or show potential for advancement understand that many of these advanced students are often ill-served by curriculum and instruction aimed at a academic expectations far lower than the one that they can and should reach.

So knowing that advanced students vary widely in their academic profiles and interests, what suggestions can be offered to educators when designing curriculum and instruction for highly capable students? In a review of the literature in the field of gifted education, Hockett (2009) synthesized the voices of curricular experts in the field of gifted education and identified five principles of high-quality curriculum and the commonalities on which they agree. The chart below lists the principles she identified with key indicators of what is meant by the principles, the practices to be considered when designing curricular options for advanced level students, and the experts who advocate these practices.

The Recognition of Ongoing Support for Developing Expertise

While most curriculum experts in gifted education would agree that these principles should guide the type of quality experiences that advanced learners should

Principle 1: High-Quality Curriculum for Gifted Learners Uses a Conceptual Approach to Organize or Explore Content that is Discipline-Based

וכנכויב, טווכו ומכוטוג ווועגר טב נטווגועבובע when applying these ideas to advanced learners whose academic profiles vary. At the heart of these principles is the notion that each learner should be challenged with incremental sophistication depending on a student's individual profile. Expertise is developed over time, with careful attention to the tender balance of challenge and support as suggested by the authors of the Parallel Curriculum Model (Tomlinson, Kaplan, Purcell, Leppien, Burns, & Strickland, 2006). In order to effectively guide the process of developing expertise in any discipline, the authors propose a heuristic for thinking about this progression through the lens of a concept called Ascending Intellectual Demand (AID). AID is intended to serve as a guide in curriculum design and instructional delivery because it articulates the changes that characterize the learner at incremental stages from novice to expert. As students grow from one level of expertise in a subject level to more advanced levels, what the learners may require at each stage along the continuum will vary. To recognize this is to suggest that teachers will need to vary the level of instructional support necessary for a student's continual growth as well as the sophistication, depth, and complexity of the curriculum to respond to the emerging optimal level of challenge in each learner since AID is always relative to the need of a particular learner (Hendrick & Flannagan, 2009). Varied levels of challenge or AID can

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Feldhusen, 1985; Hayes-Jacobs & Borland, 1986; Kaplan,

Hayes-Jacobs & Borland, 1986; Kaplan, 1979; Passow,

1982; Rogers, 2002; Tomlinson, 2005

	1974; Maker & Nielson, 1996; Renzulli, Leppien, & Hays, 2000; Shore, Cornell, Robinson, & Ward, 1991; Tomlin- son et al., 2002; VanTassel-Baska, 1998
th a discipline-based foundation uses the principles, skills, theories, ideas,	Feldhusen, 1985; Maker, 1986; Passow, 1982; Renzulli et
at essential to a field of study to illuminate the nature of the discipline itself.	al., 2000; Tomlinson et al., 2002; Ward, 1980

The structure of the discipline itself informs how the curriculum is arranged; student
should be able to see where the discipline "fits" within the larger body of knowledge and
from where it originates.Renzulli et al., 2000; VanTassel-Baska, 1989; Ward, 1980Curriculum that is integrative concentrates on the relationships between bodies of knowl-
edge; presents content related to broad- based issues and themes; focuses on cross-disci-Kaplan, 1979; Maker, 1986; Passow, 1982; VanTassel-
Baska, 1989,1998

edge; presents content related to broad- based issues and themes; focuses on cross-disciplinary concepts; and exposes students to multiple perspectives and domains of inquiry. Integration allows the learner to apply knowledge at multiple levels, transfer knowledge

within and across disciplines, see patterns and connections within and across disciplines, and understand a discipline's depth and complexity.

Curriculum should be organized conceptually that is discipline-based and integrative.

and Integrative

Curriculum Through Abstraction, Depth, Breadth, and Complexity	Understanding Beyond the General Education
Abstraction involves content, processes, and products that are more removed from or less familiar to students' experiences.	Maker & Nielson, 1996
Students may work with the implications and extensions of ideas rather than concrete examples and illustrations.	Tomlinson, 1977
Symbolism and the underlying meaning of content are stressed, as are formulating theories, examining the philosophical underpinnings of disciplines, and exploring epistemological issues.	Hayes-Jacobs & Borland, 1986; Passow, 1982; Rogers, 2002
Advanced understanding is also attained through examining curricular topics in more breadth and/or with greater depth.	National Association for Gifted Children [NAGC], 1994; Purcell, Burns, Tomlinson, Imbeau, & Martin, 2002; Shor et al., 1991; Tomlinson, 2005; United States Department of Education [U.S. DOE], 1993; VanTassel-Baska, 2005; Ward, 1980Kaplan, 1979; Renzulli & Reis, 1997
Breadth may refer to exposing students to wide variety within or across a content area or, more simply, to extending the core curriculum.	Kaplan, 1974; 1979; 1994; VanTassel-Baska, 1989; 2005
Depth refers to ways of intensifying curriculum - some of which might include using the language of the discipline and examining details, trends, patterns, unanswered questions, rules, ethics, big ideas, and relationships to contextual time. Exploring content in depth also might involve students pursuing an area of special interest at a high level, studying im- portant issues and problems related to a topic, or spending more time on learning a topic.	Kaplan, 1974; Maker & Nielson, 1996; NAGC, 1994; Passow, 1982; Purcell et al., 2002; Rogers, 2002;
Complexity is another way of modifying the curriculum to advance understanding. Content is more complex when it is more challenging and intricately detailed; integrates knowledge and concepts from various disciplines; requires higher level thinking processes; and incorporates different perspectives, theories, principles, and concepts associated with what professionals in the discipline know and do.	Tomlinson, 2005; Ward, 1980
Processes and products are more complex when they involve more steps or require more advanced resources, tasks, issues, problems, skills, or goals. For example, students might work with multiple abstractions; merge what they are learning with previous learning or tackle problems that require more originality or elegance in their solutions.	Tomlinson, 1997; 1999
Principle 3: High-Quality Curriculum for Gifted Learners Asks Students to Use Process	ses and Materials That Approximate Those of an Expert,
Disciplinarian, or Practicing Professional	
Processes both general and specific to the various disciplines should be employed in cur- riculum for gifted students.	Renzulli et al., 2000; Tomlinson et al., 2002
General process methods are those that emphasize discovery and equip students to fol- low research or inquiry-based procedures, such as assessing the credibility of a resource, following through on an investigation, and learning how to learn other necessary skills on-demand.	Maker & Nielson, 1996; Passow, 1982; Renzulli & Reis, 1997; VanTassel-Baska & Little, 2003
Each discipline has its own ways of conducting research and solving problems as well. The specific ways that practicing professionals work and act are a defensible, desirable aspect of curriculum for gifted learner.	Renzulli et al., 1997; Tomlinson et al., 2002; VanTassel- Baska & Little, 2003
Working like an expert also involves thinking like one. Integrating higher level processing skills in the curriculum—those an expert is likely to use—is therefore crucial. These might include processes for thinking critically, analytically, and creatively; making decisions; asking questions; generating new ideas; defending ideas; reconciling opposing viewpoints;	Kaplan, 1974; Maker & Nielson, 1996; Passow, 1982; Purcell et al., 2002; Renzulli & Reis, 1997; Rogers, 2002; Tomlinson et al., 2002; VanTassel-Baska, 1998

Curriculum for gifted learners also approximates expertise by developing metacognitive abilities and self-understanding. Kaplan, 1974, 1979; Kaplan, & Hedrick, 2005; Passow, 1982; Tomlinson, VanTassel-Baska, 2005

Shore et al., 1991

All thinking processes must be rooted in content and be a means to an end, rather than taught in isolation.

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Principle 3: High-Quality Curriculum for Gifted Learners Asks Students to Use Processes and Materials That Approximate Those of an Expert, Disciplinarian, or Practicing Professional

The materials that gifted students should use are often described by experts as advanced. These might include resources that are specialized, more varied, more abstract, and require higher level reading or processing skills; that treat knowledge as tentative; and that illus-trate interdisciplinary connections through concepts. In any case, students will likely need guidance or instruction in how to use these resources.

Kaplan, 1974; Passow, 1982; Renzulli & Reis, 1997; Tomlinson, 1997; VanTassel-Baska, 2005; VanTassel-Baska & Little, 2003

Principle 4: High-Quality Curriculum for Gifted Learners Emphasizes Problems, Products, and Performances That Are True-to-Life, and Outcomes That Are Transformational

A defining characteristic of these kinds of problems is authenticity— they mirror problems or are problems in the real world with either no existing solution or a solution that is unknown to the student, are directed toward change or the production of new knowledge, and have a personal frame of reference for the student.	Maker & Nielson, 1996; Purcell et al., 2002; Renzulli, 1982; Renzulli & Reis, 1997; Rogers, 2002; Tomlinson, 2005; VanTassel-Baska & Little, 2003
This type of problem solving also involves the development of authentic products directed at real audiences. The products emulate those developed by practicing professionals in a field or at least have a discipline-based foundation.	Purcell et al., 2002; Renzulli & Reis, 1997; Shore et al., 1991; VanTassel-Baska, 1989
These products are evaluated by qualified persons, such as expert judges or audiences who stand to benefit from the results, according to advanced criteria or goodness-of-fit for a certain need.	Maker & Nielson, 1996; Renzulli, 1982; Rogers, 2002; Tomlinson, 2005; Ward, 1980
In problem solving, product development, and performance, gifted curriculum experts promote students working toward outcomes that are transformational.	Purcell et al., 2002; Rogers, 2002; Tomlinson, 2005
More specifically, students take the knowledge they have learned and view it from another perspective through reinterpretation or extension, form new generalizations and ideas, and develop skills into creative forms for real audiences.	Kaplan, 1974, 1979; Maker & Nielson, 1996; Passow, 1982; Renzulli & Reis, 1997

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Principle 5: High-Quality Curriculum for Gifted Learners Is Flexible Enough to Accommodate Self-Directed Learning Fueled by Student Inter- ests, Adjustments for Pacing, and Variety		
Curriculum experts in gifted education have been strong advocates of individualizing learning experiences for highly able students, due in part to the perceived inadequacy of the general education curriculum to meet these learners' academic needs.	Passow, 1982; VanTassel-Baska, 1995; Ward, 1980	
Under the assumptions that (a) the regular curriculum is inappropriate, and (b) gifted students' time would be better spent pursuing what they want to learn, several program models include flexible components that allow students to set the course for their own learning.	Betts, 1985; Feldhusen & Kolloff, 1979; Renzulli, 1977	
Beyond specific models, experts view flexibility in curriculum for gifted learners in several ways. First, it involves learners making choices about the direction and goals of their learning. Therefore, tasks should be open ended, with no one right answer.	Kaplan, 1979; Maker & Nielson, 1996; Purcell et al., 2002; Shore et al., 1991; Tomlinson, 2005; VanTassel- Baska, 2005; VanTassel-Baska & Little, 2003	
In these endeavors, students should be encouraged to investigate areas of interest more in depth as well as develop skills that support self-directedness, such as organization, time management, self-assessment, using resources, and decision making.	Kaplan, 1979; Landrum & Shaklee, 2000; Maker & Niel- son, 1996; Passow, 1982; Purcell et al., 2002; Renzulli & Reis, 1997; Tomlinson, 2005; U.S. DOE, 1993; VanTassel- Baska, 1989	
Second, flexibility in curriculum for gifted learners requires adjustments for pacing. This may mean increasing the pace of learning by moving students more rapidly through basic skills or an entire course of study. Pacing also might be decreased to account for gaps in students' knowledge, skills, or understanding; to accommodate in-depth study; or to make sure a student can apply what he or she has learned.	Maker & Nielson, 1996; NAGC, 1994; Purcell et al., 2002; Shore et al., 1991; Tomlinson, 2005; U.S. DOE, 1993; VanTassel-Baska, 1989; VanTassel-Baska & Little, 2003; Ward, 1980	
A third, more generic attribute of flexibility in curriculum is variety. This might include va- riety in instructional approaches and materials, content and form, learning activities, skills, or learning opportunities.	Maker, 1986; NAGC, 1994; Landrum & Shaklee, 2000; Purcell et al., 2002; U.S. DOE, 1993	

be achieved in many ways, which may be helpful to educators designing effective curriculum for advanced learners that:

- Uses more basic or advanced reading, resources, and research materials.
- Applies ideas and skills to familiar or unfamiliar contexts that are similar or dissimilar from the ideas and examples explored in class.
- Encourages collaborations between students and adult experts in an area of shared interest.
- Develops solutions, proposals, or approaches that bridge differences in perspective and address relevant problems.
- Searches for useful connections among related or seemingly different elements (music and medicine, or law and geography).
- Looks for patterns of interactions in different areas of connection (e.g., ways in which geography, economics, politics, and technology tend to affect one another).
- Seeks out and evaluating unstated assumptions that are beneath the surface of decisions, approaches, etc.

The idea of Ascending Intellectual Demand can become an instructional tool for assisting teachers in providing the optimal level of challenge in curriculum and instruction to meet the merging needs and abilities of all students as they progress from one level to the next in their journey from novice to expert. Overall the concept suggests that high level, concept-based, meaningfocused curriculum and instruction should be given to the vast majority of learners, and that such curriculum should be extended for highly capable learners in terms of persistent movement toward expertise in one or more disciplines (Tomlinson et al., 2006). Coupling these ideas with those principles listed above are some of the ways educators can begin to ensure that advanced learners encounter challenge and to learn to accept, appreciate, and enjoy the work that it takes to continuously grow as a learner. This is what we did with Sam, who eventually earned his advanced degree in mathematics.

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