What Is a Thinking Curriculum?

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The Characteristics of Successful Learners Revisited

Guidebook 1 described important characteristics of successful learners that emerged from three research perspectives we discussed--cognitive, philosophical, and multicultural. Guidebook 2 explores the implications of this view of successful learners for curriculum. Given the importance of these characteristics for our conception of a "thinking curriculum," we briefly review them here. **Knowledgeable** learners acquire a substantial and organized body of knowledge which they can use fluently to make sense of the world, solve problems, and make decisions. They can also evaluate the limitations of their knowledge and their perspectives on the world. **Self-determined** learners feel capable and continually strive to acquire and use the tools they need to learn. **Strategic** learners have a repertoire of thinking and learning strategies that they use with skill and purpose to think about and control their own learning and guide their learning of new content. Finally, **empathetic** learners are able to view themselves and the world from perspectives other than their own, including perspectives of people from different cultural backgrounds. A major goal of restructuring in general and thinking curricula in particular is to develop these qualities in all students.

Traditional curricula often do not promote these qualities. Current curricula in subject areas such as science and social studies frequently attempt to cover as much content as possible, regard all content as equal, and divide content into artificial categories that bear little relationship to how individuals use content in the world beyond school. Furthermore, students' attitudes about subject matter, and the skills and strategies they need to learn it, are rarely addressed. Often, traditional curricula emphasize isolated, low-level skills, to the neglect of meaningful content and higher-order thinking, especially when dealing with lower-achieving students.

In contrast, thinking curricula, based on "new" ways of thinking about learning, treat both content and processes differently. Content includes concepts, principles, generalizations, problems, facts, definitions, etc. Process includes learning strategies and skills, creative and critical thinking, thinking about thinking (metacognition), social skills, and so on. In the next section, we describe some characteristics of a thinking curriculum.

Characteristics of the Thinking Curriculum

The Association for Supervision and Curriculum Development (ASCD) publication, Toward the Thinking Curriculum: Current Cognitive Research (1989), reviewed much of the research underlying the thinking curriculum. Lauren Resnick, who edited the volume, coined the term "the thinking curriculum." Thinking curricula described in this Guidebook share much with Lauren Resnick's definition of a thinking curriculum (1989) and also build on important characteristics of learners and the three research perspectives.

The overarching characteristic of thinking curricula described in this Guidebook is: **Thinking curricula fulfill a dual agenda by integrating content and process**. Within this agenda, students develop habits of mind with respect to learning that serve them well both in school and in the real world.

While traditional curricula tend to teach content and process separately, a thinking curriculum weds process and content, a union that typifies real-world situations; that is, students are taught content through processes encountered in the real world. Some thinking and learning processes apply across all content areas and all areas of life and thus are generic: for example, decision making, problem solving, evaluating, and comparing.

Processes may be realized differently in different content areas. They answer the question, "What sort of thinking do historians (or mathematicians, scientists, etc.) engage in as they practice their craft?" For example, scientists

hypothesize about the nature of the natural world in such a way that they can test their hypotheses. Historians may also hypothesize, but cannot test their hypotheses as do scientists; rather, they depend on primary and secondary source materials to "test" their ideas. Content is inherent in these examples--the processes that scientists and historians use clearly depend on the content with which they are dealing. Students, then, learn content and construct meaning as they employ generic and content-specific strategies. They acquire content as they plan, evaluate, solve problems, make decisions, construct or critique arguments, compose essays, and so on. In short, students acquire knowledge in carrying out tasks requiring higher-order thinking-- they practice a craft, so to speak, as they acquire knowledge.

This approach to curriculum stands in contrast to traditional curricula. Traditional curricula from kindergarten through high school, expect students to master "knowledge" in school; and knowledge is usually seen as lists of facts and definitions. A traditional curriculum does not expect students to use the knowledge until they leave school. On the other hand, students engaged in a thinking curriculum acquire content as they plan, evaluate, solve problems, make decisions, construct or critique arguments, compose essays, and so on. At the same time, the content students learn has the power to promote these higher-level processes. In short, the essence of a thinking curriculum is the dual agenda. Four characteristics emerge from this agenda. These are elaborated below.

1. The scope of a thinking curriculum promotes in-depth learning.

Important concepts and strategies need to be identified, organized, prioritized, and taught in depth. This characteristic of a thinking curriculum helps clarify what it means to be knowledgeable. A thinking curriculum does not strive to produce "walking- encyclopedias," stuffed with facts, figures, definitions, and formulas. Truly knowledgeable students may possess such information, but more importantly, they possess key concepts and tools for making, using, and communicating knowledge in a field. Knowledgeable students have learned how to learn, how to organize information, and how to distinguish between important and less important pieces of information. In sum, they have a working knowledge of a field---a tool chest for the ongoing discovery and construction of meaning---rather than a junkyard of isolated facts.

Thus, in a thinking curriculum, students develop a deep understanding of essential concepts and processes for dealing with those concepts, similar to the understanding that experts use in tackling complex tasks in their disciplines. For example, students use original sources to construct historical accounts; they design experiments to answer their questions about natural phenomena; they use mathematics to model real--world events and systems; and they write for real audiences. The thinking curriculum gives students the tools---the perspectives and methodologies and concepts they need to carry out these authentic tasks.

2. Content and process objectives are situated in real-world tasks.

Rather than focusing on simple and discrete skills, students should engage in complex and holistic thinking. This type of thinking reflects what individuals performing tasks outside of school do. As Lauren Resnick has observed, out-of-school thinking about complex~ tasks is: (1) situated in meaningful processes of making

decisions, solving problems, evaluating situations, and so on, (2) shared among individuals also involved in carrying out the task, (3) aided by the use of tools, such as reference books, calculators, and other technology, and (4) connected to real-world objects, events, and situations. In addition, out-of-school thinking is often interdisciplinary, cutting across many "school subjects.

Other desired attributes of real-world thinking as well as a thinking curriculum are: orientations to problem solving and critical and creative thinking; dispositions toward learning, including a sense of efficacy, a desire to ponder and learn, and persistence; and understanding and valuing multiple perspectives, especially different cultural perspectives. In a thinking curriculum, thinking processes with such attributes are carried out in collaboration with students, teachers, parents, and community members using tools and resources to perform real-world tasks. Thus, content and process objectives can be achieved when learning tasks stimulate complex thinking and involve true collaboration among students.

3. Tasks are sequenced to situate holistic performances in increasingly challenging environments.

This aspect of a thinking curriculum is both difficult to understand and express. The major point is that students should always be engaged with a whole task. We should not ask them to learn and practice one element of a task at a time and then to integrate these pieces into a whole performance. Such integration will seldom happen as easily as we might hope. Some educators may mistakenly believe that young children and low-achieving students especially must begin with the parts and gradually orchestrate these parts into wholes.

An example should help clarify this characteristic of a thinking curriculum. Summarizing is a common skill learned in school. In conventional curricula, young students frequently are expected to learn how to summarize by first learning each "step" in the summarizing process. They are taught these steps one at a time. Ample time is given to practice the first step; for example, categorizing items or activities described in a text under a more inclusive label. Indeed, they may complete numerous worksheets on categorizing. Then, the teacher may teach them a second "step;" for example, deleting redundant information. Again, the students practice. This approach continues until students have been taught all the steps or subprocesses thought to be involved in summarizing. In short, curriculum tends to routinize the task. Finally, students are asked to put all these subskills together. Unfortunately, many students cannot do this---they are stuck at the subskill level, each of which they might perform beautifully, but which they cannot integrate into a smooth process of summarizing.

In contrast, in a thinking curriculum, summarizing would be conceived and taught as a holistic process. Rather than fragmenting the process, it would be taught in a context or environment in which students can succeed. For young children, this might mean asking them first to summarize relatively short paragraphs that deal with information with which they are very familiar. The teacher may also ask students to work collaboratively to summarize information at this initial learning stage. As students gain skill and confidence in summarizing, the teacher would ask them to summarize longer paragraphs, perhaps containing less familiar information. In summary, a thinking curriculum always treats tasks as indivisible wholes; variations that acknowledge the novice status of the learner are changes the teacher can make in the environment.

Abundant research (e.g., Palinscar, 1984) indicates that all students---including young children and low-achieving students-- can succeed with such a holistic approach. For instance, low-achievers typically perform at a much higher level than when taught skills in a fragmented manner. In addition, holistic learning is much more likely to be interesting to students and to promote a sense of control over their own learning.

Thus, a thinking curriculum is not chopped up into isolated skills and facts; rather, it involves the holistic performance of meaningful, complex tasks in increasingly challenging environments. A thinking curriculum promotes a sense of efficacy and confidence in students. Materials and content are structured so that students gradually regulate their own learning and so that learning is always meaningful and makes sense. These goals---self-regulation and meaningful learning---are promoted in a variety of ways in thinking curricula For example, a thinking curriculum encourages students to clarify their purposes in performing a task, to assess what they already know, and to predict what is to be learned. It helps them highlight what is most important and thereby fosters feelings of control over subject matter. It explores students' attitudes about themselves as learners and about learning in the content areas. It provides opportunities for students to assess difficulties they have in learning and consider strategies they could use to overcome learning difficulties. It stresses continuing to work in the face of ambiguity, solving problems despite unexpected difficulties, and looking at problems as challenges to learn more and better. By being engaged in curriculum in this manner, students come to see themselves as successful, capable learners.

4. A thinking curriculum actively connects content and processes to learners' backgrounds.

Educators can begin to create a thinking curriculum by first considering the experiences and knowledge that students bring to school and then expanding upon and refining these experiences and knowledge by connecting them to new learning. The content and processes learned then build on students' family, community, and cultural experiences. The knowledge students acquire is meaningful and applied. In addition, students are motivated to learn when curriculum considers their experiences and the issues and problems with which they are concerned as well as their patterns of processing knowledge. The content in a thinking curriculum is relevant to important issues and tasks in the lives of students.

When students can relate school learning to important real-life issues, they are more likely to seek and value the perspectives of others---peers, teachers, parents, community members, and experts. In so doing, they develop

interpersonal competencies for creating and participating in dialogue with individuals who have different perspectives and backgrounds. Thus, they not only connect content to their own backgrounds, but they also learn how different people interpret and organize content based on their different perspectives. As a result, a thinking curriculum builds multicultural understanding while encouraging the philosophical understanding of different kinds of knowledge and the limitations inherent in attending to only one perspective on a subject. Students will thus be better prepared to participate in an increasingly global society. Understanding and valuing multicultural perspectives emerges from dialogue in a classroom that is a community of open and sustained inquiry.

What Are Some Guidelines Across Content Areas That Promote a Thinking Curriculum?

Reform Efforts

Across the Content

Areas

In response to changes in society and new research on learning, content-area researchers and experts from professional organizations have written curriculum guidelines that schools can use to develop a thinking curriculum. These guidelines may be thought of as frameworks for performing authentic tasks in the disciplines.

This last decade has witnessed many calls for curricular reform. One of the first was in reading (Becoming A Nation of Readers, Anderson, Hiebert, Scott, & Wilkinson, 1985). Others followed in mathematics, science, social studies, and language arts in general.

Many strands of research support the basic assumption that learning is a meaningful activity; indeed, that learning is thinking. Thus, all reform efforts advocated moving away from a basic skills curriculum toward curriculum based on a new notion of learning in which students engage in authentic, higher-order learning tasks.

At the same time that research indicates that educators can move away from a traditional basic skills curriculum, changes in society itself require higher-order learning. Consider the following shifts:

* Our economy is shifting from a traditional industrial base to an information and service base.

* Individuals will have a number of jobs in the course of their careers, and those jobs are continually redefined by rapidly advancing technology, decentralization of authority in the workplace, and changes in the norms that define the culture of the workplace.

* Social arrangements are more fluid now---people move from place to place, families are configured differently, and child-care responsibilities are assumed by different individuals both within and outside the immediate family.

* In the political realm, citizens struggle with difficult issues related to technology, concerns for social equity in a pluralistic society, and the nation's greater interdependence with other countries.

Successful inhabitants in such a world must make sense of large and shifting bases of information be flexible in adapting to changing environments, work effectively in teams, and truly understand and value groups with backgrounds different from their own.

In sum, societal changes compel educators to create a new curriculum. Advances in learning research show them how.

Guidelines for the

Language Arts and a

Thinking Curriculum

An important impetus for new guidelines in language arts curriculum was the "new" definition of reading. This new definition, with some variation in details, has been officially adopted by a number of states and professional organizations. The essence of the definition is:

Reading is the process of constructing meaning from written text. It is a complex process requiring the coordination of information from a number of interrelated sources. Reading is an interaction of the reader, the text, and the context in which reading takes place. While this definition focuses on the activity of reading, more and more research informs us of the intimate connections between reading and writing, and, indeed, among all the language arts---reading, writing, listening, and speaking.

Recent curriculum guidelines, such as those proposed by the English Coalition Conference (1989), urge schools to recognize these relationships. The English Coalition's guidelines include assumptions about learning and language arts, aims for students, and recommendations for curriculum, instruction, and materials. These are summarized below.

Assumptions About

Learning and

Language Arts

A major characteristic of learning is that it is active and interactive. The new guidelines stress the intimate relationship between learning and thinking and the key role of language in learning. Both involve constructing meaning from experiences with both print and nonprint materials and engaging in inquiry and problem solving. Indeed, learning is thinking.

The guidelines also value diversity among students. The experiences that students bring to learning may differ, but all students have rich prior knowledge and experiences gained in their own cultures that enable them to learn. Schools should encourage students to value diversity by using a wide variety of texts and nonprint materials and by providing for social interaction in the classroom. In fact, the guidelines stress that learning is a social activity. In this diverse social milieu, teachers must assume new roles of facilitating and mediating learning rather than merely imparting information as is done in conventional classrooms.

Aims for Students

Because language is central in learning and thinking, schools are urged to integrate the language arts across all curriculum. If this can be accomplished, students will be able to use all the language arts as a means for effective communication, pleasure, and reflection on their own lives and the lives of others both in and out of school. Moreover, a language arts curriculum should promote lifelong learning, inquiry, problem solving, and other higher-order thinking. In addition, students should be able to think about their own learning and to view texts from multiple perspectives.

Curriculum

Recommendations

* Curriculum should be based on a variety of research (e.g., child development, psychology of language and literacy).

* Language arts should be central in all school subjects.

* Curriculum should integrate both content and process. Processes should be

treated holistically; skills should be conceived as part of holistic processes and should not be taught in isolation.

* Thinking should be taught as part of the core curriculum, not in isolation.

* Content should be taught as whole ideas around which language arts can be organized rather than as isolated bits of information such as facts, lists of works or characters, or rote definitions.

* Content should include a wide variety of literature from diverse sources, such as literature from other cultures; and other texts, such as student writing, television, and technical reports.

* Students should have the opportunity to explore ideas in depth.

* Commercial materials should be used flexibly to fit a curriculum rather than take the place of a teacher-developed curriculum.

These recommendations represent a dramatic shift from the curricula in many schools. Thus, they require changes in instruction, learning activities, and materials as well as assessment. Students need many opportunities to observe a variety of uses of language and literacy; to interact with teachers, other adults, and peers in classrooms that are communities of learners; and to engage in all the language arts on their own. For example, students should have books by real authors, including books by the students themselves, readily available in their classrooms for reading on their own and sharing with others.

The teaching of writing must shift from a focus on mechanics to a goal of constructing meaning in writing both for communicating with real audiences and for learning. Composing should be taught from a process approach. Teachers need to provide ample instruction in, and time for students to use planning, composing, editing, and proofreading strategies. Students also need to interact with each other and the teacher throughout the writing process.

Relation of Language

Arts Guidelines to a

Thinking Curriculum

These guidelines, based on a substantial body of research from numerous areas, clearly reflect the characteristics of a thinking curriculum as we define it. Throughout, the theme of the merging of process and content is evident. This fusion is natural in an idea-centered curriculum in which learning is thinking. In this regard, the guidelines advise schools to teach processes holistically and to abandon the isolated skills approach. Another clear theme is an emphasis on teaching important content in depth. Students cannot grapple with ideas unless they have time to reflect on those ideas.

The guidelines also promote situated learning. For example, they recognize the central role of language in all human activity and thus the importance of stressing its variety of uses across subject areas. In particular, the stress on process writing better reflects what real writers do. Finally, the guidelines stress students' interacting and learning with and from others. Each student can make unique contributions to his/her own learning and the learning of others because of his/her experiences, knowledge, and cultural background.

The New Standards in

Mathematics and a

Thinking Curriculum

The new curriculum standards from the National Council of Teachers of Mathematics (NCTM) emphasize developing students' abilities to use mathematics in solving problems, reasoning, and communicating; and helping students to value mathematics and to feel confident in their ability to do mathematics. Thus, implementing these standards would encourage students to view mathematics as an activity that everybody can use to make sense of the world. Five general goals cut across the K-12 curriculum standards for mathematics.

Problem Solving

The NCTM proposes that problem solving should be the central focus of mathematics education. A major reason for studying mathematics is to hone one's ability to solve problems systematically. Furthermore, problem solving provides real-life contexts in which mathematical skills and concepts are learned. Mathematics should be seen as a body of knowledge and a way of thinking that is useful in approaching problems encountered in everyday situations. To promote higher-order thinking, more problems should be confronted for which there are alternate solution strategies and solutions to generate and debate. In addition, problems should be drawn from many different problem situations, and relationships among problems should be explored. And students should model problems in different ways for example, by representing them in pictures or diagrams or by acting them out with manipulatives.

Reasoning

As with problem solving, the focus in reasoning is not always to find the right answer, but to make conjectures, gather evidence, and build arguments about how to use mathematical concepts and techniques in solving problems, according to the Council. Reasoning is fundamental to creating and understanding mathematics. To make conjectures and construct valid arguments for conjectures is the essence of the creative act of mathematics. In building arguments, mathematicians, drawing from philosophy, use both inductive and deductive reasoning. Teachers can foster inductive reasoning by creating situations where students must make generalizations about patterns and relationships, and by identifying common properties among objects and problems. Deductive reasoning can be developed using logical language, such as "and," "or," and "not," and teaching the strategies of constructing counter examples and evaluating alternate solutions given the problem's initial conditions.

Communicating

Mathematics is a language. As in any language, the ability to communicate requires fluency with the signs, symbols, and terms of the language and an understanding of the rules governing the combination of these in coherent expressions. The best way to acquire the language is to use the language in problem situations in which students read, write, and discuss mathematics. The NCTM states that students who possess the power of mathematical language can:

* Articulate their reasons for using a particular mathematical representation or notation

* Share solution strategies and explain why one strategy may be better than another in certain situations

* Summarize the meaning of data they have collected

* Describe how mathematical concepts are related to physical or pictorial models

* Justify arguments using deductive or inductive reasoning

Students who can communicate in mathematics frequently discuss how mathematical concepts are captured by the symbolic machinery of mathematics. Finally, students discuss the connections between concepts and procedures among various branches of mathematics.

Valuing Mathematics

Students should view mathematics as a vital human endeavor that is related to history, culture, and science. It is one of the oldest disciplines, yet it is far from a "dead" subject. Mathematical knowledge continues to grow. In fact, the period after World War II saw more growth in mathematical knowledge than any previous period in history. Mathematics also continues to help other disciplines formalize their knowledge. Mathematics is applied to the physical and life sciences, social sciences, and humanities. Mathematics, in turn, benefits from being stimulated by the problems these disciplines pose for mathematicians. To gain appreciation for mathematics, high school students, for example, can think of ways to describe and graphically represent the continuous motion of a roller coaster. As they continue to refine and formalize their representation of the continually changing trajectory of the roller coaster, they can come to see the need for a mathematical tool to capture the notion of fluid and dynamic change. They are ready to be introduced to the power and elegance of concepts in calculus, the branch of mathematics that meets their need.

Feeling Confident in One's Ability

Many students (and adults who were victims of poor math instruction) regard mathematics as an activity in which only "gifted" individuals can engage. Others think of mathematics as a strictly computational activity that can be performed entirely by computers. These individuals have never been provided with experiences where they feel they are **creating** mathematical knowledge.

Yet mathematics is a natural and creative activity of the human mind in which we all engage. All students come to school having encountered size, shape, and order. The teacher can build on these experiences by having students reflect on everyday experiences with mathematical concepts, confront real-world problems that motivate the refinement of the concepts, and formalize these concepts with increasingly powerful mathematical machinery. By doing this, students come to feel that mathematics makes sense, that it has a meaningful connection to their everyday lives, and that it has a power worth accessing when trying to solve certain problems.

Relation of Mathematics Guidelines to a Thinking Curriculum.

The NCTM standards draw directly on the research in cognitive sciences. The characteristics of a thinking curriculum also draw from this research base, so it should be of no surprise that they are similar. Throughout the standards, it is emphasized that mathematics should never be taught as a set of abstract, "cookbook" algorithms, but as a living subject striving to make sense of size, order, and shape and attempting to craft tools that help us solve problems. Mathematics is a language for problem solving.

The standards also articulate those core concepts on which students should focus to be able to use this language in real-life problem solving. By bringing this focus to the mathematics curriculum, students can engage in sustained problem solving using mathematical concepts in different contexts. Students are increasingly challenged to use the concepts in solving more and more elaborate problems with less and less teacher support. Finally, math educators are encouraged to help students see that they are already mathematicians, and that they often think systematically about space, quantity, and order in their everyday life. Mathematics is simply a formal expression and conceptual extension of these everyday experiences.

Recommendations for Science and a Thinking Curriculum

A report released by the American Association for the Advancement of Science (AAAS) makes recommendations for restructuring curricula in the sciences. The report, entitled Science for All Americans: Project 2061 (AAAS, 1989), promotes a new view of science. Project 2061 advocates that science be taught to students not as if it were a static body of lists, facts, definitions, and formulas, but as an active, ongoing social enterprise motivated by a fundamental and universal desire to make sense of the world. A summary of Science for All Americans has recommended four overarching goals for the science curriculum that support this view of science.

Understanding the

Scientific Endeavor Project

2061 urges schools to guide students to develop an awareness of what the scientific endeavor is and how it relates to their culture and their lives. Students come to see how science, mathematics, and technology often work together, each spurring the growth of the others. They should see that an understanding of how things behave leads to the development of technology. They should appreciate how various natural and social sciences differ in subject matter and technique, yet share the assumption that objects and events have a constancy in pattern and structure that can be revealed through systematic study. They should understand that mathematical knowledge arose out of an early need for better navigation and calculation of land areas. And they should see that scientific knowledge is an open inquiry with a long history, motivated by a fundamental human desire to be curious, to probe the mysteries of the universe and life, and to gain some illumination of those mysteries in systematic study. This inquiry is furthered by development of instruments that extend our capability to hear and see phenomena in the world. Mathematics gives us a language to carry out this inquiry. Thus, the scientific endeavor is an ongoing, human endeavor uniting science, mathematics, and technology in extending our ability to understand and create change in the world.

Developing Scientific Views of the World

Project 2061 also states that students should be able to use their knowledge of science, mathematics, and technology to make their world more comprehensible and more interesting. Students must develop well-articulated views of the world based on scientific principles and concepts. Some examples of such views include an understanding of the structure of the universe and the evolution of life within it. This understanding emerges from an intriguing and increasingly sophisticated insight that the materials and forces are the same everywhere in the universe. Everywhere substance is made up of atoms, and matter attracts matter through the force of gravity. Students can use basic concepts of matter, energy, force, and motion to understand the stars above and the earth below. Students come to appreciate the rich diversity of life forms on earth at the same time that they develop an understanding of the surprising similarity of these life forms in structure and function. In addition, the recommendations propose that students should be knowledgeable about the general features of the planet earth, the living environment, human life and society, and technology.

Forming Perspectives on Science

Project 2061 notes that the social and historical nature of science are an important part of a curriculum. Students should see how the powerful ideas of science emerged from particular historical, cultural, and intellectual contexts. Students should understand that scientific knowledge has a history. Most of that history has been marked by a gradual accretion of facts, but certain remarkable episodes in this history caused us to dramatically reconceptualize how we view the world. Students should appreciate these episodes, what led up to them, and their significance for the scientific endeavor and the broader culture and history. For example, students should understand how conceptions of the physical world changed from Aristotle, to Galileo, to Newton, up to Einstein. They can role-play individuals who hold to these various conceptions and explain phenomena from these diverse perspectives. To account for a rock being pulled to earth, the Aristotelian would explain how earth (the rock) seeks out the like substance of the ground, while the Newtonian would appeal to the universal force of gravitation. Or students could study how Chinese ideas about astronomy differed from medieval European ideas, and reflect on how these different perspectives imply different conceptions of humanity's place in the universe. Or they could study how in the past, many great mathematicians learned math in Africa rather than Europe. The purpose of considering these topics is not to add yet more to an already overburdened curriculum, but to prompt students to think critically about knowledge claims made in science.

Establishing Scientific Habits of Mind

If students are to be scientifically literate, they must possess certain scientific values, attitudes, and ways of thinking. To develop these, Project 2061 urges schools to help students internalize values inherent in the scientific endeavor. These values include 1) a respect for the use of evidence, 2) an appreciation of logical reasoning in crafting scientific arguments, 3) honesty and curiosity in conducting scientific inquiry, 4) openness to ideas that challenge old ways of viewing and explaining the world, and 5) healthy skepticism about current scientific claims and arguments. Students should form balanced and well-reasoned beliefs about the social benefits of the scientific endeavor.

Students should also develop a positive attitude toward learning science, according to Project 2061. Their attitudes should affirm their capability to make sense of the world through science, highlight the importance of accurate measurement and precise instruments in producing sound scientific knowledge, and value critical thinking.

Finally, the guidelines recommend helping students develop scientific ways of thinking. This requires honing skills in observation; analyzing data; synthesizing this information by using scientific ideas; organizing data in tables, graphs, and diagrams; and communicating one's conclusions both orally and in writing.

Relation of Science

Guidelines to a Thinking

Curriculum

There seems to be a rather clear relationship between the characteristics of a thinking curriculum and the guidelines from Project 2061. The guidelines are patently directed at higher-order outcomes in science, as revealed in verbs such

as "understanding," "forming perspectives," "thinking critically," and so on. In fact, these higher-order thinking processes are the means by which content is acquired, used, and infused with meaning. A teacher might choose to teach Chinese views of astronomy as a way for students to see that scientific activity is common to all cultures and that a culture will influence how scientific knowledge develops. The guidelines also articulate organizing principles and key concepts, such as evolution and energy transformations, that students should be able to use to develop scientific views of the world. Indeed, these core concepts enable students to think meaningfully about issues and problems in science. In addition, Project 2061 insists that scientific habits of mind cannot be established unless students engage in the real-life task of posing a question, designing an experiment to address the question, and synthesizing the information gathered to develop a defensible answer. Finally, the Project~ 2061 report, Science for All Americans, suggests that students see the scientific endeavor as a fundamental human impulse to explore the environment. Hence, educators should build on the experiences that students bring to class; help them articulate what conceptions they already have of the natural world; and provide them with real-life, structured experiences where students can rethink or even restructure their conceptions in the face of new evidence and new explanatory ideas.

Guidelines for Social

Studies and the

Thinking Curriculum

Because social studies combines the fields of history, geography, and the other social sciences, and draws much of its content from the humanities, it deals with issues that are especially vulnerable to shifts in the winds of national mood and political climate. Concerns about the meager knowledge that many students have of history and geography have further fueled the debate about what social studies curricula should encompass. But there have been recent attempts to articulate a balanced approach to the social studies. An approach consistent with a thinking curriculum would help students think more clearly about current issues confronting them and their world and also explore the past and other places, thereby helping them expand their perspectives on today's issues. As students build knowledge of history and geography, they can use this knowledge to inquire more deeply into the origins and dimensions of present problems. Students can generate questions about society and seek out answers by exploring what is distant in time or place or culturally different. In this way, a historian's habits of mind are cultivated, bolstered by familiarity with problem-solving processes in the social sciences, and undergirded by conceptually-based, well-organized knowledge drawing from history, geography, and civics.

This approach is advocated in Charting a Course: Social Studies for the 21st Century, a report on curricular reform in the social studies issued by the National Commission on Social Studies in the Schools. This commission has recommended that social studies curricula for the 21st century embody a number of characteristics. Some of these characteristics are highlighted below.

Understanding One's Role in Democratic Society

The Commission stresses that social studies in a thinking curriculum should help students acquire a number of attitudes. Students gain an awareness of their roles as individuals and as members of a society. Students come to understand the responsibilities these roles entail, especially in a pluralistic democracy. Respect for the richness that cultural and individual diversity brings the nation and the world should be developed through civic understanding and global awareness. Students attain a profound sense of connection to others in the past and across the globe by identifying common democratic passions and concerns. Students studying the American Revolution understand various manifestations of human strivings for basic rights---in American colonists, students protesting in Tiananmen Square, and Nelson Mandela and his followers in South Africa. Students see connections between the actions of radicals in the French Revolution and recent executions in Romania. Finally, students develop respect for themselves as participants in a democratic society when they are given real opportunities to render community service or solve social problems within the school or classroom. Students involved in a thinking curriculum for social studies see themselves as active and responsible members of a community, society, and a "global village."

Building on Core

Integrative Topics

Throughout the Social

Studies Curriculum

To develop the viewpoint and strategies of one conducting social inquiry, students need to focus on core integrative topics in depth. A social studies curriculum should be consistent and cumulative in treating these topics in depth and over the entire K-12 school experience. The Commission suggests some of the following topics and concepts: (1) Social studies can develop an international perspective by having students study other places and by providing multicultural perspectives. Students should understand the many ways in which groups, communities, and nations evolve, create, and modify rules to structure social interactions. (2) The concept of community should be explored in all its various manifestations. Portraits of communities from the past and across the globe, as well as investigations of their own neighborhood communities, can deepen students' understanding of the origins, purposes, and variety of communities. (3) Students should develop increasingly sophisticated models of the physical and social world. Each learning experience should be located in space with globes and maps, and located in time with notions of generations, eras, and periods. Students then develop a matrix of time and place that will help them make connections between history and geography. (4) The important concept of culture can be developed by considering ethnic diversity and the various ways culture is embodied in artifacts and events, such as holidays, art, music, literature, and bodies of knowledge. For example, students can learn how the Chinese use an abacus to perform calculations and how ancient Arabs developed our current number system based on the abacus.

Integrating Concepts

From the Social Sciences

With History and

Geography

To keep the study of history and geography from focusing exclusively on memorizing dates and capitals the Commission urges that concepts and understandings from political science, economics, sociology, anthropology, and the other social sciences be integrated throughout the social studies curriculum. Students should develop a firm understanding of the concepts, principles, and methodologies of the social sciences so that they have the tools to construct meaning in history and geography. These tools include strategies for acquiring, organizing, and using information, as well as relating knowledge acquired to interpersonal relationships and social participation. Students should know how to generate and synthesize data on social phenomena, how to find primary sources, and how to search information bases. In addition, the Commission states that students need to:

* Think critically about the reliability of information sources

* Give meaning to the gathered information by forming concepts

* Develop arguments that explain patterns in data

* Represent problems and issues (often by presenting information visually through graphs, maps, diagrams, and tables)

* Make informed decisions about historical events and current policies

* Reflect on how they have thought through a social issue and the possible limitations of their methodology and conceptual framework

Finally, students should be able to use their knowledge and beliefs to inform actions in their personal and social life and in community and political

participation.

Deeply Exploring Cultures and Major Civilizations Other Than the United States

In this time of greater interdependence in the world, it is especially important, according to the Commission, that students develop understandings of other civilizations. The point is not to cover all major civilizations superficially, but to look at selected civilizations in depth to cultivate genuine understanding of the history, geography, values, and ways of a people. In addition, students develop a heightened awareness of their own heritage, values, and behavior when they see similarities and differences among other cultures and civilizations. This awareness can promote multicultural learning in the classroom and beyond.

Developing Interdisciplinary Perspectives on Topics in Social Studies

The content of social studies curriculum offers abundant opportunities to make connections between the humanities and the natural and physical sciences as well as among the social sciences. The human adventure extends to all these areas. People produce knowledge and express their human desire in the context of a particular culture and historical period. Thus, any field of human endeavor---science, mathematics, literature, music, dance, art---can be seen from the perspective of the time and place in which it was undertaken and its course of development over its history.

Using Knowledge From Social Studies Actively to Confront Vital Questions and Issues

Content knowledge from the social studies should not be regarded as fixed knowledge to be memorized, but as the means through which open questions about society can be explored. Teachers can challenge students to explore the historical origins of any current problem or issue, to see the connections between how that problem or issue is addressed by our society and how the same issue is addressed by societies distant in time and space, and to pursue how this study might: help us think more innovatively about solutions to societal problems.

Relation of Social

Studies Guidelines to a

Thinking Curriculum

The relation of these recommendations from the National Commission on Social Studies in Schools to the characteristics of a thinking curriculum is clear. The recommendations emphasize helping students construct meaning in history and geography by employing the methodologies and concepts of the social sciences. The recommendations repeatedly emphasize the importance of resisting the push for coverage; instead, they recommend in-depth study of selected civilizations to explore themes such as culture and community that cut across the social sciences. Consistent with the characteristic of content objectives situated in real-world tasks, the recommendations also insist on using content to address open issues and vital questions in the lives of students. The Commission insists that social studies curriculum have continuity and that this continuity derive from core concepts that are treated in more and more complex ways as the students move from kindergarten to high school graduation. Finally, the Commission suggests that these core concepts be tied to what is familiar to students and then be expanded to larger and unfamiliar contexts.

Can Implementing a Thinking Curriculum Foster New learning?

The different curriculum standards reveal a common spirit. Over and over again, these professional organizations admonish traditional models of education for emphasizing memorization, and decry their push to cover content at the expense of deep conceptual understanding. Instead, the reports regard learning as the active, goal-directed construction of meaning. All emphasize in-depth learning; learning oriented to problem solving and decision making; learning embedded in real-life tasks and activities for thinking and communicating, and learning that builds on students' prior knowledge and experiences.

Implementation of the new standards in schools would help to develop students who are successful learners---learners who are knowledgeable, self-determined, strategic, and empathetic. By focusing on core concepts and treating them in depth, students acquire a firm conceptual base for organizing the content they learn into coherent knowledge structures. By emphasizing the connection to their own experiences and attitudes, the guidelines, when implemented, would validate students' experiences and enable them to become competent "knowledge workers" in the various disciplines. By uniting process and content, students learn the strategies they need to acquire, produce, use, and communicate knowledge. And, finally, by looking at the subject areas from multiple personal, cultural, and historical perspectives, students develop empathy for the experiences, feelings, and world views of others.

The new definition of learning can serve as the framework for restructuring a curriculum. By using a new school-based definition of learning, drawn from the research-based definition presented in Guidebook 1, all members of a school community and its broader community can develop a common language for curricula reform. Sharing this language will help build a community of individuals who have a common framework for curricular reform. They will have a basis for rethinking, as a community, the content and intent of the curriculum.

In addition, all professionals in the school will come to see that the reforms in their own disciplines--whether it be language arts, mathematics, science, or social studies--have a common basis, since all reforms are guided by a common research base and conceptual framework for learning. Thus, they can make curricular changes as a community, and they also can have common ground for interdisciplinary efforts. The characteristics of a thinking curriculum will become part of the school mission that the school as a whole and its community formulate in collaboration.

Fundamental

Restructuring in

Urban and Rural

Contexts

Rural and non-rural schools may engage in the process of fundamental restructuring in very different ways. Below v are descriptions of two schools that illustrate these differences. Staff from both schools are featured in Video Conference 2.

Urban Example

East St. Louis Public Schools, IL

Fredrick Birth, science coordinator for the East St. Louis schools, developed a science curriculum to solve serious social and academic problems in that district. The students did not have adequate prior knowledge to understand the science textbook and were unable to conduct the experiments in them. Consequently, students' already limited science experiences were not being addressed. Many teachers were reluctant to use the texts because they did not have adequate time in their crowded curriculum to provide the background knowledge students would need to understand the concepts and experiments. In addition, many elementary teachers had limited experience in teaching science. This situation was reflected in students' very low science scores on the California achievement test. Students graduated without the skills they would need for technical jobs.

Mr. Birth's approach reverses the order of science instruction typical in some schools. He developed laboratory centers in which students first engage in hands-on activities, especially experiments, and then learn the concept involved either by listening to teacher explanations, inferring the concept themselves, or reading about it in a text. Currently, there are six teachers and twelve centers. Each teacher is responsible for two centers. Students who attend are those most in need of science literacy. They spend two to three days, 30-40 minutes per day at their center. They learn all aspects of science over a year (e.g., biology, chemistry), but with no time constraints for any one element. In addition to a hands-on approach, the curriculum stresses scientific habits of thinking---observing, hypothesizing, planning an experiment, reaching a conclusion--and helps students make connections between science concepts and processes and their own lives. For example, students hypothesize what will happen if they use drugs, observe effects of drugs on people, and

reach conclusions about taking drugs. Parents are encouraged to participate in the program and have become enthusiastic about their children's participation in science fairs. Students' who participated in Mr. Birth's experimental program saw not only dramatic increases in their science scores on the California test but in their motivation and self-confidence. It is expected that the achievement of students in the program now will also increase. Teachers, too, have benefited. They meet regularly to share ideas and problems.

This program exemplifies a thinking curriculum within a content area. Students learn science concepts and processes in depth without the limitations inherent in "covering content." They engage in science authentically and holistically, as real scientists do. The approach--examining and puzzling about natural phenomena and then inferring concepts that explain phenomena reflects the sort of processing these students are familiar with. Finally, students learn how science can inform their own lives and how it can help them make decisions about issues they face out of school.

Rural Example

Deer River Public Schools, MN

Deer River is a rural community in Minnesota where more than 50 percent of the student body come from low-income homes. In addition, Native Americans represent 30 percent of the population. In an effort to help students deal with our changing society and to value and understand cultures other than their own, specifically the Ojibwe culture, four teachers in the district are developing a technological, multicultural curricular strand. Other cultures common in the area will be studied in the future. The four teachers received support to develop the curriculum when they were named Christa McAuliffe Fellows by the National Foundation for the Improvement of Education.

The Ojibwe people are involved in developing the curriculum. They are identifying aspects of their culture--artifacts, history, government, customs, and so on--that are important for students to learn as well as misconceptions the curriculum should help dispel. In addition, Ojibwe people will interact directly. Students will interview the Ojibwe people and visit them as they work. The community's White Oak Society is constructing replicas of Ojibwe villages where students can learn about the Ojibwe culture in its authentic state. Such an in-depth focus on a whole culture quite naturally will involve interdisciplinary learning. In addition to learning important social studies concepts (e.g, factors that make up a culture, importance of getting along with other people), students will have many opportunities to develop language arts skills through interviewing, writing and interpreting their interviews, and learning traditional Ojibwe stories. They will be able to learn some math concepts and skills through Ojibwe counting games, and some science concepts as they learn about native plants, herbal medicine, and the like. They can learn design concepts by studying Ojibwe art. With help from teachers, students will develop hypertext (combination of video, disc, computer information, and word processing technologies) that will become a learning resource students both create and use. High- school students will learn sophisticated video technology so they can videotape both the interviews and the Ojibwe people in various settings.

This multicultural curriculum richly embodies the concepts of a thinking curriculum. It fuses content and process. Students will engage in processes such as analyzing data from interviews as a way to understand what they have learned about Ojibwe culture. Students will learn about the culture in depth by interacting with and observing Ojibwe in their natural context. Such experiences are an authentic model for learning about any culture; as such the curriculum will be situated in the real world. In addition, students will perform holistic tasks such as interviewing, analyzing data, drawing conclusions about what they observe and write about their experiences, making decisions, and so on. Finally, the content will make connections to and build on students' prior knowledge by focusing on a culture close to home and by connecting math, science, language arts, and social studies to real-world embodiments of concepts in those content areas.

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