NW Regional Educational Laboratory

Table of Contents Chapters

Differentiating Content

MAKING MODIFICATIONS TO MATHEMATICS AND SCIENCE

content is one aspect of in providing challenging learning opportunities. Gifted educators recommend that science curriculum for high-ability students should move at a faster pace and feature less repetition. It should also allow students to delve into important ideas and thought processes (Boyce et al., 1993). In mathematics, students should study advanced content in earlier grade levels (Johnson & Sher, 1997).

Organizing the curriculum around major themes and ideas is one of the first steps in differentiating content. Using broad concepts helps to create opportunities for students to learn and apply integrated and complex ideas (Berger, 1991). Some key themes in mathematics include functions, patterns, scale, rates, and change (Johnson & Sher, 1997). Systems, models, reductionism, and evolution are among the major concepts in science (Van Tassel-Baska, Bailey, Gallagher, & Fettig, 1993). The following publications may be helpful in identifying other major themes and concepts in mathematics and science: *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), and *National Science Education Standards* (NRC, 1996).

It is important that mathematics and science content focus on more than computation, formulas, and vocabulary. All students benefit from a curriculum that does not focus exclusively on basic skills. A broader focus allows students who may not have strong computation or memorization skills to demonstrate their abilities in abstract reasoning, creativity, and conceptual understanding. There are different methods for encouraging students to move beyond the basic concepts of the

mathematics and science curriculum.

One recommendation for differentiating content for gifted students is increasing the level of abstractness and complexity (Maker & Nielson, 1996). For example, students might study a concept at the theory level: identifying and testing mathematical or scientific laws or connecting seemingly disparate ideas. Students might learn about or develop complex systems that have many sections and processes.

Key Components of Mathematics Curriculum for the Gifted

- Content with greater depth and higher levels of complexity
- A discovery approach that encourages students to explore concepts
- Focus on solving complex, open-ended problems
- Opportunities for interdisciplinary connections

(Johnson, 1993)

Key Components of Science Curriculum for the Gifted

- Significant and deep content
- Emphasis on understanding concepts rather than memorizing facts
- An inquiry approach with students as active investigators
- Opportunities for interdisciplinary connections
- Investigating real problems and situations
- Guiding students toward scientific habits of mind

(Van Tassel-Baska, 1994)

Adding variety to the content that students work with is another important strategy. Students are exposed to new materials, books, tools, and people, which helps to stimulate curiosity and creativity. Gifted students might work on projects in which they investigate the history of an idea or generate formulas or laws from their own observations (Tirosh, 1989). Adding topics that are not part of the regular curriculum can also be effective. For example, in mathematics, students might learn about transformational geometry, topology, number theory, and logic (Wilmot & Thornton, 1989).

Bloom's Taxonomy of Educational Objectives can be helpful in

designing content for gifted students (Bloom, 1956). Bloom's six levels of knowledge are knowledge, comprehension, application, analysis, synthesis, and evaluation. The final three levels are most appropriate for gifted students and may help teachers to identify ways for students to work with content in more advanced and more challenging ways (Smutny & Blocksom, 1990). Analysis involves using content to classify, compare, contrast, investigate, and deduce information and ideas. Synthesis will require students to use ideas and knowledge to create original work, using it to invent, design, and plan-for example, developing a theory or hypothesis. Evaluation requires students to interpret, verify, criticize, defend, and judge ideas and information.

One of the simplest ways to present more challenging content is to provide advanced materials for gifted students. Textbooks, tradebooks, and other resources from higher grade levels or even written for adults will help provide more complexity and will often be more appropriate (Maker & Nielson, 1996). Teachers might want to provide library books on the subjects the class is working on or on related topics. Students might also use a list of suggested resources to find and select their own materials. It will also be helpful to provide mathematics or science texts from higher grade levels or even from the college level.

Curriculum Compacting and Flexible Pacing

Curriculum compacting is a method of differentiating content for high-ability learners developed by Renzulli and Reis (1998). There are three basic steps: pretesting students at the beginning of a unit, eliminating content or skills that students already know, and replacing the skipped content with alternative topics or projects.

In order to plan for curriculum compacting, the teacher analyzes an upcoming unit to determine the key concepts and skills. Next, she selects the best way to identify students who have already met the learning objectives. The choice of pretest will depend on the type of knowledge or skills that need to be assessed. Some options include unit tests, essay questions, brief interviews, and observations (Reis & Renzulli, 1992).

Students who demonstrate their proficiency on a pretest will collaborate with the teacher to select alternative activities. Students may use the time to work on independent projects of their own design. Or the teacher might assign an enrichment activity that the class is not yet

ready to pursue. The students who complete the activity may wish to act as advisors when the whole class is ready to begin (Smutny et al., 1997).

Sometimes there will be specific areas in which the student is still developing skills. In this case, the teacher might ask the student to rejoin the class at certain points during the unit. Alternatively, the student might complete skill-building activities on her own. The student may also need to join the class for discussions and problem-solving or inquiry activities.

Curriculum compacting should be an option for all students in the classroom, not just those labeled "gifted" (Renzulli & Reis, 1998). Students who have strengths in a particular content area or who have studied a topic that they are interested in on their own time will benefit from having an opportunity to pursue other activities.

Another strategy for changing the pace of the curriculum is called "Most Difficult First" (Winebrenner, 1992), and it is most appropriate for mathematics. Students are allowed to work on the five most difficult problems instead of completing the whole assignment. If the students are successful, they are allowed free time or are asked to work on an alternative activity (Winebrenner, 1992). Again, this option is available to all students in the class.

Flexible pacing means that students are allowed to work at the level most appropriate to their abilities (Miller, 1990). There are several ways to provide students with suitable options. Advanced students might join higher-level classes in mathematics or science. A group of students might move through material at an accelerated pace. Or high-ability students might be allowed to work independently at their own pace (Daniel, 1989).

As they plan for flexible pacing, teachers will probably find it necessary to consult with their colleagues who teach higher grade levels or advanced classes. Their guidance will help to identify the advanced content and skills that students learn. They will also need to be aware of the students who have been working at an accelerated pace when those students join their classes in the future (Conroy, 1993).

Models for Differentiating Content

The Enrichment Triad Model (Renzulli & Reis, 1986) is intended to guide the development of enrichment activities, but it can also be used as a method for structuring a unit for the whole class. The model consists of three sequential levels of activities that are increasingly challenging and complex. Type One activities are exploratory and expose students to new topics. The primary purpose of these activities is to engage students and spark their interest. Some possible activities include demonstrations, guest speakers, field trips, and exploration through open-ended discovery tasks (Renzulli & Reis, 1986).

Type Two activities are designed to help students learn and develop the information and skills related to the subject of the unit. They will involve such concepts and skills as problem solving, critical thinking, interviewing, analyzing and organizing data, and communicating orally and in writing (Renzulli & Reis, 1986). These skills are often needed for the next level, Type Three activities, which are very challenging and require a high level of creativity and persistence. Students become first-hand inquirers and experimenters, working as if they were professional scientists or mathematicians, and creating authentic products (Renzulli & Reis, 1986).

The Cognitive-Affective Interaction model was designed to help students develop the skills for divergent and creative thinking (Williams, 1986). Williams defines eight factors-four cognitive and four affective-needed for divergent thinking. The four cognitive qualities are fluent thinking, flexible thinking, original thinking, and elaborative thinking. Risk-taking, complexity, curiosity, and imagination are the four affective qualities (Williams, 1986).

Williams also suggests 18 teaching approaches that will encourage creative thinking and that can be used across the disciplines. The

following are some of the strategies from the model:

- Present students with **paradoxes** to analyze and test
- Use **analogies** to introduce new concepts; ask students to create their own
- Allow students to think about **discrepancies** in what is known
- Ask **provocative questions** and provide time for inquiry
- Examine **examples of change** and the process of change
- Use **examples of habit** and the results of habit-bound thinking
- Encourage **tolerance for ambiguity** with open-ended problems
- Encourage students to use their **intuition** and follow their hunches
- **Study creative people** and their thinking processes
- **Evaluate situations** by analyzing possible consequences and implications
- Help students practice **creative reading, listening, and writing** skills

(Williams, 1986)

Backward Forward

It's Just Good Teaching
