EFFECTIVE School Practices

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FOCUS: TOOLS FOR MIDDLE SCHOOL SUCCESS

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- Donald Crawford
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- Keith Hollenbeck
- ChangNam Lee

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ADI

Philosophy of *Effective School Practices*

1. Teachers are responsible for student learning.
2. The curriculum is a critical variable for instructional effectiveness.
3. Effective teaching practices are identified by instructional research that compares the results of a new practice with the results of a viable alternative.
4. Experiments should not be conducted using an entire generation of Americans. The initial experimentation with a new practice should be small in scale and carefully controlled so that negative outcomes are minimized.
5. A powerful technology for teaching exists that is not being utilized in most American schools.

Effective School Practices is published quarterly by the Association for Direct Instruction. The mission of the Association for Direct Instruction, as stated in the by-laws, is to promote the improvement of educational methods.

The name *Direct Instruction* originated with the highly effective instructional model first developed by Zig Engelmann in Project Follow Through during President Johnson's Great Society legislation. Although the evaluation of Project Follow Through showed the Direct Instruction model to be far more effective than the other models on every identified outcome, education in America remained generally unchanged.

A few educators, impressed by the extraordinary results of the original Direct Instruction model and the programs that were developed as DI evolved, formed the Association for Direct Instruction in 1981.

Today, this organization is a vanguard in promoting school practices that have been validated as effective through the use of the scientific method in educational research.

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e-mail: BGrossen@oregon.uoregon.edu

OVERVIEW
Tools for Middle School Success

Over the past decade, much of the research conducted under Doug Carnine's leadership at the University of Oregon has been investigating effective instructional interventions for middle school students. Zig Engelmann and associates have also been applying Direct Instruction theory to higher level cognitive tasks for more sophisticated learners. The combined results of these efforts have been rewarding in terms of higher achievement levels for at-risk populations. The instructional tools that have resulted from this work and some of the research studies that evaluate these interventions for higher level thinking are featured in this issue.

Big Idea Designs

One of the most important instructional features of the tools described here is a "big idea" design. A big idea is an underlying framework that applies to a large domain of knowledge. Because of the wider generalizability of big ideas, instruction that focuses on teaching the big ideas allows more learning from less teaching. Big ideas increase the efficiency of the instruction, if they are well conceived. Design around well-conceived big ideas serves to accommodate diverse learning needs while accelerating the performance of the group as a whole. Examples of big ideas from the various middle school tools are provided in the following section, "Middle School Curricula With 'Big Idea' Designs."

Chapter 1 from the *Understanding U.S. History* text is reprinted in its entirety. In this chapter the "Problem-Solution-Effect" big idea is presented to students. This big idea is used throughout the text as a framework for understanding social events. Students see so many examples of this big idea, that they *all* "get it" and get it well. Students also quickly learn to apply this framework to understanding current events from the newspaper and social issues in their local school and community. Learners do not differ in regard to whether or not they learn how to use this big idea to understand history and current events. They all learn how to use the problem-solution-effect framework. Learners differ more in regard to how much detail they remember about the events they have studied.

Chapter 1 also illustrates the use of interspersed questions, which are a validated strategy for aiding comprehension. Readers who haven't formed a habit of asking themselves questions and thinking about what they read as they read, see a model of how this process works. Middle school history teachers may duplicate chapter 1 and try it with their students. *Understanding U.S. History* was developed with extensive consultation with the National Center to Improve the Tools of Educators. The principles of effective instructional design outlined by NCITE are incorporated in the development of the text. (The University of Oregon has the copyright.)

Other big ideas described in this section include the "ruling out game" taught in *Reasoning and Writing*, the ratios word problem strategy in *Connecting Math Concepts* and in the *Core Concepts* math videodisc programs, and the convection model in the Earth Science videodisc program.

Of course, the old stand-bys, *Corrective Reading* and *Morphographic Spelling*, are essential tools for removing the barriers of illiteracy. In many of the middle schools we have been working in lately, as many as 1/3 of the students read below the 3rd grade level and are unable to read well enough to do their assignments. *Corrective Reading* and *Morphographic Spelling* are also organized around big ideas, that is, they allow for more learning from less teaching. The 50 or so sound-symbol relationships taught in *Corrective Reading—Decoding* are the big idea of word recognition. All students do in *Corrective Reading—Decoding* is learn how to apply this knowledge fluently and automatically without error, and they become fluent readers. In *Morphographic Spelling*, approximately 600 morphemes and three main rules for combining them are the big idea. With this knowledge students can spell approximately 12,000 words.

The research section of this issue includes two articles that provide comprehensive syntheses of the research on the use of the history text and the

***Note from the staff of* Effective School Practices:** *We regret the poor quality of the photos in the last issue. The original we sent to the printers did not look like the copies that came back. We are making plans to move to a higher quality of printing and paper, so that photos will reproduce more nicely. Thank you for your patience.*

math videodisc programs. A partial listing of the research on *Corrective Reading* is also included.

Integration

Additional components to the tools featured in this issue allow integration across subject areas. For example, the problem solving instruction that was added to the science videodisc course in Earth Science, teaches students how to formulate questions to elicit the information they need to solve a problem (see "A Middle School Science Program"). This problem solving strategy will readily transfer to other subject areas when it is reinforced by providing problems in social studies or mathematics that require students to find additional information in order to solve the problems.

Once students have learned the questions they should ask to solve problems, they need to learn how to find answers to those questions. An additional component to *Reasoning and Writing* teaches students to search a reliable source for answers to questions. This component is described in the study on reasoning and writing included in the research section. In that study students learned to search the Grolier's Multimedia Encyclopedia to find answers to questions. These search skills also apply to searching the internet for information. These search skills complement the strategies students learn in *Reasoning and Writing* for evaluating the logic of an argument, identifying alternative possibilities that are consistent with the evidence, and describing the kind of information that would discredit the conclusion or any of the possibilities. The skills students learn in the combined set of programs lead them to become sophisticated consumers of information.

What about Training?

Buying the programs alone will not guarantee high achievement levels. Teachers need to learn how these programs are used to get results. Some of us who have been involved in the middle school research are working on a training dissemination model. This model involves using the people who get outstanding results in middle schools for training new teachers at new sites in the effective use of these tools. Schools interested in implementing these tools should check into the available training and in-class coaching. (See the High Performing Schools information on page 85.)

Editor

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Julie Eisele	George Brent	Vicci Tucci	Steve Graf
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Chapter 1 from a Middle School History Text Designed Around Big Ideas

From *Understanding U.S. History, Volume 1–Through the Civil War*

Douglas Carnine
Donald Crawford
Mark Harniss
Keith Hollenbeck

Letter from the Authors

United States history is very complicated, with many important people and events. This book was written to enable you to understand the ideas that link these important events. These ideas help explain what happened in the past, what is happening now, and what may happen in the future. Because of the focus on important ideas, this book does not try to include all the people and events covered in other books.

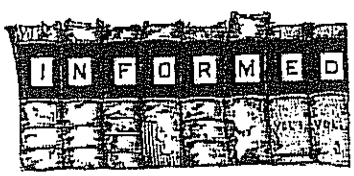
One of these important ideas is the problem-solution-effect sequence that is described in this chapter, beginning with economic problems and people's rights problems. Other important ideas include how the environment influences the way people live, four factors that determine the likelihood of group success, seven aspects of a healthy economy, and the four stages in developing cooperation. These and other important ideas are developed gradually throughout the book and applied in different ways. For example, the four factors of group success are used to understand the success of early settlements, victors in war, and winners in political campaigns. There are also opportunities to seek out additional information on these important ideas and to write about them in essays that take various forms: compare and contrast, description, problem-solution-effect, persuasive, and imaginative.

But the book does not try to explain these important ideas all at once. As they are introduced throughout the book, you will become more and more sophisticated in your understanding of history. But this sophistication takes time to develop. If at first the book seems easy, it is because you haven't learned about very many important ideas. By the time you finish the book, you will be impressed with how well you understand United States history.

To emphasize what these important ideas are, we have written a test question for each one. You will see them labeled as Test Questions. You will also notice that the book gives answers to these test questions. The answers clearly state the important ideas. One answer is called **basic.** It outlines the important ideas. The second answer is called **exemplary.** It elaborates by giving more explanation and examples.

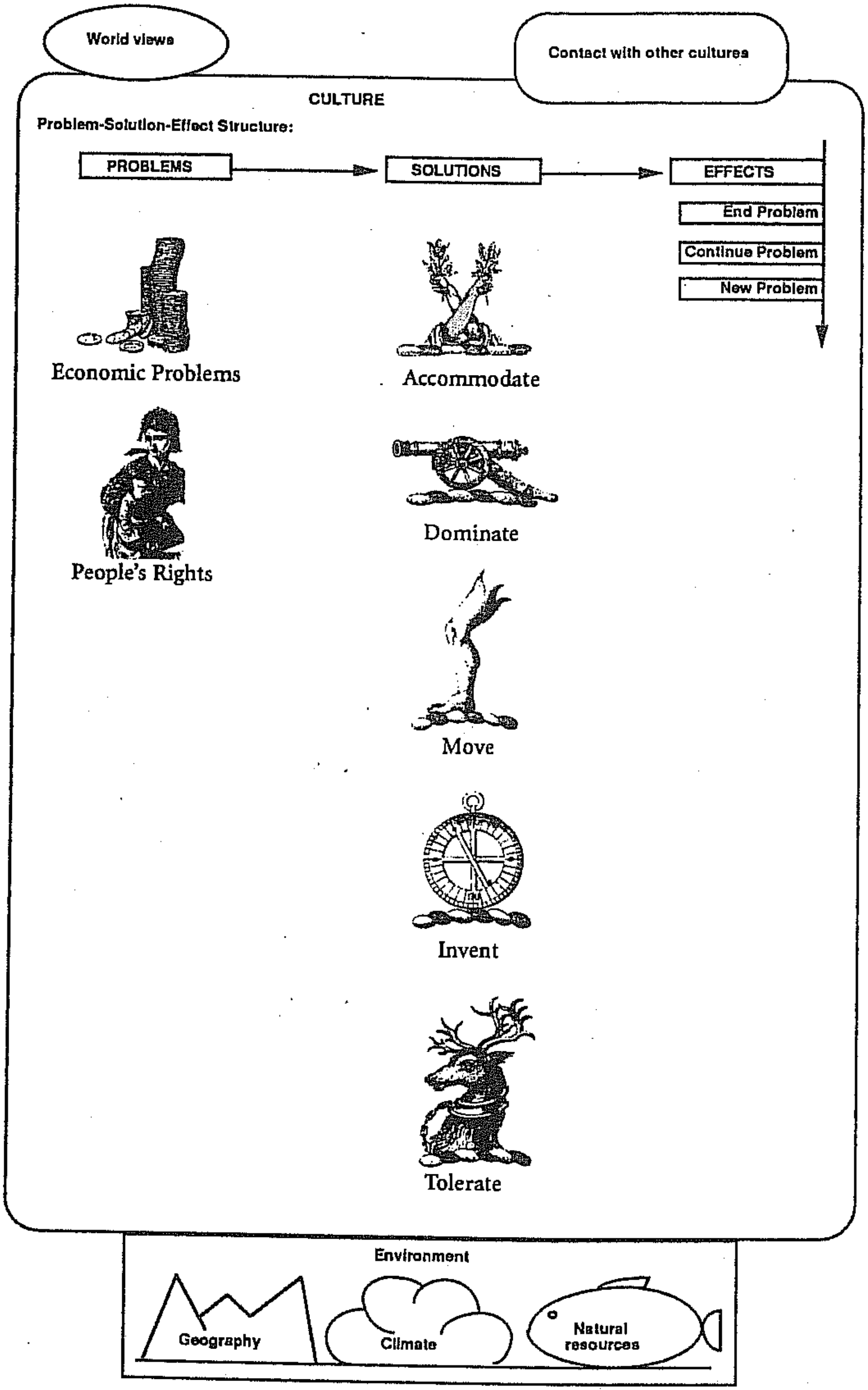
"The people are the ultimate guardians of their own liberty... History by apprising them of the past will enable them to judge the future; it will avail them to the experience of other times and other nations; it will qualify them as judges of the actions and designs of men...."

Thomas Jefferson



"... you shall be filled with peace and goodwill and your mind filled with a yearning for the welfare of the people of the Confederacy.... Look and listen for the welfare of the whole people and have always in view not only the present but also the coming generations, even those whose faces are yet beneath the surface of the earth--the unborn of the future Nation."

Native American Constitution of the Five Nations


World views
Contact with other cultures
CULTURE
Problem-Solution-Effect Structure:
PROBLEMS
SOLUTIONS
EFFECTS
End Problem
Continue Problem
New Problem
Economic Problems
People's Rights
Accommodate
Dominate
Move
Invent
Tolerate
Environment
Geography
Climate
Natural resources

Chapter 1

Introduction to Problems, Solutions and Effects in U.S. History

Studying history with this book is like looking back in time through a window. When we look through this window, we can relive important problems and see how people tried to solve their problems. Sometimes these solutions had positive effects. Often, however, solutions had unintended effects that created new problems.

Problems can also be thought of as creating opportunities. Sometimes solutions can be thought of as the way people take advantage of opportunities. Much of history can be seen as problems that presented opportunities and how groups of people responded.

Two Types of Problems

People have problems when they are unable to get or keep things and rights they want or need. Most problems faced by groups of people are economic problems or people's rights problems.

Economic Problems

Economic Problems

An **economic problem** involves difficulty in getting and keeping things that people need or want. For example, people need three basic things: (a) food to eat, (b) shelter to keep them dry and to protect them from the weather, and (c) clothing to keep them warm. People want things such as televisions or fancy clothes. When people can't get and keep what they need or want, they have an economic problem.

1 When do people have an economic problem?

2 What are three basic needs?

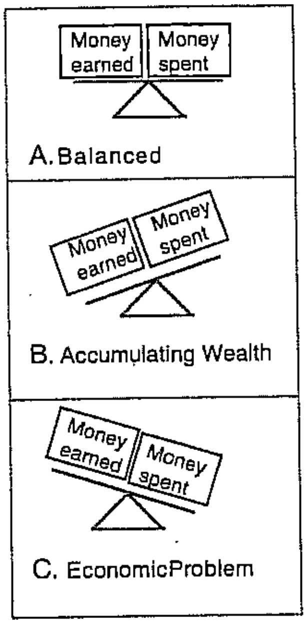
Over the past 400 years, the way people have met their basic needs has changed dramatically. Four hundred years ago, Native American families grew crops and hunted and killed their own food, helped build their own shelters, and made their own clothes. Now not many people grow their own food, build their own shelters, or make their own clothes. Today, families earn money by working. When members of a family work, they exchange their time and skills for money. The money they earn is spent on food, shelter, clothing, and other things such as entertainment. If a family earns more money than it spends, the family will have extra money. When a family saves money, they are accumulating wealth. If a family spends more money than they earn, they end up in debt. A family that gets too much into debt has an economic problem. They cannot afford the things they want and need.

Discussion Are you as a student accumulating wealth, or do you have an economic problem?

Larger groups also can have economic problems. Factory owners, for example, earn money by selling their products. Some factories make and sell clothes, while others make and sell computers. A factory spends money for many things, such as paying for materials, equipment, buildings, and workers' salaries. Factory owners have economic problems if they spend more money making things than they receive by selling those things.

Governments can have economic problems, too. Governments get money by collecting taxes from their citizens. Governments spend money to pay for

Figure 1.1 Economic Situations



protection by the military, social services, education, and many other services. They have problems if they spend more money than they receive from taxes.

Businesses and governments are like families. When businesses and governments save money, they are accumulating wealth. When they spend more money than they earn, they have economic problems and cannot get all the things they want and need.

Figure 1.1 shows three different economic situations that families, businesses, governments, and other organizations may experience.

1. If families, businesses, governments, and other organizetions earn as much as they spend, they will be **economically balanced.** This situation is shown in box A. For example, if a family earns $4,000 a month and spends $4,000 a month, then it is economically balanced.
2. If a group earns more than it spends, the group will **accumulate wealth.** This situation is shown in box B. For example, if a business earns $50,000 a month and only spends $30,000 a month, then it is accumulating wealth.
3. If a group spends more than it earns, it will have an **economic problem.** This situation is shown in box C. For example, if a government takes in one billion dollars in taxes a month but spends two billion dollars a month, then it has an economic problem.

Complete sentences three and four.

3 A group accumulates wealth when it earns ____________________.

4 A group has an economic problem when it spends ____________________.

Discussion Give some examples of ways that farms might obtain money. Give some examples of ways that farms might spend money. What might happen if a farm earns more money than it spends? What might happen if a farm spends more money than it earns?

Discussion Give some examples of ways that schools obtain money. Give some examples of ways that schools spend money. What might happen if a school takes in more money than it spends? What might happen if a school spends more money than it takes in?

Later, you will read about different types of economic activities such as manufacturing, trade, and agriculture. Many factors determine the success of economic activities. Factors you will study include labor, transportation, markets, equipment, debts, and profits.

Thousands and thousands of years ago, these factors were not very important. People did not even have money. They spent most of their life getting food, clothing, and shelter. They hunted animals and gathered berries. There was much uncertainty about having enough food. As years passed, people learned how to raise and harvest crops; they had more control over their supply of food. People then began to accumulate wealth. They used some of this wealth for more expensive household goods and luxuries, and for arts such as painting, music, sculpture, and literature.

5 How did people use the wealth they accumulated?

Throughout history, wealth has not been shared equally by all people. Usually, the people who have had the most wealth also have been the people who have had the most rights. Throughout history, economic problems have been related to people's rights problems.

People's Rights

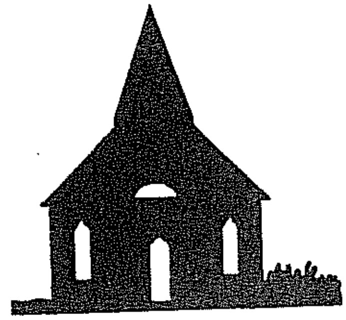
People's Rights Problems

A **right** is the freedom to do a certain activity. When people are not given basic rights, they have a **people's rights problem.** The United States

Constitution guarantees people in the U.S. certain basic rights, such as:

1. Religious freedom.
2. Freedom of speech.
3. Protection under the law.

6 What are three rights of people guaranteed in the United States Constitution?



The right of **religious freedom** means that you can go to any place of worship that you choose, or you can choose not to attend a church, temple, or mosque at all. If you did not have religious freedom, the government might force you to worship in ways you do not believe. If you refused to worship in the way you were told, you might be punished or physically harmed. According to the U.S. Constitution, you would have a people's rights problem.

7 Define the right of religious freedom.

Many countries have the right of **freedom of speech.** This right allows you to say or write what you have good reason to believe is true. If you did not have freedom of speech, then you might be arrested for saying or writing things that the government did not like. This would be a people's rights problem.

8 Define the right of freedom of speech.

Protection under the law means that you cannot be arrested unless you are charged with a specific crime. If you are arrested, you can have a lawyer advise you. You can also ask for a jury trial. If you did not have protection under the law, you could be jailed without reasonable cause. You might not be able to get a fair trial. According to the U.S. Constitution, you would have a people's rights problem.

9 Define the right of protection under the law.

10 Name and give an example of three rights of people listed in the U.S. Constitution.

Discussion Can you think of times in history or even today when people have been denied basic rights?

Equality of rights exists when all people have the same rights. Not having equality of people's rights has been a significant problem for some groups of people. Three groups of people who have often not been given equality of rights are women, people from different races, and people who are poor.

11 When does equality of rights exist?

Equality for women. There are many examples in history where women did not have equality of rights. For example, at one time in the U.S., women could not vote and most could not own property. Today, women sometimes can't get the kind of jobs they want just because they are women. Sometimes they do the same work as men but get less pay because they are women.

Equality for people from different races. In most countries, there is one group that makes up the majority of people. In the United States, the majority of people come from European backgrounds and are considered "white." However, many Americans are not white. They are considered to be from different **races.** People who are from the same **race** share common physical characteristics and origins. People who are not white often have had problems getting equal rights in the United States, even though the Constitution grants those rights to everyone. For example, until 1865 in America, most African people were slaves and did not have freedom of speech or protection under the law. Also, Native Americans were rarely allowed to be citizens of the U.S. People who have come from Asia and Latin America have also had people's rights problems.

Figure 1.2 Summary of Economic and People's Rights Problems

Examples of Two Major Types of Problems

1. ECONOMIC Examples

When a family does not have enough money to buy food

When a large company spends more money than it earns and has to fire employees to save money

When a government spends more money than it earns and has to borrow money from other countries

2. RIGHTS OF PEOPLE Examples

Not having religious freedom

Not having freedom of speech

Not having protection under the law

Not being able to vote just because you are from a different race or you are a women or do not own land

Equality for people from different economic classes of society. People are often grouped in ways other than gender or race. Sometimes people are classified according to how much money they make. People who have high incomes are classified as being in the upper economic class. They often are accumulating wealth. People who have middle incomes and make enough money to live comfortably are classified as being in the middle economic class. Poor people who have low or no incomes and are struggling to survive are classified as being in the lower economic class.

Sometimes people are not given equality of rights because of their economic class. For example, over 200 years ago in England and its American colonies, people in the lower economic class did not own land and were not allowed to vote. Also, people in the lower economic class could not always get the right of protection under the law because they could not pay for a lawyer. Even today, when groups are granted rights by law, they may not actually have equality of rights.

This book will discuss times when people did not have rights just because they were a member of a certain group.For a summary of these problems, see figure 1.2.

12 List three groups who have not had equal rights.

Discussion Do women, people of other races, and poor people have equal rights today in the United States? Do women, people of other races, and poor people have equal rights today in other countries?

Overlapping Problems. Economic problems and people's rights problems are often related. For example, people being too poor to buy land in the American colonies, an economic problem, resulted in their not being able to vote, a people's rights problem. Here's another example: People have a people's right problem because they are of a different race and can't get a higher-paying job. Not getting a higher-paying job results in an economic problem, too.

About 2,500 years ago, most people who lived in Rome were poor and did not have many rights. For example, Roman poor people could not vote. In contrast, wealthy Roman men who owned land were called citizens. These citizens usually could vote, had freedom of speech, and had protection under the law. In Rome, the people who had wealth were the people who had the most rights.

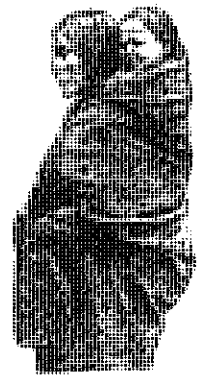
13 Name one instance of economic and people's rights issues linked together.

Discussion Describe and give examples of how economic and people's rights problems are often linked together.

The Development of People's Rights in the U.S.

Often, people who do not have economic problems do not have people's rights problems. But even wealthy people can be denied their rights. In England about 1,000 years ago, people who owned land could get in serious trouble if they spoke out against the king. The king could have people killed without those people having protection under the law. Very slowly over the past 1,000 years, more people began gaining their rights in England. In 1215, a law called the Magna Carta granted males who had large holdings of land many rights. Later, males in England who were wealthy from trade or industry gained rights. Eventually, laws gave equal rights to all people in England.

In North America, the race and gender of people determined which rights they could expect to have. The English who settled in colonies such as Virginia, Maryland, and South Carolina were mostly males and, as in England, only men could vote for local public officials. Colonies such as Massachusetts and Connecticut were settled by families; and while many men listened to women's views, the right to vote was limited to men. Neither Native American nor African men were permitted to vote.



After the abolition of slavery, African-American males were finally granted the right to vote by the Fifteenth Amendment, which became law in 1870. But Native Americans were still not considered citizens. Most could not vote until Congress declared them citizens in 1925. Men of Mexican descent, who lived in the Southwest when it was taken from Mexico, were given U.S. citizenship in 1848 and could then vote in local elections

People from Asia were the last racial group to become citizens and gain the right to vote. Immigrants from China or Japan in the 1800s were not allowed to become citizens of the United States. Immigrants from China were not able to become citizens until 1943. Immigrants from Japan and Korea could not become citizens until the 1950s.

Many women were guaranteed the right to vote by the Nineteenth Amendment, passed in 1920.

14 When did people of different races and women gain the right to vote in the U.S.?

When you read about the early history of the United States, you will see that some white males had most of the wealth and most of the people's rights. Thus most of the economic and political decisions in the early history of the United States were made by wealthy white males. You read about so many white males in early U.S. history because they had the wealth and rights that allowed them to influence important historical events. In recent history, women, Native Americans, African Americans, Latin Americans, Asian Americans, and people from the lower economic class are having more and more influence over important events.

15 Why did individual women, Native Americans, African Americans, Latin Americans, Asian Americans, and people from the lower economic class have less influence on important events in **early** American history?

End-of-Section Questions: **Two Types of Problems**

1. **Vocabulary.** Write the vocabulary word or words for each lettered definition:
   a. difficulty in getting things that people need or want.
   b. when people are not given basic rights.
   c. the government cannot force you to worship in ways you don't believe. You may choose to go to church or not.
   d. allows you to say or write what you believe is true.
   e. you cannot be arrested unless you are charged with a specific crime; right to a lawyer and trial by jury.
   f. a group of people who share common physical characteristics and origins.
   g. all people have the same rights.
2. When do people have an economic problem?
3. Name three rights listed in the Constitution.
4. Three different groups of people have not always had equal rights in the U.S. Name these three groups.
5. Below is a list of examples of having three types of rights. Identify whether the example refers to **religious freedom, freedom of speech**, or **protection under the law:**
   a. the right to have a lawyer advise you.
   b. going to the church of your choice without anyone stopping you or hurting you.
   c. the ability to protest with other people against a law.
   d. the ability to disagree with the president of the United States without being arrested.
   e. people who go from door to door trying to convince other people of their beliefs.
   f. allowing everyone to have a fair trial.
6. Below is a list of examples of not having three types of rights. Identify whether the example refers to **not having religious freedom, not having freedom of speech**, or **not having protection under the law:**
   a. being imprisoned for saying things that the ruling party of the country did not like.
   b. being thrown into prison for no reason.
   c. being injured or killed because you belong to a religion or for practicing a religion.
   d. being forced to leave the U.S. for saying things the government does not like but that are true.
   e. being arrested for practicing a certain religion.
   f. being left in jail for a long time without having a trial.

"Cautious, careful people, always casting about to preserve their reputation and social standing, never can bring about a reform. Those who are really in earnest must be willing to be anything or nothing in the world's estimation."

Susan Brownell Anthony
1860

Solutions and Effects

You have already read about two types of problems. Now you will read about solutions to those problems. Later, you will read about possible effects of a solution.

Solutions

Solutions are the actions people take to solve a problem. Five important ways that people have attempted to solve their problems are:

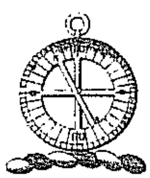
1. Moving.
2. Inventing.
3. Dominating.
4. Tolerating.
5. Accommodating.

Moving

Sometimes people move to solve their problems. **Moving** solves problems by leaving a problem behind in an old place and finding a new place that hopefully does not have the old problem. England established colonies on North America in the 1600s. People from England moved to the colonies to escape economic problems or to solve people's rights problems.

The people who came to the United States were called **immigrants. Immigrants** are people who leave their country of birth to settle in a new country. Most American families started as immigrants. Some families immigrated to America over 200 years ago. Some families still immigrate to America to solve problems.

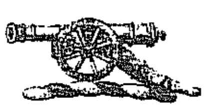
16 How does moving solve problems? Give an example.



Inventing

Some problems can be solved by the **invention** of something new. **Inventing** solves problems by creating new ways of doing old things, or new abilities to do things people could not do before. For example, in the early 1800s, people could not farm on the Great Plains because the soil was too heavy to plow. The invention of the steel plow solved this economic problem. Another example is the invention of the long rifle which helped the Americans win their independence from Britain. This rifle's ability to shoot accurately over long distances helped the Americans defeat the British. Some inventions have caused serious problems. For example, inventions of larger, safer ships in the 1600s made it profitable to buy and sell large numbers of African slaves, which solved a transportation problem for the slave traders. But it created a people's rights problem for many Africans.

17 How does inventing solve problems? Give an example.



Dominating

Dominating is a way to solve problems that involves one group that has more power than other groups. **Dominate** means that one group has control over another group. There are many ways to dominate. One kind of domination is with rules and laws. A group makes laws to control another group. During the early 1700s, Britain dominated the American colonists with trade laws, tax laws, and punishment laws.

People can also dominate other people physically. When groups of people from different countries use weapons to try to dominate each other, the result is war. For example, the colonists and the British used weapons and tried to dominate each other in the Revolutionary War. Later, you'll read about four factors that help explain which country is likely to dominate in a war.

18 What does dominate mean? Give an example.

Tolerating

When people or groups of people **tolerate** a problem, it means they put up with something that doesn't please them. Tolerating is not exactly a solution. It is an attempt to "solve" a problem by ignoring it or doing nothing. Some problems do go away. Usually, a group that does not have enough power to dominate the other group and cannot use moving or inventing to solve the problem will have to just "put up with" a problem. When people cannot do anything about a problem, they must tolerate it. For example, poor people have had to tolerate dangerous working conditions because they could not afford to quit their job.

19 Does tolerating solve problems? Explain.

20 When will a group tolerate a problem?

Accommodating

When people or groups of people **accommodate,** they change how they think or what they do to solve a problem. Accommodation is used as a type of solution when two groups have about equal power. If one group has great power, that group will often dominate and not accommodate. Groups often accommodate each other by **negotiating.** When groups **negotiate,** they talk with each other about how to solve a problem. Negotiating involves working towards a **compromise** where each group gives up something so that both groups will agree to a solution. If two U.S. History teachers want to use different books, they will probably have to accommodate. Possibly one teacher will select the book, while the other teacher gets to select which groups of students to teach.

Many times in history, groups have accommodated each other to solve problems. For example, after America won its independence from Britain, some people in America wanted each state to be like a separate country. Other people in America wanted the colonies to join together and make one country. Because the colonists could agree to a compromise, they became a country of united states. As people learn to solve more of their problems through accommodating, people may not use dominating as much to solve their problems.

21 What does accommodate mean?

22 What does compromise mean?

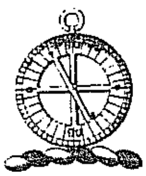
23 How does accommodating solve problems? Give an example.

Discussion How would life be better if people tried to accommodate more and dominate less?

One way to remember the five solution types is to use the first letter of each solution type to spell the word **ADMIT.** Notice that using the first letter of **A**ccommodate, **D**ominate, **M**ove, **I**nvent, and **T**olerate spells the word **A-D-M-I-T.** If you remember the five letters in the word **ADMIT**, you can use the letters to help you recall the five types of solutions.

24 What do the letters in the word **ADMIT** stand for?

A ccommodate
D ominate
M ove
I nvent
T olerate



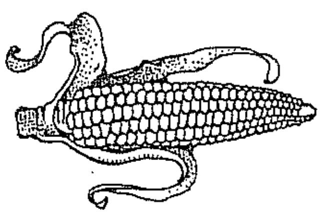
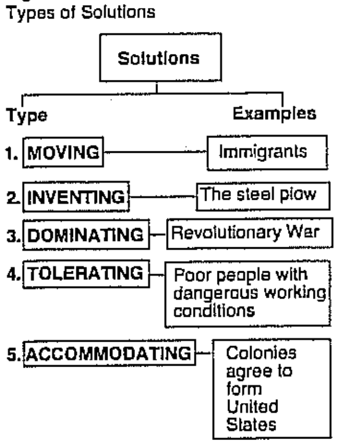


Figure 1.3 Summary of Five General Types of Solutions



"What is man without the beasts? If all the beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beasts also happens to man. All things are connected. Whatever befalls the earth befalls the children of the earth."

Chief Seattle
(1786-1866)

25 Below is a list of examples of different types of solutions. For each one, tell what type of solution is being described.
   a. Johnny was insulted, but he didn't do anything.
   b. Jennifer crowds in front of Ralph, and Ralph pushes Jennifer out of line.
   c. Sally and Jessie want to use the same book, so they agree to share it.
   d. Jeff wants to be able to ride his bike in the dark, so he creates a paint that makes his tires glow in the dark.
   e. Jack does not earn much money in his current job, so he decides to leave and look for work in another town.

26 Name five general ways people have solved problems.

As you learn more about history, you will see that as situations change, some solutions are used more often and some are used less often. Some solutions are more likely to occur at one point in history than at another. For example, early in the history of the United States, **moving** was a very important solution. Settlers moved to new desirable places where no other settlers lived and started farms and businesses. They would buy or take the land from the Native Americans. For settlers, this solution was effective because America had a lot of open territory. For Native Americans, this solution caused many people's rights problems. Today, people in the United States move less often to acquire land because almost all the desirable land has already been settled.

As moving became less important as a way to solve problems, **inventing** became more important. People developed methods of science that allowed them to gain new knowledge. This increase in knowledge has led to more and more inventions. For example, new ways have been invented to grow more **food** on the land that is settled.

27 Why is moving being used less often?

28 Why is inventing being used more often?

Figure 1.3 shows the five general types of solutions and gives an example for each solution type.

Discussion Read about the Lee family:

The Lee family lives in a small, quiet town. One day the next door neighbors move out and some new neighbors move in. The new neighbors are very noisy. They argue and scream all day long. At night they have wild parties that last until 3:00 or 4:00 in the morning. All the noise makes it hard to sleep. Because of lost sleep, the parents have been late to work several times. Their boss has threatened to fire them if they are late one more time.

Describe how the Lee family could use each of these solutions:
Accommodating.
Dominating.
Moving.
Inventing.
Tolerating.

Effects

When people solve a problem, there are effects. There are three types of effects:

1. The problem ends.
2. The problem continues.
3. The solution causes a new problem.

Figure 1.4 shows the two types of problems, five types of solutions, three types of effects, and the way problems, solutions and effects can be linked.

Figure 1.5 shows an example of a problem-solution-effect sequence. In this example, the problem is an economic one. One winter, deer did not have enough food to eat. Some people attempted to solve this problem by setting out hay for the deer. In other words, they accommodated to the needs of the deer. The effect of this solution was that the deer did not die, but lived to have many babies. The effect resulted in a new problem, because next year there were even more deer requiring more food.

You can understand more about history by looking for this problem-solution-effect sequence: (1) identify important problems, (2) identify how people attempted to solve the problems, and (3) identify the effects of the solutions. The problem-solution-effect sequence can help you understand not only what has happened in the past, but also what is happening today. Most problems today are still economic or people's rights problems. The types of solutions used today are usually accommodating, dominating, moving, inventing, and tolerating. When you read a newspaper or news magazine, you will find many examples of economic and people's rights problems. You can think about how the five types of solutions might be used. You can also predict what the effects might be and what new problems might result.

Figure 1.4 Problem-Solution-Effect Structure

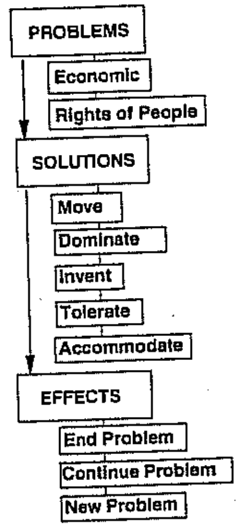
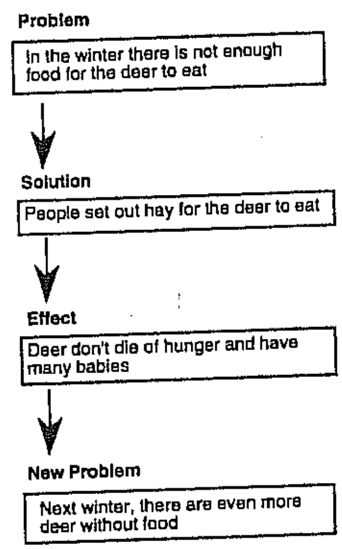


Figure 1.5 Problem-Solution-Effect Example



Discussion What economic and people's rights problems are happening now in the world? What economic and people's rights problems are happening now at your school? What might be a solution and the effect for each of these problems?

Test questions will focus on important events and relationships in U.S. History. Two sample answers appear after each question—a basic answer and an exemplary answer.

Test List the two general types of problems, five types of solutions, and three types of effects.

Basic Answer: People had economic and people's rights problems. They solved these problems by accommodating, dominating, moving, inventing, and tolerating. A solution may solve the problem, not solve the problem, or create a new problem.

Exemplary Answer: People had economic problems in getting enough money and people's rights problems in getting certain freedoms. They solved these problems by accommodating (for example, negotiating and compromising), dominating (for example, fighting), moving (for example, immigrants coming from another country), inventing (for example, coming up with a new way of doing something), and tolerating (for example, putting up with a problem). A solution may solve the problem, not solve the problem, or create a new problem.

Major Influences on Cultures

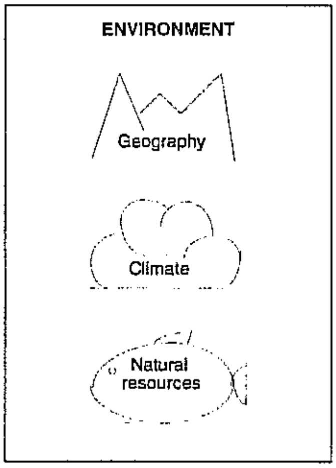
All people need food, clothing, and shelter. Everyone has to solve the problems of how to get enough food, clothing, and shelter. How a group of people go about solving the need for food, clothing, and shelter tells you a lot about their **culture.** At a simple level, **culture** is the way of life of a group of people.

29 What is culture?

Discussion A more complete definition of culture includes all the behavior patterns, arts, and products of people's work and thought. Name things that are part of your culture.

How a group of people solve the problems of food, clothing, and shelter depends on where they live. Where they live is their **environment,** their surroundings. The environment includes the climate, the natural resources available in the area, and the geography. **Natural resources** are valuable things that occur in nature such as water, soil, wild plants, animals, and minerals. The natural resources that were important to Native Americans were trees, fish, wild animals, and edible wild plants. Native Americans solved the problems of food, clothing, and shelter by making very good use of all the natural resources their surroundings had to offer. **Climate** is the typical weather in an area. Climate is the temperature, wind, and precipitation (rain and snow) that can be expected for each season in a certain place. The **geography** of an area is its land features such as mountains, valleys, and rivers. Geography includes the availability of flat land, the quality of the soil, and the abundance of water.

Remember, three aspects of the environment that influence the culture of the people who live there are: (1) the climate, (2) the natural resources, and (3) the geography of a place.



30 Define environment.

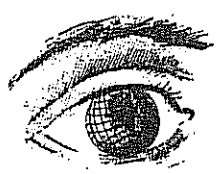
31 Define natural resources.

32 Define climate.

33 Define geography.

34 What three aspects of the environment influence the culture of a people?

Beliefs about the purpose of human life also influence culture and the way that people have tried to solve their problems. Basic beliefs about the origins and purpose of life are sometimes called **world views**. This book will discuss the different world views of groups that played a part in U.S. history: Native Americans, Europeans who moved to America, Africans who were originally brought to the Americas as slaves, and Asians who moved to America. Each of these groups had complex beliefs about the origins and purpose of human existence. For example, an important part of the general world view of most Native American tribes was that the land was open to all the people in their tribe to use for hunting and gathering food.

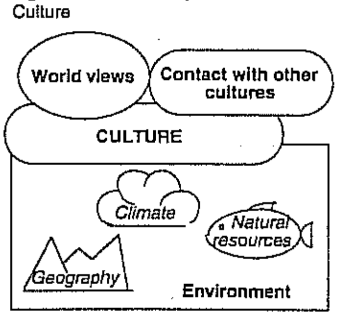


World Views

35 What are world views?

A culture's contact with other cultures has had very powerful effects. Contacts with other cultures often involve dominating, accommodating, and tolerating. Earlier in this chapter, you read about ways one group tried to solve problems involving another group. When Africans made slaves of other Africans and sold them to Europeans, the culture of Western Africans changed. When Native Americans began losing their land to European settlers, the culture of the Native Americans began to change. Contacts with other cultures is a powerful influence.

Figure 1.6 Three Major Influences on a Culture

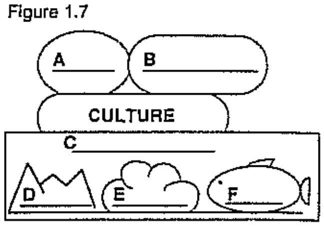


36 What might change the culture of a group?

Discussion Describe how a culture is changing today because of contacts with other cultures.

Figure 1.6 summarizes the three influences on culture: the environment, the world view of the group, and contact with other groups of people. Understanding these three major influences on a culture is important to understanding history.

Figure 1.7



37 What are three major influences on a culture?

38 Using Figure 1.7, label (A) through (F):
A, B, and C—the three major influences on a culture, and
D, E, and F—the three aspects of the environment.

Multiculturism

Different world views, contacts with other groups, and different environments create different cultures. Understanding how different influences contribute to differences in culture can help you appreciate the many cultures that influenced U.S. history. The United States is currently a multicultural nation. That means the nation includes people from different cultures.

Multiculturism in the United States resulted from people of different cultures coming to North America. The Native American cultures have been in the Americas for over 10,000 years. European cultures came to the Americas about 500 years ago when the Italian explorer Christopher Columbus, working for the queen and king of Spain, arrived in 1492. The first permanent British settlement in North America was in 1607. African culture came to the British colonies with the first slaves in 1619. The United States declared its independence in 1776, creating a new country to go along with its new culture. A new form of government for the country, the U.S. Constitution, was agreed to by most of the states by 1788. Men of Mexican descent were given citizenship in 1848. By 1850, Chinese immigrants from Asia had come to the west coast of North America to pan for gold. The end of the Civil War in 1865 kept the country united and began a slow and painful journey to extend people's rights to all citizens.

39 Why is the United States called a multicultural country?

40 At what time did the following events occur?
   a. The Civil War ended.
   b. Chinese immigrants from Asia came to the west coast of North America to pan for gold.
   c. The first permanent British settlement was established in North America.
   d. How long ago did Native Americans come to North America?
   e. The United States Constitution was agreed to by most of the states.
   f. Christopher Columbus traveled from Europe to North America.
   g. Africans were brought to North America.
   h. The Declaration of Independence was signed.
   i. Men of Mexican descent were given U.S. citizenship.

Multiple Perspectives

Multiple perspectives are different ways of looking at the same event. Multiple perspectives means being able to understand how the same event affects groups of people in different ways, and how each of the groups understands the event. With multiple perspectives, people from one culture can better understand the viewpoint of another culture. One of the reasons women, other races, and the poor now have more people's rights is the development of multiple perspectives. With multiple perspectives, more Americans are understanding the importance of everyone having equal rights.

Multiple perspectives are also important in understanding problems, solutions, and effects in history. Often solutions that solve one group's problem cause problems for another group.

Current Example of Multiple Perspectives

When a new airport is built, it might help solve economic problems for the people who work at the airport. But the same event may cause an economic problem for people who live close to the new airport and want to sell their houses, because the noise of the planes landing and taking off might make people less willing to buy houses near the airport. Homeowners may have to sell their houses for less money than they are worth. These multiple perspectives are shown in Figure 1.8. The same event is a solution for one group of people and a problem for another group of people. Understanding multiple perspectives will help you understand why different groups react to the same event in different ways.

Multi-

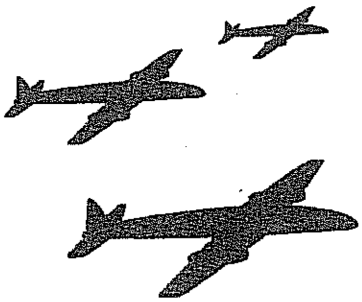
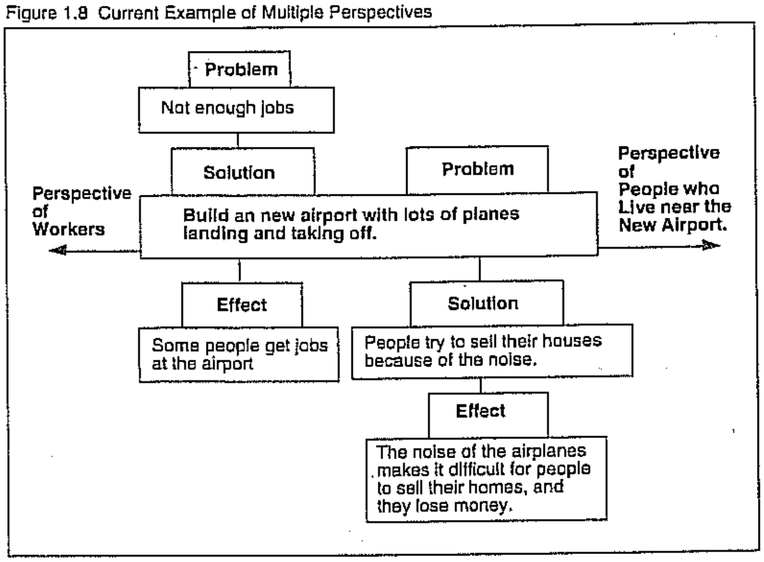
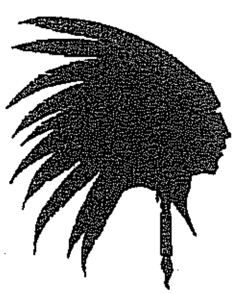


Figure 1.8 Current Example of Multiple Perspectives



Multiple Perspectives

People's Rights



Historical Example of Multiple Perspectives

In the following historical example of multiple perspectives, the event is the signing of **treaties** between the U.S. government and Native Americans. **Treaties** are agreements between groups of people.

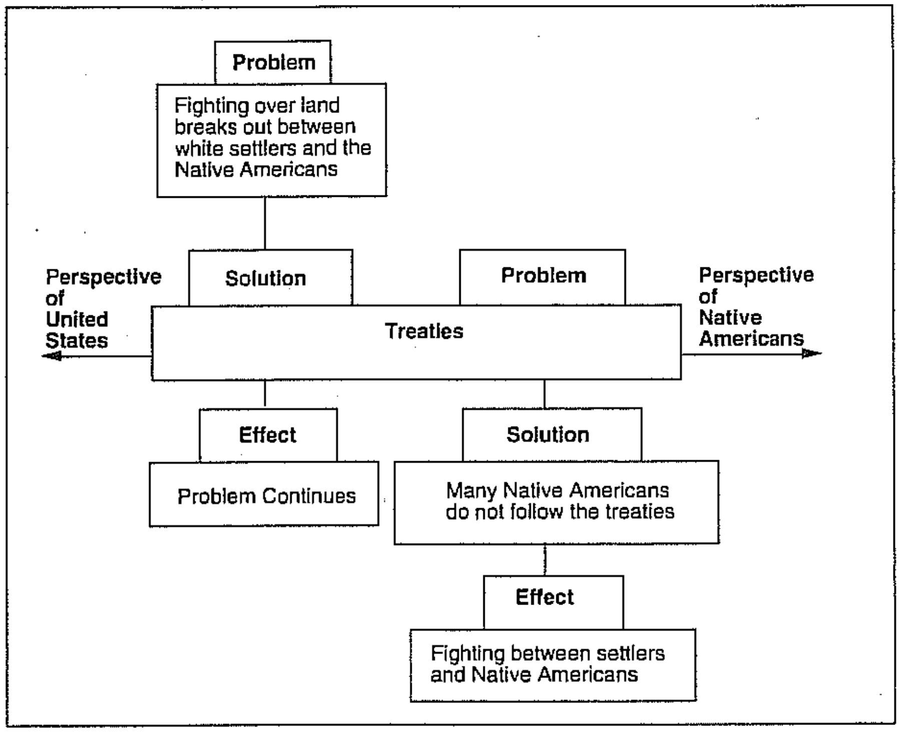
In the 1700s, United States settlers began to move westward in large numbers. Most of these settlers were trying to solve economic problems by starting their own farms. Some were moving to solve a people's rights problem of not having religious freedom. When settlers moved west, they moved onto land where Native Americans lived. Fighting often broke out between Native Americans and settlers. The United States government tried to solve this problem by writing treaties. The United States government viewed these accomodations as a solution. The Native Americans viewed these same treaties as a problem, because often the Native Americans who signed the treaties did not represent the entire tribe, and sometimes the United States used force or trickery to get Native Americans to sign the treaties. In addition, the world view of many Native Americans was that the land could not be owned by a single person. Native Americans and the U.S. government had multiple perspectives on the treaties. Many Native Americans refused to follow the treaties, often because they felt that the chiefs who had signed the treaties did not represent them. The effect was that many Native American tribes fought the U.S. government and white settlers.

These multiple perspectives are shown in Figure 1.9. The same event is a solution for one group of people and a problem for another group of people. For the United States, treaties were a **solution**. For Native Americans, treaties were a **problem**. Multiple perspectives will help you understand why different cultures and groups may react in different ways to the same event.

41 The U.S. government thought that writing treaties with the Native Americans was a solution. Tell about the treaties from the perspective of the Native Americans.

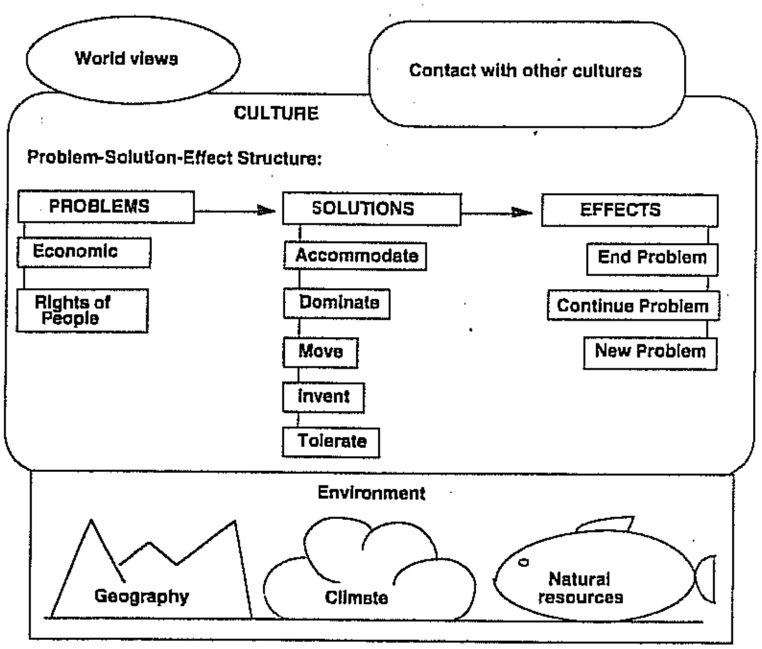
Discussion Identify the multiple perspectives of a current problem. Identify the two groups and the event that the two groups view differently.

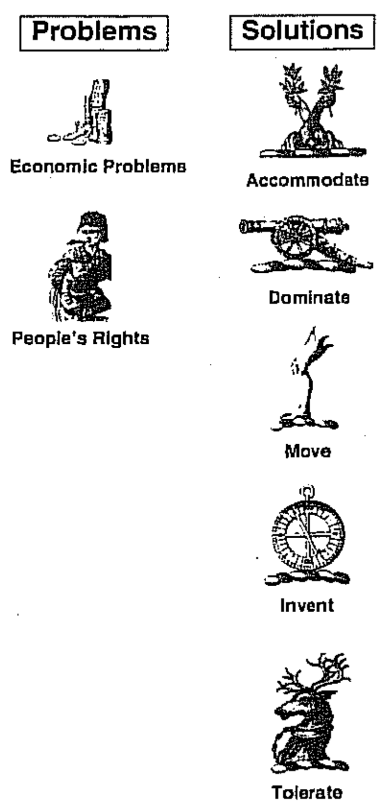
Figure 1.9 Historical Example of Multiple Perspectives



Graphic Organizer Summary

42 Use the graphic organizer summary to do an oral presentation on this chapter.





End-of-Section Questions: **Solutions and Effects**

Part A: **Core Test Question**

1. List the two general types of problems, five types of solutions, and three types of effects.

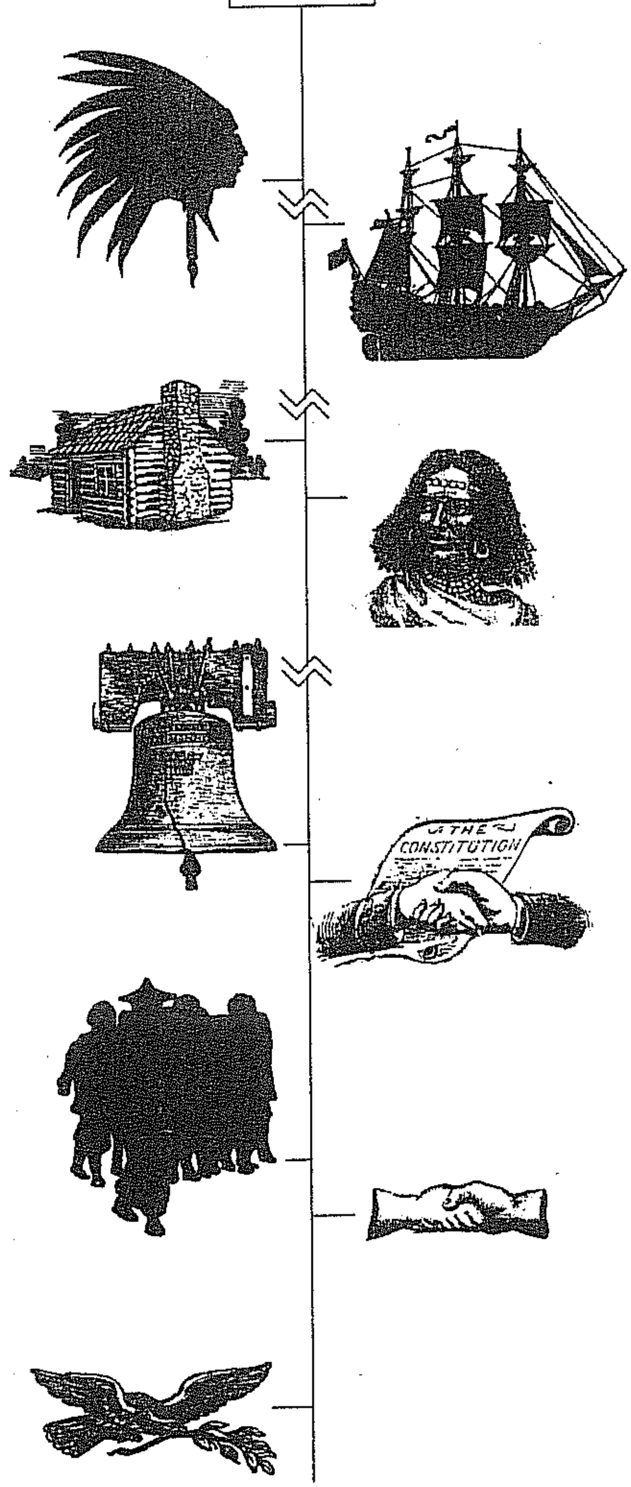
Part B: **Supplemental Questions**

2. **Vocabulary.** Write the vocabulary word or words for each lettered definition:
   a. creating new ways of doing old things, or new abilities to do things people could not do before.
   b. when people or groups of people put up with something that doesn't please them.
   c. different ways of looking at the same event.
   d. when people or a group of people change how they think or what they do to solve a problem.
   e. one group has control over another group.
   f. leaving a problem behind in an old place and finding a new place that hopefully does not have the old problem.
   g. the way of life of a group of people.
   h. vaulable things that occur in nature, such as water, soil, wild plants, animals and minerals.
   i. the climate, natural resources available, and geography for an area.
   j. typical weather of an area.
   k. the land features, such as mountains, valleys, and rivers, of an area.

3. What do the letters **ADMIT** stand for? Give an example of each.
4. For the U.S. government, writing treaties with the Native Americans was a solution. Describe the treaties from the perspective of the Native Americans.

5. At what time did the following events occur?
   a. The Civil War ended.
   b. Chinese immigrants from Asia came to the west coast of North America to pan for gold.
   c. The first permanent British settlement was established in North America.
   d. Native Americans came to North America.
   e. The United States Constitution was agreed to by most of the states.
   f. Christopher Columbus traveled from Europe to North America.
   g. Africans were brought to North America.
   h. The Declaration of Independence is signed.
   i. Men of Mexican descent were given U.S. citizenship.

Timeline



Chapter 1 Questions

Part A: **Core Test Question**

1. List the two general types of problems, the five types of solutions, and the three types of effects.

Part B: **Supplemental Questions**

2. **Vocabulary.** Write the vocabulary word or words for each lettered definition:
   a. the government cannot force you to worship in ways you don't believe.
   b. difficulty in getting things that people need or want.
   c. allows you to say or write what you believe is true.
   d. you cannot be arrested unlass you are charged with a specific crime; right to a lawyer and jury trial.
   e. when people are not given basic rights.
   f. a group of people who share common physical characteristics and origins.
   g. all people have the same rights.
   h. differant ways of looking at the same event.
   i. when people or groups of people change how they think or what they do to solve a problem.
   j. one group has control over another group.
   k. leaving a problem behind in an old place and finding a new place that hopefully does not have the old problem.
   l. creating new ways of doing old things, or new abilities to do things people could not do before.
   m. when people just "put up with" a problem.
3. What do the letters in the word **ADMIT** stand for?
4. What is one reason why inventing is being used more often and moving is being used less often?
5. Name three rights listed in the Constitution.
6. Three different groups of people have not always had equal rights. Name these three groups.
7. For the U.S. government, writing treaties with the Native Americans was a solution. describe the treaties from the perspective of the Native Americans.
8. **Review of Timeline Question.** At what time did the following events occur?
   a. The Civil War ended.
   b. Chinese immigrants from Asia came to the west coast of North America to pan for gold.
   c. The first permanent British settlement was established in North America.
   d. Native Americans came to North America?
   e. The United States Constitution was agreed to by most of the states.
   f. Christopher Columbus traveled from Europe to North America.
   g. Africans were brought to North America.
   h. The Declaration of Independence was signed.
   i. Men of Mexican descent were given U.S. citizenship.

Directions for Problems 9-16. Read each item. Identify the type of problem. Identify the type of solution. Predict the effect of the solution.

9. The Smith family cannot pay their rent and are going to be evicted from their apartment. Mr. Smith has been unemployed for a year because the automobile factory closed where he used to work. He has heard of a job in construction in another state. The family wants to go to that state to solve their problem.
10. The women at XYZ Company get paid less than the men even when they do the same work. Some women have been talking about asking their union to work out an agreement with XYZ Company to increase the women's pay.
11. Jack has been thrown in jail. No one has told him why he is there, he does not have a lawyer, and he has not had a trial by jury. He does nothing but sit in his cell and wait.
12. Speedy Seed Company promises to fill all its orders within 24 hours or do it for free. They had so many orders one day they were only able to fill 50% of them. The rest they had to give away for free. The next week, one of their employees developed a seed packaging device that is 50% faster than the one the company uses now. He has offered to sell it to the company.
13. Jeremy is being picked on by the school bully during recess because he is small. Finally, he becomes so angry that he throws a rock at the bully.
14. There has been no rain for months in the western part of a country. Nothing can grow. Many families are leaving their land and traveling to the eastern part of the country in hopes of finding food.
15. People who belong to a new religion are being killed by people who belong to an older religion. The people who belong to the older religion have more weapons and soldiers than the people who belong to the new religion. Slowly, the people who belong to the older religion are winning the war and destroying the people who belong to the new religion. The people of the new religion don't know what to do.

Part C: **Modern Problems**

- Look through a local or national newspaper and locate economic problems and people's rights problems.
- Make a list of the type of problems you find.
- Pick three of the problems you located in the newspaper and identify the types of solutions that have been tried or are being suggested to solve the problem.
- Decide what you think the effect of the solution will be and whether you think that the solution that was identified is the best solution for the problem.
- Think of alternative solutions and discuss how these solutions might bring about a different effect.

A Big Idea in Middle School Reasoning and Writing

Program	Levels for Middle School	Publisher
Reasoning and Writing	•D •E •F	SRA, 1-800-882-2502

One big idea taught in *Reasoning and Writing* is the "ruling out game." The ability to rule out alternative explanations or possibilities based on facts and evidence is central to many higher level activities. Below is an example of an instructional activity used in Level E of *Reasoning and Writing* to teach the ruling out game. Students are to figure out what is in the mystery box by using the clues to rule out the possibilities that are listed, until they see what remains as a possibility. The outline diagram structures the way they think about the problem. The stepwise boxes indicate stepwise sequential thinking. Students are to transfer the words provided in the outline diagram to the paragraph they write describing how they analyzed and solved the problem. They fill in the blanks with their own words, resulting in a complete, coherent paragraph.

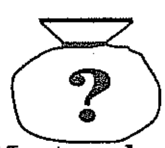
The thought process involved in the ruling out game applies to many other kinds of activities. Figure 2 illustrates the application of the ruling out game to making a decision based on criteria. The Hunter family wants to buy a new house. They will need to use the ruling out game to identify the houses that meet their criteria. In this problem, there are two houses that meet the criteria. In this case, students must compare these two houses to determine which one has more advantages, based on the criteria.

Follow the outline diagram to explain how you identified the mystery object.

Mrs. Johnson goes to the grocery store and purchases one food item. That item fits into a small bag.

Possibilities

an apple
a can of dog food
yogurt
a banana
a can of soup
a jar of olives
a dog bone
a jar of mustard



Mystery bag

Clues

A. The food is in a container.
B. The container is not a jar.
C. The food is served in a dish or bowl that is placed on the floor.

Outline diagram

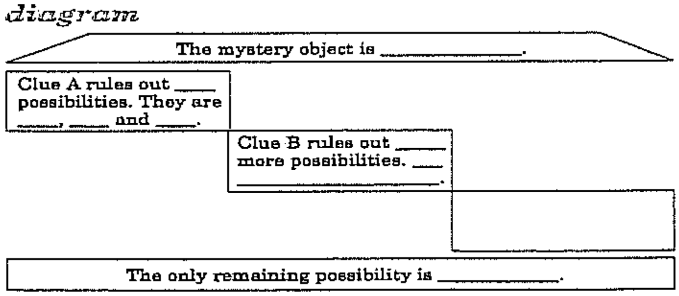


Figure 1.

Note: Illustrations were taken from level E of *Reasoning and Writing*, SRA.

Follow the outline diagram to write how you selected the best house for the Hunters.

Requirements for the Hunter family's new house

1. The house must be within 6 blocks of an elementary school.
2. The house must be within 1 mile of a shopping center.
3. The house must have 4 bedrooms and 2 baths.
4. The house must cost no more than $100,000.
5. The house must be in good repair.

Facts

Location	33 Elm	18 Maple	26 W. 5th	200 Laurel	56 E. Main
Distance from elementary school	4 blocks	5 blocks	7 blocks	4 blocks	5 blocks
Distance from shopping center	$\frac{7}{10}$ mile	$1\frac{1}{2}$ miles	4 blocks	3 blocks	3 blocks
Number of bedrooms	4	4	4	4	3
Number of baths	2	2	2	2	2
Cost	$99,000	$98,000	$97,000	$86,000	$103,000
Condition	good	needs repairs	good	superior	good

Outline diagram

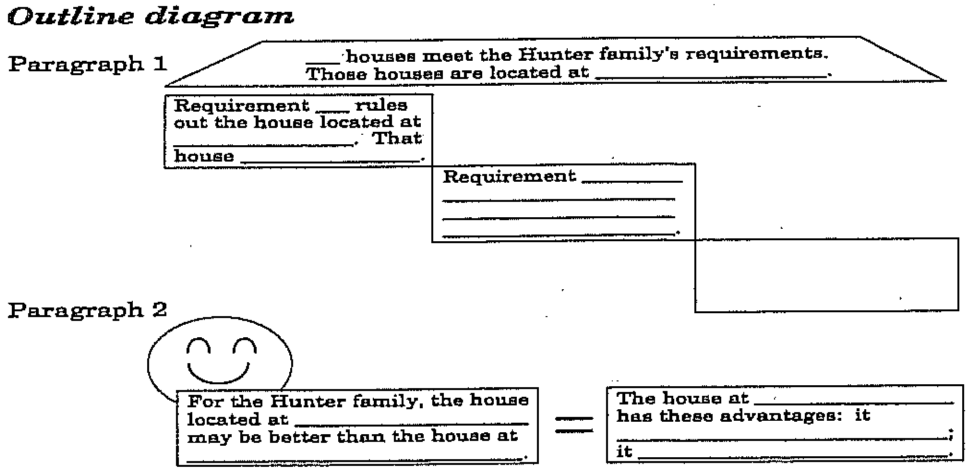


Figure 2.

Figure 3 illustrates a problem where students apply the ruling out game to help Donna select the best plan for learning how to ride a horse. Donna is in a difficult situation. Her goal is to learn to ride a horse, but she lives in a city, she has never ridden a horse before in her life, and she has no idea how a person learns how to ride a horse. In an earlier activity, students applied their research skills for finding answers to questions to come up with several different plans for Donna. Some are less practical than others. Here the students must use the ruling out game to select the most practical plan. There are no criteria in this problem. The students must use a little common sense about what is practical and what is not.

The ruling out game also represents the thought process involved in testing a hypothesis. Scientific experiments are designed to rule out explanations for observed events. In Figure 4, students identify a problem with Sam's thinking: Sam came to a premature conclusion; he identifies bag A as the bag with a different weight from the others. However, another possibility is that bag B is the bag with a different weight. Students must apply the ruling out game to tell Sam how to set up the experiment that would test this other possibility. They must also describe the conclusion that would come from either outcome of the test (i.e., they must interpret the data they get from the experiment).

Follow the outline diagram and write two paragraphs about the most practical plan for Donna.

Donna's goal is to learn to ride a horse.

Facts

- She lives in a city.
- She has never ridden a horse.
- She has to figure out some way to pay for learning how to ride.

Possible ways that Donna could learn to ride a horse:

Plan 1 (Buying a horse): Donna could buy a horse, saddle and gear.

Plan 2 (Moving): Donna could move 40 miles away to the country and live on a farm that has horses.

Plan 3 (Taking lessons): Donna could take riding lessons at a nearby community college.

Outline diagram

Only one plan is practical.

Paragraph 1

______________ is not practical because ______ ____________________. Also, ______________.

______________ is not practical because ______ ____________________. Also, ______________.

Paragraph 2

The most practical plan is for Donna to ____________________ ____________________.

=

The plan has these advantages: it ____ ______________ ; it ______________.

Figure 3.

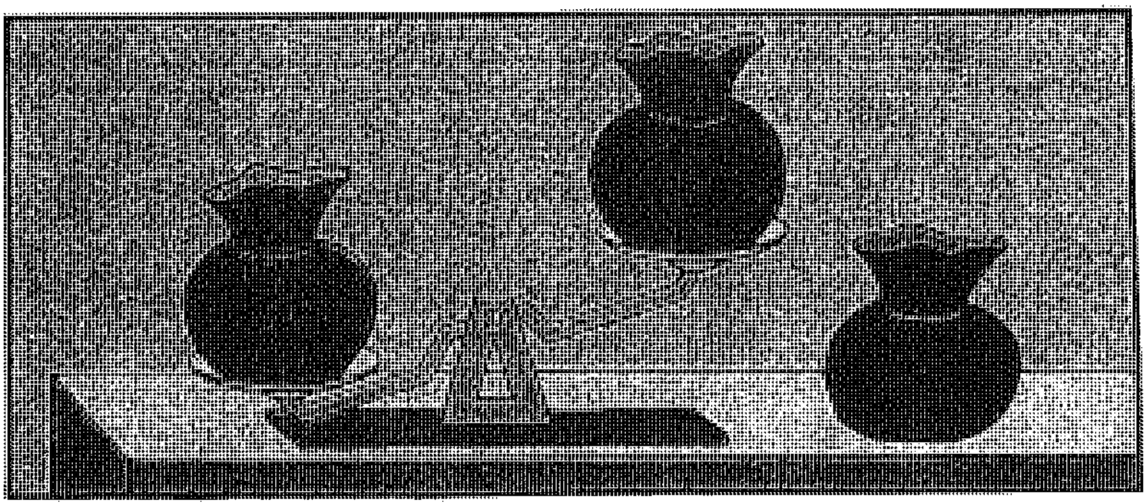
Follow the outline diagram to write about the possibility that Tom's test does not rule out.

Here's Tom's problem:

Tom has three large bags. One of them is not the same weight as the other two. Tom doesn't know which bag that is. He doesn't know whether that bag is lighter or heavier than the other two. So Tom puts bags A and B on a balance scale. The side with bag A goes down.

Tom's conclusion

Bag A is the bag that doesn't weigh the same amount as the other bags. Bag A is heavier than the others.



Outline diagram

Paragraph 1

Tom's test is inadequate. It does not rule out the possiblity that ______________.

To rule out that possibilty, Tom could ______________ ______________.

Paragraph 2

If the scale ______________, ________ is not the same weight as the other bags. ________ is ______________.

If the scale ______________, ________ is not the same weight as the other bags. ________ is ______________.

Figure 4.

Middle School Mathematics Curricula Designed Around Big Ideas

Program	Levels for Middle School	Publisher
Connecting Math Concepts (Complete curriculum with built-in maintenance of skills that have been taught)	•E, •Bridge to F, •F	SRA, 1-800-882-2502
Core Concepts Videodisc Programs (short, modular programs, which can be used independently, but provide little or no maintenance of skills taught in the other programs)	•Mastering Fractions, •Mastering Decimals and Percents, •Mastering Ratios and Word Problems, •Mastering Equations, Roots, and Exponents, •Mastering Informal Geometry	Phoenix Film BFA, Phone: 1-800-221-1274.

A major educational goal for all students is better problem-solving performance. Problem solving can be thought of as the application of knowledge to solve a novel problem. Two examples of design around big ideas are described below.

Using Ratios to Solve Problems

Because problem solving covers such a broad range of objectives and activities, it is helpful to work from a sample problem, such as the following:

> Your classroom is going to be in charge of ordering milk for the school. Students can choose either white milk or chocolate milk. Make an accurate estimate of how much white milk and chocolate milk to order each day for the entire school.

The kind of understanding and reasoning involved in the milk-ordering problem implies that students who solve it have acquired relevant knowledge and, depending on the task, can use the knowledge appropriately. More specifically, for a given concept, students need to not only understand what the concept means but also know how to apply it and when to apply it. These ways of using knowledge can be illustrated with proportions, a "big idea" central to solving the milk-ordering problem; students set up the proportion of white milk to chocolate milk for the class and for the entire school.

	Class	Entire school
White milk	______	______
Chocolate milk	______	______

One way to help students understand the *what* of a new concept is to relate it to a familiar concept. A familiar concept that can serve as a basis for understanding proportions is division. Problem A below is stated and worked as a division problem.

> A. A truck holds 8,400 pounds of coal. It delivers the same amount of coal at seven different places. How much coal does each place get?

The division problem indicates that the total weight of 7 equal-sized groups is 8,400 pounds. The solution gives the weight for one group: $8{,}400 \div 7 = 1{,}200$.

Problem B, which is mathematically equivalent to Problem A, is stated and worked as a proportion problem.

> B. The truck delivers 1/7th of its load of coal to a school. The truck carries 8,400 pounds

of coal. How much coal will be delivered to the school?

A proportion can explicitly express this relationship:

$$\frac{\text{School coal}}{\text{Total coal}} \quad \frac{1}{7} = \frac{\boxed{}}{8400}$$

One out of every 7 pounds of coal is delivered to the school. The denominators in the proportion problem express that the 7 groups weigh 8,400 pounds; the numerator of 1 indicates that the numerator of the equivalent fraction will give the weight for one group.

Problem B not only develops the *what* (i.e., the proposition described a relationship between school coal and total coal) for proportions, but also illustrates a set of steps for *how* (i.e., write the units, insert the numbers that are known, and solve) students can work a proportion problem. The students set up the units for the proportion (pounds of coal for the school and pounds of total coal) and the proportion itself, placing the numbers in the appropriate place in the proportion. The students then compute the answer—1200 pounds of coal.

Knowing the *what* and the *how* for a big idea such as proportions is not sufficient for solving problems such as the one for milk ordering, however. Students must also learn about the *when* if they are to successfully solve problems such as A and B in Figure 1. Problem A is a positive example of when to use a basic proportion because applying that strategy for problem A produces a correct answer. Students who do not adequately comprehend the *when* for using a basic proportion will list 8400 as the total number of cartons for problem B, just as they would do for problem A. The 8400 is written in the denominator of problem B across from total cartons, when in fact the 8400 is for cartons of apple juice. Thus the answer of 2400 cartons of grape juice is incorrect.

More complete knowledge about the *when* of proportions would alert students to the fact that there is not a place to list the 8400 cartons of apple juice, for the only units in the proportion are for grape juice cartons and total cartons. Students taught the *when* for using a proportion do not inappropriately use a basic proportion with problem B. Problem B is a negative example of when to use a basic proportion, because applying that strategy problem B produces an incorrect answer.

Although a basic proportion cannot be applied with the numbers given in problem B, the combination of a basic proportion and data analysis allows students to solve for the number of grape juice cartons. The application of this combination is illustrated in Figure 2. The combination of basic proportions and data analysis illustrated in Figure 2 incorporates the *what*, the *how*, and the *when* of basic proportions. This combination, along with an understanding of probability and estimation, allows students to solve the milk-ordering problem de-

Problem A: A truck delivers cartons of juice to a store. 2/7 of the juice is grape. The truck has 8400 cartons of juice. How many cartons of grape juice will the truck deliver?

	Fraction		Juice Cartons
Grape / Total	$\frac{2}{7}$	=	$\frac{\boxed{2400}}{8400}$

Problem B: A truck delivers cartons of grape and apple juice to a store. 2/7 of the juice is grape. The truck will deliver 8400 cartons of apple juice. How many cartons of grape juice will the truck deliver?

	Fraction		Juice Cartons
Grape / Total	$\frac{2}{7}$	=	$\frac{\boxed{2400}}{8400}$

Figure 1. Positive and negative examples of when to use a basic proportion.

Step 1:

The students set up the ratio table and fill in the numbers given in the problem.

	Ratio	Juice Cartons
Grape	2	
Apple		8400
Total	7	

Step 2:

The students use their knowledge of addition/subtraction number families to come up with the missing number in the ratio column:

$$7 - 2 = \boxed{5}$$

	Ratio	Juice Cartons
Grape	2	
Apple	$\boxed{5}$	8400
Total	7	

Step 3:

The students write and solve the proportion to determine the number of cartons of grape juice:

$$\frac{2}{5} = \frac{\boxed{3360}}{8400}$$

	Ratio	Juice Cartons
Grape	2	$\boxed{3360}$
Apple	$\boxed{5}$	8400
Total	7	

Figure 2. Proportion and data analysis applied in solving a complex problem.

scribed near the beginning of the article.

First, students might assume that the preference for types of milk in their class represents the probability of the whole school's preference. Based upon that assumption, the students can determine a proportion of chocolate to white milk for their class, find the total enrollment of the school, map all this information in a proportion table, and calculate a solution to the problem. These steps are illustrated in Figure 3.

There are many extensions of the milk-ordering problem that students also are able to solve. The actual attendance could be used instead of total enrollment, which would cut down on milk ordered (and wasted). The students could also determine how well their preferences for white and chocolate milk represent all the other classes. They could gather data from the other fifth-grade classes and compare it with their data. Finally, they could evaluate the accuracy of their estimate by comparing it with the number for the type of milk the students actually selected.

The milk-ordering problem and these extensions meet many goals of the standards of the National

Step 1:

The students conduct a survey in their class to determine the numbers for white and chocolate milk. The students also find out from the office the total enrollment for the school.

There are 32 students in the class; 22 prefer chocolate milk and the rest prefer white.

There are 479 students in the school.

Step 2:

The students organize their data in a ratio table.

	Fifth-grade Class	Entire school
Chocolate	22	
White	10	
Total	32	479

Step 3:

The students solve a proportion determine the estimated number of chocolate milk cartons for the entire school.

$$\frac{22}{32} = \frac{\boxed{329}}{479}$$

Chocolate	22	329
White	10	
Total	32	479

Step 4:

The students determine the last missing number using their knowledge of addition/subtraction number families:

$$479 - 329 = 150$$

Chocolate	22	329
White	10	150
Total	32	479

Figure 3. Proportions, data analysis, and probability applied in solving a complex problem.

Council of Teachers of Mathematics (1989). As students discuss their options for selecting a sample group (e.g., a single class, all the classes, one class from each grade level, etc.), they are working together to enhance their understanding of mathematics. As they weigh the relative merits of using total enrollment versus actual attendance, they are engaging in conjecture and invention. As they link their understandings of the various big ideas of proportions, data analysis, and probability, they are learning to connect mathematical ideas, to solve problems, and to apply mathematics broadly.

Teaching Volume

Another example of a big idea is volume. Students usually learn seven distinct formulas for volume. A big idea reduces the number of formulas students must learn to three slight variations of a single formula—area of the base times the height (B • h). Expressing volume as area of the base times a multiple of the height enhances understanding while simultaneously reducing the quantity of content to be taught.

Seven figures are displayed in Figure 4. For the three figures in which the sides go straight up—rectangular prism (box), wedge, cylinder—the volume is the area of the base times the height (B • h). For figures that come to a point (pyramid with a rectangular base, pyramid with a triangular base, and a cone), the volume is not the area of the base times the height, but rather the area of the base times 1/3 of the height (B • 1/3 • h). The sphere is a special case—the area of the base times 2/3 of the height (B • 2/3 • h)—where the base is the area of a circle that passes through the center of the sphere, and the height is the diameter. This analysis of big ideas fosters understanding of the key concept that volume is a function of base times height. As Gelman (1986) stated, "A focus on different algorithmic instantiations of a set of principles helps teach children that procedures that seem very different on the surface can share the same mathematical underpinning and, hence, root meanings" (p. 350).

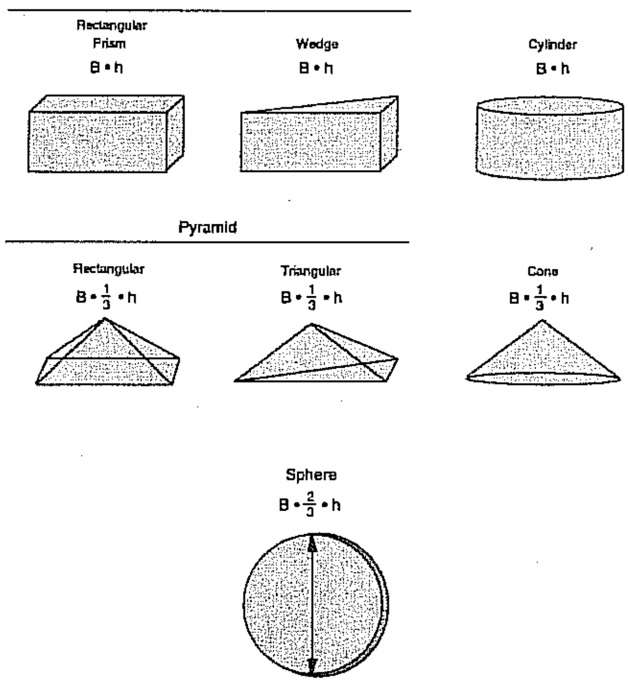


Figure 4. Volume as the "big idea" of area of the base times a multiple of the height.

References

Gelman, R. (1986). Toward an understanding-based theory of mathematics learning and instruction, or in praise of Lampert on teaching multiplication *Cognition and Instruction, 3,* 349-355.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

Middle School Science Curricula Designed around Big Ideas

Program	Components for success	Publisher
*Core Concepts **Earth Science*** Videodisk Program	•35-lesson videodisk program •workbook applications •problem-solving activities (small group) •labs	Phoenix Film BFA 1-800-221-1274
*Core Concepts **Understanding Chemistry*** Videodisk Program	•20-lesson videodisk program •workbook applications	

The *Earth Science* and *Understanding Chemistry Core Concepts* videodisc programs (Systems Impact, Inc., 1987) provide explicit, in-depth coverage of core underlying causal principles in science. A specific description of the earth science program follows. The chemistry program is designed according to the same principles.

The Earth Science videodisc program consists of 6, 5-lesson units, including six in-program tests, as well as quizzes, reviews and remedial exercises. In each lesson (approximately 45 minutes long), two or more concepts were taught using dynamic video selections and fairly short explanations followed by application items. Each of the concepts that are taught are tested, referenced to a criterion of performance, and retested before the next lesson.

Earth science is usually divided into three declarative topics: the solid earth (geology), the atmosphere (meteorology), and the ocean (oceanography). In the videodisk program, these topics are integrated around the big idea of convection, the underlying explanation of many of the dynamic phenomena occurring in these three declarative topic areas. Plate tectonics, earthquakes, volcanoes, and the formation of mountains are all influenced by convection in the mantle. The dynamics of the atmosphere that cause changing weather are influenced by global and local convection patterns. Similarly, the ocean currents, thermo-haline circulation, and coastal upwelling are influenced by global and local convection. The interaction of these phenomena in the earth and the atmosphere result in the rock cycle, weathering, and changes in land forms. The interaction of these phenomena in the ocean and in the atmosphere result in the water cycle, wind-driven ocean circulation, El Niño, and climate in general.

To gain an in-depth understanding of convection, students first master a full understanding of the interaction of density, pressure, force, and heating and cooling. For example, students learn that heat causes a substance to become less dense, that less dense substances move from a place of high pressure to a place of low pressure, and so on. Furthermore, students learn specific set of facts about the solar system, the ocean, the solid earth, and the atmosphere that are essential to understanding and applying these principles. For example, students learn that the sun is the primary source of heat, that the tilt of the earth as it rotates around the sun causes changes in the amount of heat received in different areas of the earth (i.e., changing seasons), that the core of the earth is hot, that the ocean is very, very deep, and so on.

Figure 1 illustrates the big idea of convection and the various phenomena it explains. These phenomena can be described in conceptual models that use words and diagrams to highlight the major concepts and the causal relationships among them. These models then represent basic problem-patterns in earth science. These models are presented only after key concepts in the model and the interaction of those concepts are taught.

The key concepts are first introduced using carefully designed and sequenced examples requiring students to learn important discriminations. For example, density is introduced using a dot in a cube to represent 1 gram of weight. Students see two cubes with differing numbers of dots and are asked which is more dense. Then figures of different sizes are shown (see Figure 2). Empty cubes are placed over segments of the objects to show students how to evaluate density. By looking at the number of dots in the cube, students can tell that substance B is more dense than substance A, although blob B is smaller. Later, real objects are illustrated with the rule that if a substance is more dense than the medium containing it, it will sink. If the substance is less dense, it will rise or float.

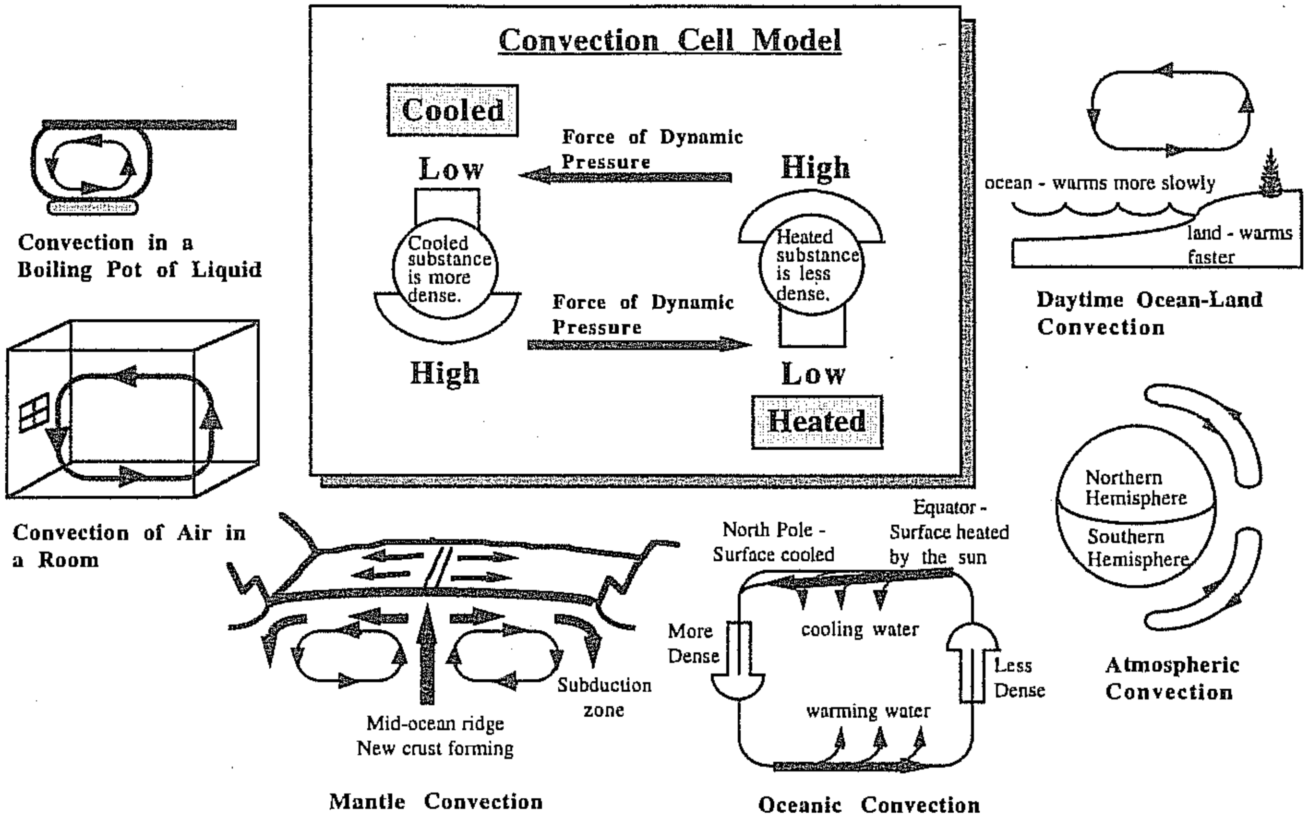


Figure 1. A conceptual model of the convection principle and its applications.

Figure 3 presents the conceptual model that summarizes the instruction that brought the rules about changing density, pressure, heating and cooling, together in the underlying principle of convection. A portion of a substance is heated in position A. As it expands, it becomes less dense and rises, leaving behind the area of low pressure. An area of high pressure is created above the heated substance at point B. The substance then moves from the high pressure area at B to the low pressure area at C. That low pressure is created as substance in front cools, contracts, and sinks. The sinking substance creates a high in front of it, as at point D. The substance then moves from the high pressure area at point D to the low pressure area at point A. The cycle repeats itself over and over, forming rotating cells, called convection cells, which appear at the top of point A.

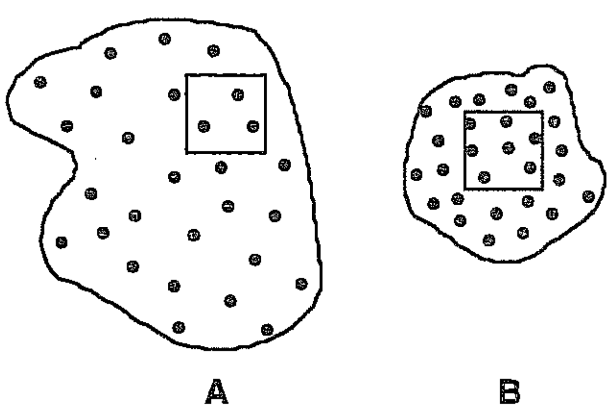


Figure 2. An example diagram to teach the concept of density in the considerate treatment.

After this, the convection schema is then used to make sense of other phenomena, such as ocean currents and air currents. Figure 4 shows the conceptual model of convection cells in the solid earth and how convection accounts for plate tectonics, which in turn can explain the formation of granite mountains, volcanoes, earthquakes, and so forth. The crust of the earth actually rides on top of convection cells. At point E in Figure 4, the crust comes together at the subduction zone, where the oceanic crust goes under the continental crust, causing earthquakes, volcanoes, and rift valleys. At point F in Figure 4, the ocean crust is pulled apart by two convection cells, causing deep ocean trenches and volcanoes.

Other conceptual models illustrate convection as an explanation for phenomena from the diverse areas of geology, oceanography, and meteorology. Each of these models establish a problem pattern. These models are not unrelated but form part of a unified, structured convection schema.

Students first mastered a relatively small set of Earth science concepts presented in a five-lesson segment and then received practice in using these concepts to solve problems. The problem-solving practice was designed to focus students' attention on representing the problem in terms of the underlying causal principles. This was done by frequently presenting underspecified problems, that is, problems that did not have enough information to allow the students to solve them. In response to these items students were expected to write questions to elicit the relevant information for solving the problem. By asking students to identify relevant information for solving the problem, students have to recognize the problem-pattern in terms of its underlying causal principle.

The students learn to identify the relevant data through a substantial number of varied practice

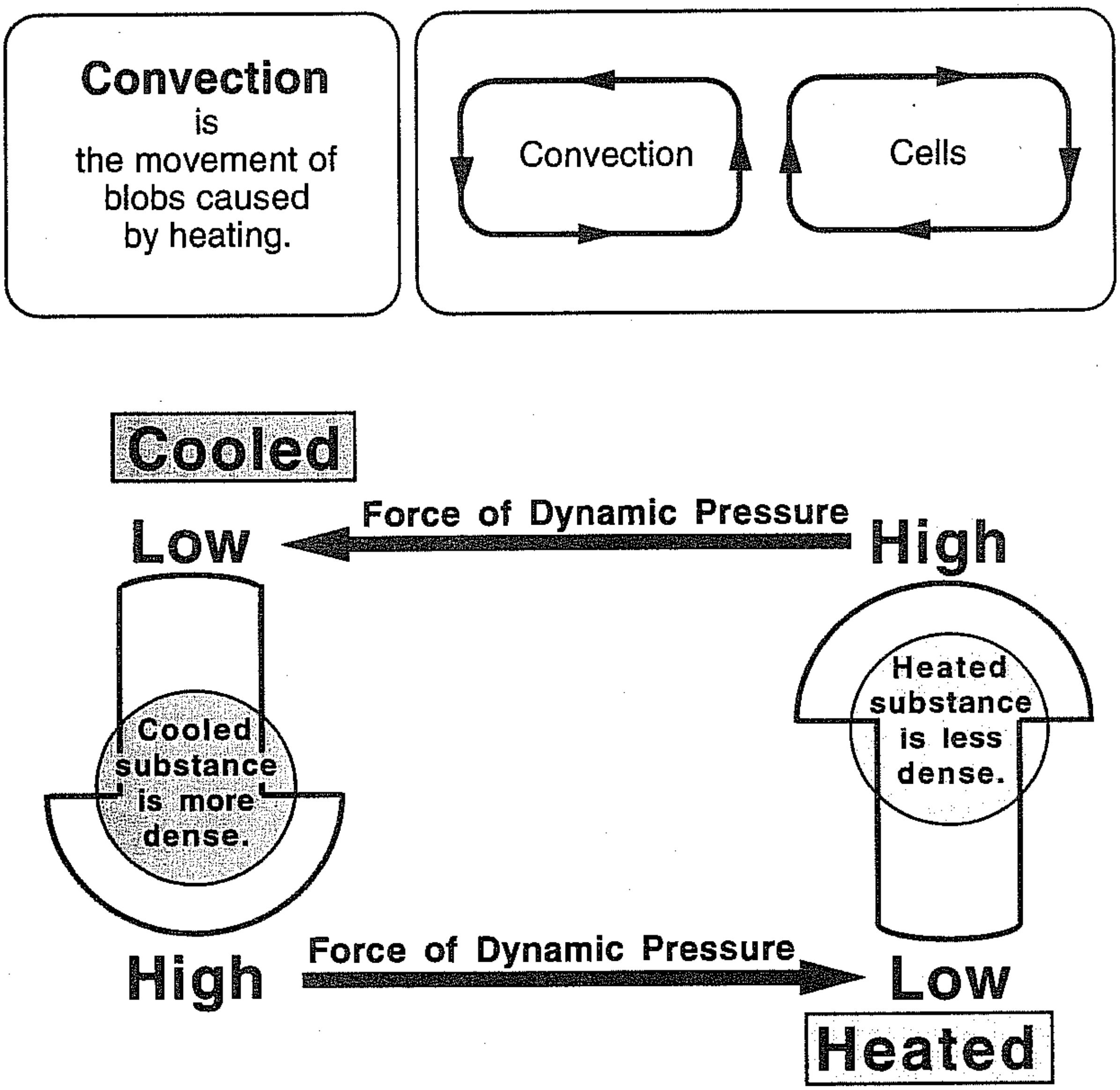


Figure 3. A conceptual model that summarizes the principle of convection.

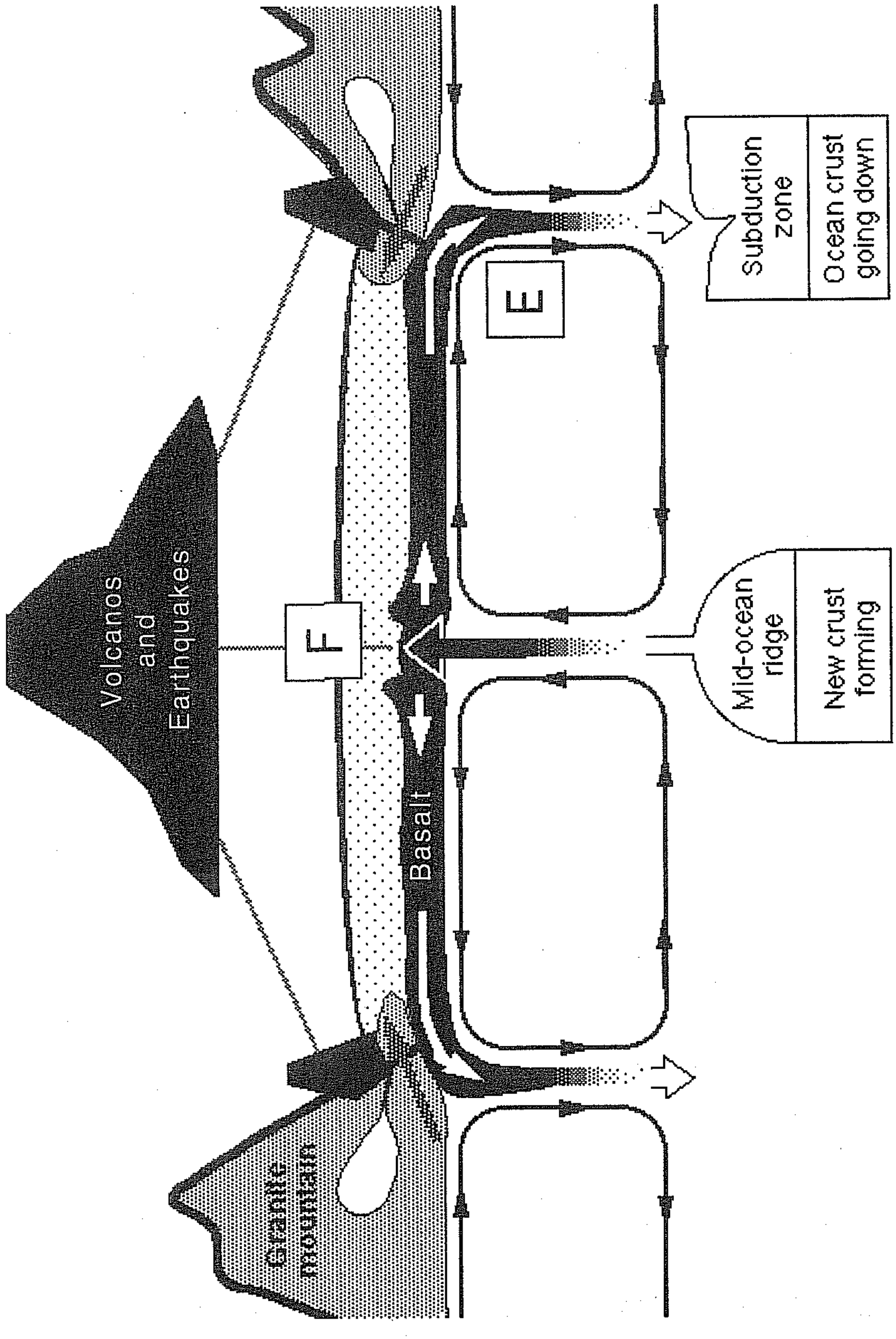


Figure 4. A conceptual model of convection cells in the solid earth.

items that are sequenced from fully prompted to unprompted for each of five Earth Science units. In fully prompted problems, the students are asked to select the relevant data that was missing in the problem statement then answer to the question.

The following is an example of a fully prompted problem:

> We decreased the temperature of a substance from 230 degrees to 120 degrees. We want to know if the substance changed phases.
>
> Choose the fact that will tell you if the substance changed phases.
>
> 1. The substance was in a pan.
> 2. The substance has a melting temperature of 100 degrees.
> 3. The substance has a boiling temperature of 210 degrees.
> 4. The substance was cooled with ice.
>
> Did the substance change phases?
>
> 1. No.
> 2. Yes, it changed from a solid to a liquid.
> 3. Yes, it changed from a solid to a gas.
> 4. Yes, it changed from a gas to a liquid.

(The students need to know that the boiling temperature of the substance is 210 degrees, since the temperature fell from 230 to 120 degrees. The substance changed from gas to a liquid).

Partially prompted problems differ from fully prompted questions in three ways: (a) they did not tell how many pieces of information were missing, (b) they were about real-world situations, and (c) the students had to give a short answer to the problem rather than select the answer from a list. The following is an example of a partially prompted problem:

> An air mass is trapped in your valley overnight. You want to predict the weather for tonight.Select the information you would need and then answer the question.
>
> a) The air mass is part of a warm front.
> b) The daytime temperature is 70 degrees.
> c) The sun will set at 6:40 p.m.
> d) The air mass has a relative humidity of 90 degrees.
> e) The overnight temperature will be 35 degrees.

First, the students must decide what information is relevant, and then use that information to answer the question. (In the problem above, the student is interested in the relative humidity of the air mass and the temperature change. The prediction would be foggy or rainy tonight.)

The unprompted problems are more complex. The students must carry out all of the steps and ask for additional information when necessary. After the information is provided by the teacher, the student must solve the problem. Following is an example of an unprompted, underspecified problem:

> You are sitting on the beach of a large lake. You catch a whiff of smoke, and you know there are not supposed to be any fires about. Do you suspect a fire on land or on the lake?

This problem cannot be answered unless the student knows that day winds move from lake to shore and night winds from shore to lake because of the temperature differential. The student has to ask whether it is night or day before the question can be answered. (While it is true that local wind patterns may cause a difference, the generalizable rule about winds moving from a warmer to a colder area would apply here.)

Corrective Reading

Corrective Reading programs (SRA) are designed for students from grade 3 through 12 who have difficulty with reading. The programs correct inefficient and ineffective reading habits as well as teach necessary skills that lead to accurate decoding. *Corrective Reading* is equally effective with regular education and special education students.

Organization

1. The *Corrective Reading* programs teach decoding rules through sound and letter patterns and word discriminations (i.e. rat, rate; rob, robber, robs, robe) not through long explanations and memorization.

2. The programs are designed to assist the student in recognizing information within the word that can be used for accurate word identification.

3. All programs provide for adequate practice. New elements are introduced and practiced for three days and are then integrated into the reading selection.

4. *Corrective Reading* programs are mastery programs that include correction procedures, progress monitoring, and motivational strategies.

Presentation

1. Scripted lessons provide a framework that allow students to focus on the task and not on the directions. Scripted lessons also decrease teacher wordiness and increase student responses. This places the emphasis upon student learning through student production, not teacher talk. Scripted lessons also allow for consistency that frees the teacher to respond directly and immediately to the student.

2. Unison responding maximizes instructional time. It allows the teacher to hear and correct inaccurate student responses. All students are responding thus all students are practicing all elements.

Corrective Reading Programs	
Decoding A Decoding B1 Decoding B2 Decoding C	Comprehension A Comprehension B Comprehension C

Morphographic Spelling

Morphographic Spelling (SRA) is a 140-lesson program that teaches students about 600 morphemes and three major rules for combining them into words. Using this knowledge students are able to spell over 12,000 words. These words include most words on the Dolch list and most commonly misspelled high school and college words. Students will also be able to apply the morphographic analysis to words not taught in the program, and will learn the principles for spelling nearly all English words.

What's the difference between a morphograph and a syllable?

Morphographs are the smallest units of meaning in written English. A morphographic analysis is simpler than a syllabic analysis for spelling. For example, here are some words with endings that sound like "shun."

Morphographic Analysis	Syllabic Analysis
in vent ion	in ven tion
con vent ion	con ven tion
pro fess ion	pro fes sion
muse ic ian	mu si cian
con fuse ion	con fu sion

In spelling "confusion," students must apply the rule they learned about when to drop e: "When you add a morphograph that starts with a vowel, you drop the e."

The advantage of the morphographic analysis is that the parts students learn generalize to spelling a lot of other words. With the morphographs listed in the left column, students can also spell infuse, infusion, confess, confession, profuse, profusion, invent, convent, profess, music, confuse. The parts learned in a syllabic analysis are not as useful in building new words. The morphographs also often allow transfer of some meaning to other words. For example, "muse" in music and amuse has the same root meaning. The meaning base of morphographs makes many difficult spelling discriminations easier. For example, "ian" and "ion" can be discriminated from one another, not by their sound, but by their meaning. "Ian" refers to a person, while "ion" does not.

How long and how frequent are lessons?

Lessons are designed to require about 20 minutes. Lessons should be presented every day, thus allowing the student to complete the entire program in one school year or less.

The placement is presented below. Students who make more than 3 mistakes on part A are too low for the program. Students who make less than 3 mistakes on part B are too high for the program.

Part A		Part B	
1. fun	6. stop	1. really	6. swimming
2. starch	7. care	2. strengthening	7. heroically
3. hat	8. spent	3. laziness	8. uncontrolled
4. red	9. chip	4. notable	9. photography
5. twin	10. that	5. congressional	10. professional

Five Intervention Studies Evaluating *Understanding U.S. History*

Douglas Carnine, University of Oregon
Jennifer Caros, University of Oregon
Donald Crawford, University of Wisconsin-Eau Claire
Keith Hollenbeck, University of Oregon
Mark Harniss, Northern Illinois University, DeKalb

Five studies were conducted to evaluate the efficacy of a textbook designed around the six curricular design principles. Two studies conducted in 1993-94 were oriented toward formative evaluation and field-testing of the experimental textbook (Crawford & Carnine, 1994; Crawford, 1994). Of these studies, one focused on history knowledge measured through writing (Crawford & Carnine, 1994), while the other focused on history knowledge measured through multiple choice and short answer tests (Crawford, 1994). Armbruster and Anderson (1984) acknowledge that "the best way to evaluate students' ability to learn from textbooks, of course, is to try the textbook out on a sample from the intended audience of readers" (p. 187). Therefore, these "real audience try-outs" investigated instructional design and measurement issues and guided changes in the textbook accordingly. This classroom-based data decision-making acted as a way of evaluating the efficacy of the experimental history textbook for all students within a classroom.

Feedback from these field-testing efforts was integrated into the textbook, which then was evaluated in three additional studies conducted the following year (Caros, 1996; Harniss, 1996; Hollenbeck, 1996). These studies investigated history knowledge measured through writing (Hollenbeck, 1996), multiple choice and short answer tests (Harniss, 1996), and curriculum-based vocabulary probes (Caros, 1996). One of these studies also included the observational component that measured students' engagement and accuracy (Harniss, 1996). Figure 1 details the research questions, participants, duration, and measures for each study. The writing studies are described first, followed by the studies investigating history knowledge in other ways.

Field-Test Study on Writing

Purpose

In addition to more traditional short answer and multiple choice tests, the experimental textbook included tasks that "satisfy traditional psychometric canons of reliability and validity, but that also reflect the complex orchestration of [historical] knowledge and skill" (Wineburg, 1994, p. 58) and have explicit positive consequences for teaching and learning (Messick, 1988, 1994). Our writing tasks were designed to not only allow teachers the opportunity to teach for integration across the curriculum, but provide consequential feedback on the students' learning.

Much of testing (including history) in the past emphasized decontextualized factual learning (the easily testable) over critical, deeper understanding (Wilson & Wineburg, 1993). An alternative to fact-based testing is performance assessments. Wilson and Wineburg define performance assessments as essentially asking "people to do or produce something" (p. 730). The performance assessments for each chapter within the history textbook took the form of a primary source essay question that has students write about historical events. After reading the primary source material, students "explain [in an essay] to a relative or colleague what was going on and why it was important" (Baker, 1994, p. 100). In these problem-based essays, students extract, interpret, organize, and integrate information from the textbook chapter and from new or novel information from the primary source document itself (Baker, 1994; Greene, 1994). The primary source essays let students use big ideas, conspicuous strategies, and primed background knowledge to complete a judicious review of chapter content.

Participants

Participants for the first field study were eighth-graders from a middle class community in the Pacific Northwest. For the purpose of this field study, four eighth-grade intact sections or classes were used. Two teachers taught two sections or periods of United States History each. The teacher who taught the two sections utilizing the *Understanding U.S. History* textbook acted as the experimental classroom, and the other teacher who taught the two other sections utilizing the traditional U.S. History textbook acted as the control. A total of 56 students were in the two experimental class periods, and a total of 48 students were in the two control class periods.

Curriculum

The control history section was fully integrated with language arts, was theme driven, and had many active hands-on projects. Two textbooks, *Our Nation Conceived and Dedicated: Volume One–Prehistory to 1840* (Peck, 1983) and *Proud Nation* (May, 1984) were used. The control teacher used many of the National Council for the Social Studies' (NCSS) recommended experiential teaching methods. Students in the comparison classes also learned from videos—which were always followed by one of several types of writing activities.

In contrast, the experimental textbook classes separated history instruction from language arts by period, creating a 50-50 split in time devoted to each subject. Almost all of the class time during the history period was spent in round-robin reading of the textbook passages, oral answering and discussion of interspersed questions from the textbook, and completion of written exercises from the textbook.

Measures

For a final performance assessment, students were given portions of the Declaration of Independence to read, along with a translation, and asked to explain what happened before it was written to cause the people of the 13 colonies to become so unhappy with Britain.

Scoring issues

Diverse learners do not write as well as their regular education peers (see, Poplin, Gray, Larsen, Banikowski, & Mehring, 1980; Thomas, Englert, & Gregg, 1987; Watkinson & Lee, 1992). Compared to the writing of their general education peers, special education students' writing, for example, is characterized by more mechanical errors, more spelling errors, poorer handwriting (Thomas et al., 1987; Tindal & Parker, 1991; Watkinson & Lee, 1992), and shorter length (Nodine, Barenbaum, Newcomer, 1985; Tindal & Parker, 1991). These mechanical problems bias subjective essay ratings (see, Charney, 1984; Cizek, 1991; Herman, 1992; Huot, 1990). Furthermore, Diederich's (1974) and Graham and Dwyer's (1987) research showed that just the label associated with behavior or academic difficulties can cause a lower subjective essay score. The fact that specific characteristics (e.g., from length of essay to student label), superficial to the actual writing, negatively bias subjective essay ratings, and the fact that special education students' writing contains more of those characteristics precludes valid conclusions or judgments regarding their content area knowledge based on their essay score without some specified scoring criteria that attempts to control for those factors.

To alleviate the aforementioned scoring issues during the initial pilot study, the procedures and methods of scoring from CRESST Performance Assessment Models manual (Baker, Aschbacher, Niemi, & Sato, 1992) were field-tested. The CRESST manual was modified slightly to simplify the scoring criteria (see Crawford & Carnine, 1994, for an indepth description of this modified scoring procedure).

To briefly summarize the scoring, each of the traits (prior knowledge, principles, argumentation, and misconceptions) are scored separately. The prior knowledge score counted the number of relevant facts included in the essay. The principle scale was a count of the number of historical generalizations (either a concept or a principle of history) used with comprehension. Argumentation counted the number of explicit elements of organization and coherence present in the essay, such as summary statements of essay's main idea/thesis or explicit structure used to provide coherence and orient the reader. Text detail measured the use and integration of material from the primary source passage in the essay. Misconceptions was a measure of the seriousness of incorrect information, or misinterpretations, in the essay.

Results

Results of this field-test performance assessment of the history knowledge (see Table 1) indicated that differences on the three primary trait scores most closely associated with history knowledge significantly favored the experimental textbook students. Those primary traits were prior knowledge, principles, and misconceptions. The misconceptions score was based on a negative score range where a score closer to zero was better.

The mean score for the prior knowledge for the experimental group was 3.18 (range of 0 to 7), and the mean score for the control group was 0.72 (range of 0 to 3). The mean score for principles for the experimental group was 1.13 (range of 0 to 3), and the mean score for the control group was 0.19 (range of 0 to 2). The mean score for overall quality for the experimental group was 1.13 (range of 0 to 3), and the mean score for the control group was 0.19 (range of 0 to 2). The mean score for principles for the experimental group was 0.36 (range of 0 to 2), and the mean score for the control group was 0.02 (range of 0 to 1). The mean score for misconceptions for the experimental group was -0.27 (range of 0 to -2), and the mean score for the control group was -0.60 (range of 0 to 2).

The groups did not differ on the two primary traits most associated with writing skill and less associated with history knowledge, argumentation, and text detail. All essays were scored by one rater, blind to condition. Interjudge agreement on the primary traits yielded reliability scores for prior knowledge, principles, argument, text detail, and misconceptions of .75, .80, .80, .60, and .80, respectively.

Essay Writing Study

Purpose

The variability in reliability associated with the modified CRESST scoring protocol was also noted for the original CRESST scoring procedures. Baker (1994) noted that the CRESST's "rubric reliability and validity depend very strongly on the individual rater's specific level of knowledge of each topic" (p. 103). To achieve our moderate reliability, many hours were undertaken in training raters. Realizing that (a) we could not control individual rater's level of knowledge, (b) we would be unable to train all general education teachers in our modified scoring procedure, and (c) superficial characteristics of student essay writing bias more traditional subjective essay ratings (see Huot, 1990, for a review), an alternative objective content-specific scoring rubric was developed.

Thus, to support the scoring guide's generalizability across instructional settings, it had to control for these scoring problems. Therefore, this essay study used a stipulated scoring guide, modeled after Meyer's research, as well as the Advanced Placement U.S. History examination used by the College Board Admissions Testing Program (Breland, Danos, Kahn, Kubota, & Bonner, 1994) and Elliott's (1980) "Scoring Criteria for Evaluating Students' Use of the Author's Structure in Their Written Recall Protocols" (p. 208). Using a specified checklist or scoring rubric, like Breland et al. (1994) and Elliott (1980), strengthened inter-rater and inter-rater reliability. It also negated the effects of individual rater's levels of historical knowledge and thus augmented the external validity of the scoring guide. Field-testing of the specified scoring rubric showed the new modified scoring guide to be practical for classroom use, because it was (a) efficient time wise; (b) content valid, because it focused on curriculum concepts and facts; and (c) reliable, because it stipulated what was being scored.

Meyer (1977a, 1977b) and Meyer, Brandt, & Bluth (1980) believe that textbook structure is an important common element in both the comprehension and production of expository text. It appears that an explicitly embedded textbook structure may directly improve recall for unfamiliar expository text as well as indirectly improve the quality of students' expository writing (Taylor & Beach, 1984). For example, if the experimental textbook's explicit text structure benefited all students, including mainstreamed special education students, then between-group (high, middle, and low) differences should be minimal and the low groups' scores should approximate those of the middle group.

Participants

Participants in this study were from three intact classes of eighth-grade students in a middle income middle school in a mid-size Pacific Northwest city. All three classes were taught by the same teacher. Students across classes were classified into three groups: (a) diverse (either receiving special education services as learning disabled or receiving counseling services as highly at-risk students; n = 26); (b) middle (not receiving any specialized services and achieving grades of C through B; n = 37); or (c) high (the best students academically within their grade, including those identified as talented and gifted; n = 26). The classification was done by the classroom teacher, the special education teacher, and the school counselor from the school.

Procedures

To control for teacher influence, the teacher used the same combination of two teaching procedures in all three periods. The first was a traditional process where all students followed along as one student read aloud from the textbook. Students were required to answer the interspersed textbook questions in their notebook as the class period proceeded. The second procedure, modeled after the Guided Reading Procedure (see Manzo, 1995, for a detailed explanation), focused on unaided recall through summarization and organizing information around the textbook's big ideas.

Measures

The primary source was from the chapter that focused on the development of the 13 Colonies. Figure 1 shows the primary source prompt. The key big idea of the chapter was that environmental factors associated with each of the three colonial regions influenced their economic development. The main concepts that described or augmented the key big idea were climate, geography, natural resources, agriculture, manufacturing, and trade. Students' end-of-chapter primary source essay would need to use those six concepts, to show samenesses and differences between the three colonial regions.

As stated earlier, the primary source essays were scored on whether the students organized them according to the chapter's text structure, its concepts, and its facts. Because the descriptive text structure of the chapter used in this study presents information about its topics in a list-like, nonsequential manner, essays were scored as correct if the recalled information at the concept and fact level was accurate and matched an a priori list. In other words, no score points were tied to information position. Credit was given at the concept and fact level for meaning that preserved gist or paraphrases as well as for exact meaning preservation or verbatim recall. Because the new scoring guide was sensitive to both the text structure level and its concepts and facts, it reflected both the content and the structural components of the essay and thus depicted the amount of information in the student essay as well as their overall organization.

Scoring reliability

Essay scoring reliability was obtained by having a trained graduate student randomly rescore 25% of the total student essays. The graduate student independently analyzed the written student essays in order to identify the top level structure used by the student, as well as the concepts and facts identified by the student. The reliability of the scores were analyzed using the number of exact hits [same matching rating] at each level, which were tallied and then divided by the total possible hits (Jentzsch & Tindal, 1991). Reliability coefficients for the text structure level was 1.0. Reliability coefficients for the concept level was .96 and for the fact level was .93. The obtained reliability coefficients were then compared to Jentzsch and Tindal's guidelines for interpretation. Reliability coefficient interpretation across the three ratings ranged from strong [.93 and .96] to perfect [1.00]. A preeminent factor that influences scale stability is having explicitly defined scoring criteria (Applebee, 1981; Cooper, 1977; Diederich, 1966 & 1974; Heller, 1991; Odell & Cooper, 1980). The specified essay scoring criteria at all three levels created a highly reliable essay assessment.

Results

Statistical analysis using an analysis of variance (ANOVA) showed nonsignificant differences between the three groups of students on their text structure scores. The mean text structure scores for the Diverse, Medium, and High groups were 1.89, 1.95, and 2.0, respectively. These results were nonsignificant at a .05 level; $F = 1.640$, $p < .20$.

> You and your friend live in Britain during colonial times. The two of you have just listened to a speech by Ben Franklin about the 13 Colonies. Benjamin Franklin said:
>
> *Many persons in Europe [have] ... expressed ... their desire of transporting and establishing themselves ... [in the 13 Colonies]; but who appear ... to have formed through ignorance, mistaken ideas and expectations of what is to be obtained there ...*
>
> *The truth is, ... most people cultivate their own lands, or follow some handicraft or merchandise [in the 13 Colonies].*
>
> *Strangers are welcome because there is room enough for them all, and ... [the first colonists] are not jealous of them.... In short, America is the land of [labor], and by no means what the English call Lubberland, ... where the streets are said to be paved with ... loaves [of bread], the houses tiled [roofed] with pancakes, and where the ... [birds] fly about ready roasted, crying, Come eat me!...*[2]
>
> Your friend was one of the British people who had mistaken ideas about how people in the 13 Colonies earn a living. After Franklin's speech was over, your friend wants to learn more about the 13 Colonies. Your friend wants to know about the aspects of each colonial region that affects how colonists can earn a living. Review and add detail to any important information from Franklin's speech and then tell your friend any further information that might answer his question.

Figure 1. Chapter 4 primary source prompt.

The concept level scores were significantly different at a .05 level ($F = 5.013$, $p < .0087$) between the three groups of students. The mean concept level scores for the Diverse, Medium, and High groups were 14.77, 16.41, and 17.27, respectively. The post-hoc Scheffe found that there was a significant difference ($p = .01$) between the Diverse mean concept level score and the High mean score. However, there was not a significant difference between the Diverse mean score and the Medium mean score ($p = .09$) or between the Medium mean score and the High mean score ($p = .51$).

Lastly, analysis showed significant differences ($F = 7.094$, $p < .0014$) between the three groups of students on their fact level scores. The mean fact level scores for the Diverse, Medium, and High groups were 13.62, 16.08, and 17.04, respectively. These differences were significant at a .05 level. The post-hoc Scheffe indicated a significant difference between the Diverse mean score and the Medium mean score ($p = .02$) and a significant difference between the Diverse mean score and the High mean score ($p = .002$). There was not a significant difference between the Medium mean score and the High mean score ($p = .54$).

Discussion

Students in the Low groups did not differ significantly from students in the High or the Medium group on their ability to use the chapter's descriptive text structure in their writing, and they did not significantly differ from Medium students in their ability to recall the chapter's concepts. Diverse students, however, did differ from the other two groups in their ability to recall and integrate the chapter's facts into their essay. This last finding mirrored those of the first field-test. Baker's (1994) research also found that students did not augment essay concepts with details (facts).

Overall, writing scores suggest that the descriptive textbook structure had indirect effects on students' writing competence. The students in all three groups demonstrated that they were aware of the chapters' descriptive top-level textbook structure pattern. Diverse students, while displaying a sensitivity to the textbook's top-level structure, tended to recall fewer concepts and facts than their Medium and High peers. Differences in awareness of those concepts and facts were reflected in the type and amount of information students were able to recall for use in their essays. These level difference results corroborate the findings of Kintsch and van Dijk (1978), Lorch and Lorch (1985), Lorch, Lorch, and Inman (1993), Meyer (1975), and Thorndyke and Yekovich (1980) that students' comprehension of expository text involves a top-down search of the hierarchical text representations, starting with the text structure and ending with text detail or facts. Students knew the chapter material because of the big ideas—they were able to use the chapter's textbook structure as a writing structure to get their ideas down on paper.

Field-Test Study on History Knowledge

Purpose

This study attempted to measure history knowledge in a more traditional way through the use of curriculum-specific short answer and multiple choice tests. A curriculum-specific test was created from both the control textbook and from the experimental textbook to assay students' substantive knowledge.

Participants

Participants in this study were eighth-grade students in four U.S. history classes from one middle school in a lower middle class suburb of a small city in the Northwest. At the start of the school year, the sample included 25, 27, 28, and 26 students in the two experimental and two comparison classes respectively. By the end of the year, the sample was down to 21, 17, 26, 17 students in the same classes. Two middle school teachers, each with more than ten years' experience, had primary responsibility for instruction throughout the intervention. Each teacher served as his/her own control by having one class use the experimental textbook and the other class use a commercial textbook (Garraty, 1982). Each teacher taught his/her own two classes (the comparison and the experimental class) in roughly the same manner: proceeding at the same speed, using the same videos and other supplementary activities at the same time in both classes, teaching U.S. history for the same amount of time. In short, most instructional variables other than the textbook were matched between conditions. Pretests, including standardized achievement tests, did not show any differences between the groups.

Measure

A curriculum-specific test was constructed from both the experimental and the control textbook. The first part of the curriculum-specific test came from 48 matching questions drawn from the experimental textbook end-of-section tests. A second curriculum-specific test was drawn from supplementary testing materials that went along with the control textbook's first end-of-unit test used by the comparison group.

Results

Both the experimental curriculum-specific test and the comparison curriculum-specific test yielded a significant difference favoring the experimental condition. The experimental group went from 11.6 at the pretest to 26.8 at the posttest, while the comparison group went from 9.9 to 20.0 at the posttest. The ANCOVA showed a significant difference by condition (F=9.41, p=.003) and by teacher (F=5.86, p=.02), but no significant interaction because experimental class scores were higher for both teachers. More impressively, on the test from the comparison curriculum, the experimental group also improved more, going from 8.6 at the pretest to 14.3 at the posttest, while the comparison group went from 9.3 at the pretest to 12.8 at the posttest. The ANCOVA yielded a significant difference by condition (F=4.36, p=.04), but no significant interaction or teacher effect. Notably, students learned more in the experimental condition even when measured by a curriculum-specific test taken from the textbook used in the control classroom.

Discussion

Results of the curriculum-specific tests suggest that students taught with the experimental textbook acquired more of the content than comparison students. Students using the experimental textbook outperformed the comparison group on the tests drawn from the comparison textbook tests, in addition to performing better on the tests from their own textbook. The magnitude of effect size on the comparison curriculum test was .49, and the magnitude of effect size on the experimental curriculum test was also .49.

History Knowledge and Classroom Engagement Study

Purpose

This study investigated students' performance in three ways. First, a curriculum-specific test was implemented to determine students' history knowledge. Second, oral reading fluency measures were collected and correlated with performance on the curriculum-specific test. Finally, we conducted a behavioral observation to investigate students' engagement and success.

Participants

Students of the study were four special education eighth-grade classrooms (n = 29) in two middle income, predominately Caucasian, middle schools in two small northwest cities. These classes were taught by four certified special education teachers. Students were classified as seriously emotionally disturbed, learning disabled, or low performing. Low performing students were selected for remedial services by the schools' administrators and teachers.

Procedures

Groups were randomly assigned to treatment within each school. One teacher at each school used the experimental textbook, and one teacher at each school used a traditional, district-adopted textbook (Garraty, 1991). A curriculum-specific test was administered at the end of the study as a posttest. Oral reading fluency measures were administered at the beginning and end of the study. In addition, students were observed using a researcher-developed observation code.

Measures

Curriculum-specific test

The criterion-referenced measure was constructed of short answer, matching, and multiple choice questions selected equally from the experimental textbook and the traditional textbook. One teacher from each treatment condition selected the questions that most accurately represented the information covered in their respective curricula. The final test was composed of 32 questions.

Oral reading fluency

Three passages were randomly selected from the experimental text, the traditional text, and a Macmillan 6th grade basal reader for a total of nine passages. These passages were administered using standardized directions. Students were timed for one minute and number of words read per minute and number of errors per minute were calculated. Students' median scores from each of the three texts were selected as the best estimate of their reading fluency.

Observations

The observation instrument investigated student engagement and accuracy during history instruction. Teacher and student interactions were coded at 10-second intervals for 10 minutes per student. Most students were observed at least three times during the intervention, although some were observed fewer times due to chronic absenteeism. Rater training is described by Harniss (1996). Inter-rater reliability data were collected in the classroom for approximately 15% of observations. Because of the relatively low sample size, we used a nonparametric Wilcoxon Matched Pairs Signed-Ranks Test to determine whether reliability estimates were significantly different from observer estimates. On none of the variables were significant differences between observer estimates and reliability estimates noted.

Results

Curriculum-specific tests

Univariate ANOVAs with classroom hierarchically nested in condition were conducted to evaluate the difference between groups on the criterion-referenced measure. Results of the *F* tests show significant differences between groups on criterion-referenced measure. Students in the experimental group performed significantly higher, F (3, 18) = 6.14, p=.005. The experimental group's mean score was 18.6, and the comparison group's mean score was 13.3.

Additional analyses were conducted to determine whether there were differences between a group's performance on questions selected from the experimental text versus those selected from the comparison text. First, ratios were calculated because the two parts of the test did not have an equivalent number of questions. Next, t-tests were conducted. Table 1 shows the results of the two t-tests.

These results show that students were not significantly different on the items selected from the comparison text, but were significantly different on the items selected from the experimental text in favor of the target group.

Oral reading fluency

Oral reading fluency measures were analyzed in two ways. First, the measures were analyzed to see if there were differences between groups before or after the study. Second, the measures were correlated with the curriculum-specific test to determine whether students reading fluency was related to performance on the measure of history knowledge.

Three repeated measures ANOVAs were conducted on each of the three passages. For the Macmillan passage, results showed no significant differences by condition F (1, 22) = .075, p=.787; significant differences by time F (1) = 21.85, p=.000; and no significant interaction F (1, 22) = .222, p=.642. For the traditional text passage, results showed no significant differences for condition F (1, 22) = .080, p=.779; significant differences by time F (1) = 24.39, p=.000, and no significant interaction, F (1, 22) = 1.14, p=.298. For the experimental text passage, results showed no significant differences by condition, F (1, 22) = .427, p=.52; significant results by time F (1) = 13.30, p=.001; and no significant interaction, F (1, 22) = .134, p=.718. These results suggest that there were no differences between conditions, but significant growth in oral reading fluency for both groups from the beginning of the study to the end.

The relationship between students' scores on measures of history knowledge and oral reading fluency was investigated by correlating students' average oral reading fluency at the end of the study to measures of history knowledge collected at the end of the study using a Spearman's Rank Correlation. These correlations were broken down by condition to determine whether there were different relationships depending on condition. Table 2 shows the corrected Rho and p-value from the Spearman's.

The results of this analysis show that the oral reading fluency scores of students in the comparison group were moderately correlated with the criterion-referenced measure. In contrast, oral reading fluency scores for the target group were non-correlated with the criterion-referenced measure.

Observation

Results of the observation suggested that students in the experimental group were significantly more actively engaged and significantly less off-task than the comparison group. In addition, they answered significantly more questions correctly and significantly fewer questions incorrectly. Table 2 shows the descriptive statistics for the observations.

Discussion

The findings in this study are consistent with other research showing a connection between process variables, such as engagement and accuracy, and product variables, such as student achievement on curriculum-specific tests. Interestingly, these differences are functionally related to implementation of a well-designed textbook. Students in the target group performed significantly higher on the criterion-referenced test. When the test was divided to determine differential performance on questions

Table 1. Descriptive Statistics and *t*-tests for Comparison and Experimental Sections of the Criterion-referenced Measure

	Target			Comparison			
	n	*M*	*SD*	*n*	*M*	*SD*	*p*
Comparison Questions	12	.38	.21	15	.41	.25	.754
Experimental Questions	12	.87	.22	15	.38	.26	.000

Table 2. Correlations Between Oral Reading Fluency and History Knowledge Scores by Condition

	Macmillan	Traditional	Experimental
Target	.144 (p = .633)	.257 (p = .395)	.074 (p = .806)
Comparison	.614 (p = .042)	.495 (p = .101)	.586 (p = .052)

derived from each curriculum, there were no significant differences between conditions on the questions selected from the comparison text, but there were significant differences in favor of the target group on questions selected from the experimental text.

In addition, our findings suggest that there were no differences between groups on oral reading fluency although both conditions did grow over time. This latter finding is encouraging since all of these students were low performing in general and many were poor readers. On average, students in both groups improved approximately 20 words per minute over the course of the study.

We also wanted to know whether there was a relationship between student oral reading fluency and their scores on measures of history knowledge. We suspected that students' reading skill might correlate with their performance on the history measure. Interestingly, this hypothesis was true for the comparison group which had moderate correlations between all oral reading passages and the criterion-referenced measure, but not for the target group which had low correlations between the oral reading passages and the criterion-referenced test. It appears that how fluently target students read was not related to their ability to perform on the criterion-referenced test. One explanation for this finding is that target students were able to acquire history knowledge despite their poor reading fluency, because the design of the text facilitated their retention and recall, and because they were familiar with answering the types of questions tested in the criterion-referenced test.

We asked whether students' engagement and accuracy during history instruction would be different depending on the type of text they used. First, we wanted to know whether students would be more on-task and less off-task depending on the type of text they used. Our findings show that there was a difference between students' engagement across conditions. Students in the target group were significantly more actively engaged than students in the comparison group. In addition, students in the comparison group were significantly more off-task than the students in the target group. In the context of this study, these findings suggest that teachers were able to keep students more actively engaged when using the experimental text than the comparison text. These results may again tie into the difficulty level of the material with which students were required to interact. Difficult tasks requiring students to utilize poorly organized information may result in student frustration, failure to persist in the learning activity, and resultant off-task behavior.

It appears that the type of curricular-design principles implemented into the experimental textbook significantly affected student performance. These findings are especially important in light of the population used in this study. Students with learning disabilities, behavioral disorders, and students who are at risk for failure were able to access and use history knowledge.

Vocabulary Study

Purpose

Student proficiency with the interpretation and use of vocabulary taught in history is a critical component of history achievement. Without adequate word knowledge, student ability to comprehend content and communicate acquisition of new concepts is severely restricted (Becker, 1986). Vocabulary knowledge accounts for an estimated 70% to 80% of comprehension (e.g., Carroll, Richman, & Davies, 1971; Howell, Fox, & Morehead, 1992). Fact systems and higher order reasoning build on more simple repertoires of skills and concepts (e.g., Becker, 1986), and students are expected to use vocabulary to deliver meaning that demonstrates knowledge or understanding of ideas (e.g., Norris, 1992).

If fluency is functionally defined as the rate of accurate responding above which behavior is maintained, generalized, and easily recruited into complex performances (Howell, Zucker, & Morehead, 1985; Johnson & Layng, 1992; Lindsley, 1992; White & Haring, 1980), then fluency-based standards of student performance are necessary for ongoing evaluation and improvement of instruction. Preliminary investigations of these standards used vocabulary proficiency probes that address two of the design principles that are most readily adjusted by teachers—primed background knowledge and judicious review.

Preliminary Validation Studies

Participants

The vocabulary probes were initially validated with 92 students in two general education (n = 60) and four special education (n = 32) eighth-grade classrooms in three middle income, predominately Caucasian middle schools in two small northwest cities. The two general education classes were taught by the same teacher in one school. The four special education classes were taught by four teachers in two schools in two school districts. Students in these classes were classified as seriously emotionally disturbed, learning disabled, or low performing (see study 1).

Procedures

The study length was 20 weeks. Both of the general education classes were instructed in the experimental text. Participants in the special education classes in each of the two schools were randomly assigned to either the experimental or the control comparison group. The two experimental groups were instructed in the experimental text, and the two comparison control groups were instructed in the district-adopted traditional text. The vocabulary probes were administered to students in all six classes once per week.

Measures

The annual domain was a total of 92 vocabulary terms and their meanings taught in the first six chapters of the experimental text. Vocabulary terms were randomly sampled from this domain to construct a set of alternate-form vocabulary probes. Two probe formats were used to sample student vocabulary knowledge. For both formats, the administration directions were prescribed, the administration time was five minutes, and objective scoring rules were used to assign values to student responses. The five-minute time limit was established, in a pilot study, as the optimal time for maximizing test-retest, and alternate-form reliability.

For the first format (Format A), each probe form consisted of a set of 60 meanings drawn from the annual vocabulary domain, with a randomly ordered list of their 60 corresponding terms. This format, illustrated in Figure 2, required selection responses. Students were directed to match the given meanings with their corresponding terms. The scoring metric was the number of terms correctly matched with their corresponding meanings. For the second format (Format B), each test form consisted of 20 meanings randomly sampled from the annual vocabulary domain. This format required production responses. Students were directed to write the terms corresponding to the given meanings. The scoring metric was the number of correct terms written.

Results

Data was collected over time for Format A only. The mean performance of general education students increased from 12 to 40 correct terms per five-minute probe. The mean performance of special education students in the experimental groups increased from 3 to 16 meanings per five-minute probe. The mean performance of the special education comparison students decreased from 4 to 1 meanings per five-minute probe. Figure 3 shows the changes in performance of special education students over time.

A cumulative Format A power test (i.e., all vocabulary terms in the annual domain combined into one test administered without a time limit), correlated strongly with a cumulative Format B power test, and with a cumulative critical relations power test administered during the final week of the study. In addition, the cumulative Format A power test correlated moderately with the primary source essays written at the end of each chapter (and scored using a modified version of the rubric developed by CRESST) and with teacher grades.

Discussion

The vocabulary probes satisfied diverse professional standards for validation research. Two sets of criteria were applied to evaluate the quality of the measures: (a) behavioral assessment (e.g., Barlow, Hayes, & Nelson, 1984), and (b) traditional psychometric (e.g., American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1985; Kane, 1992; Messick, 1988; Nunnally, 1978). Results of the preliminary validation study indicated that the probes displayed strong psychometric properties for eighth-grade students. Reliabilities were consistently high; substantial evidence was obtained for construct validity. These findings support the proposed model of applying weekly assessment principles to construct standardized fluency measures that test for vocabulary acquisition and maintenance, and may be used by teachers to monitor and improve the rate of student progress toward annual vocabulary achievement goals. The following section describes the application of the vocabulary probes with a different population of at-risk students.

Effects on Vocabulary Proficiency

This study was conducted to replicate and extend findings of the preliminary validation study to a different population of at-risk students.

Participants

Participants of this study were students in two eighth-grade classrooms (n = 65) in a low income,

Name: ______________________ **Date:** ______________________

allows you to say or write what you believe is true.		a. accommodate
a branch of the government made up of judges and courts, and has the power to interpret laws.		b. amendment
difficulty getting things that people need or want.		c. bill of rights
to make a law no longer be in effect.		d. climate
you cannot be arrested unless you are charged with a specific crime; right to a lawyer and trial by jury.		e. dominate
people sent to a meeting to speak and vote in place of the group who sent them.		f. economic problem
creating new ways of doing old things, or new abilities to do things people could not do before.		g. executive branch
a paper signed by a judge that allows the police to search someone's home or property.		h. freedom of speech
when people or a group of people change how they think or what they do to solve a problem.		i. inflation
a list of rights that the government agrees all people will have.		j. invent
an elected group of representatives who can make laws.		k. judicial branch
to formally agree to a plan, usually by voting on it.		l. judicial review
the right of the Supreme Court to judge whether laws passed by Congress follow the rules of the Constitution.		m. legislature
typical weather of an area.		n. multiple perspectives
formal written change to a document, such as the Constitution.		o. nullify
a branch of government with the power to carry out, or enforce, the laws.		p. override
the government cannot force you to worship in ways you don't believe. You may choose to go to church or not.		q. political tactics
one group has control over another group.		r. protection under the law
to pass a bill in spite of the President's veto.		s. race
a group of people who share common physical characteristics and origins.		t. ratify
ways of trying to solve a political problem, which is usually to get enough votes for your side.		u. religious freedom
over time, it takes more and more money to buy the same things.		v. representatives
different ways of looking at the same event.		w. search warrant

Figure 2. Vocabulary formats.

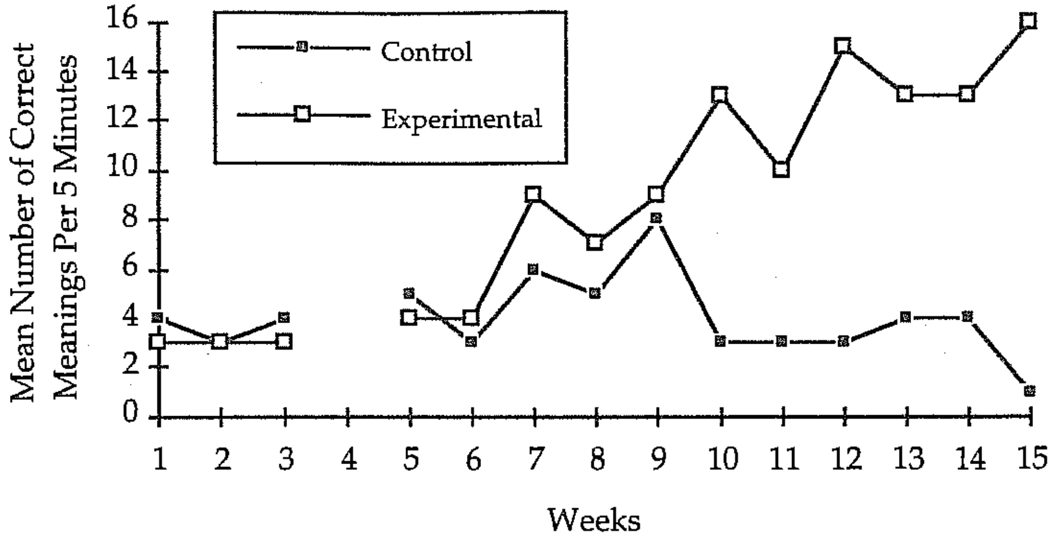


Figure 3. Changes in performance of special education students over time.

100 percent African American elementary school in a large midwestern city. Students were previously assigned to classrooms based on achievement level—students in one class were previously identified as the lower performing students (i.e., qualified for remedial services under the Elementary and Secondary Education Act). All students in both classes failed to meet the State Board of Education socials studies standards when they were tested in sixth grade two years prior to the study. These students were selected because they were participating in a classwide curricular intervention study that included the experimental history text and an earth science curriculum that was also designed according to the six principles of effective curriculum design.

Measures

The domain was the total 46 vocabulary terms taught in Chapter 1 (Introduction to Problems, Solutions, and Effects in U.S. History), Chapter 7 (Cooperation Leads to the United States Constitution), and Chapter 8 (The Bill of Rights) of the experimental text. Due to severe time constraints, only three chapters were taught; and each probe form, consequently, consisted of the whole set of terms. Format A was used to sample student vocabulary knowledge. Each probe consisted of a list of the 46 meanings that comprised the domain, and a randomly ordered list of their 46 corresponding terms. The scoring metric was the number of terms correctly matched with their corresponding meanings. See Figure 2 in previous section. A third format was also piloted. This third format (Format C) consisted of the same list of 46 meanings, and a randomly ordered list of their 46 corresponding terms. Students were directed to write the terms corresponding to the given meanings, and told that the terms must be spelled correctly. The scoring metric was the number of correctly spelled and matched terms.

Results

Data was collected over time for Format A only. The mean performance of both classes more than doubled over nine instructional days. The mean performance of the higher performing class increased from 15 to 36 correct meanings per five-minute probe, and the performance of the lower performing class increased from 7 to 17 meanings per five-minute probe. Figure 4 shows these increases in student performance over the nine days. The mean alternate-form reliability correlation was .81 and the range was .67 to .91. The mean performance of the higher and lower performing classes on the Format C was 32 and 20 correct meanings per five-minute probe, respectively.

Discussion

Used with textbook material designed around big ideas, the vocabulary probes are an efficient and motivating way of helping to ensure that review is sufficient, and distributed, cumulative. Beyond making substantial gains in vocabulary proficiency, the participants of this study performed exceptionally well on their state-mandated Constitution test. All students passed the test the first time, in contrast to previous years, when many students were required to rewrite the test several times. Finally, on a student survey administered at the end of the study, 97 percent of the students answered "Yes" to the question, "Do you think you learned a lot about U.S. History in this class?"

Conclusions

As early as 1946, Thursfield noted that "the good American history course emerges from a solution of the inter-related problems of content, organization, and method" (p. 15). Solving these problems is not easy, however, and history instruction is not immune to the fundamental debates that rage throughout the field of education. There are disagreements over whether to use textbooks or not, whether depth of study is more important than breadth of coverage, whether our goal is to help students achieve cultural literacy or develop the attitudes of historians, and about what types and forms of assessment should be used.

The interventions described in this chapter are teacher-directed, textbook-oriented, emphasizing depth of understanding measured by a variety of assessments, but not emphasizing either cultural literacy or the attitudes of historians. The history knowledge is portrayed as a series of "cases" that illustrate how groups attempted to solve problems; e.g., analyzing the four stages of cooperation according to the four factors of group success. These and other big ideas were applied in analyses of primary source documents and of accounts of current events. While the big ideas analysis benefits a full spectrum of learners, the design principles are particularly important for diverse learners. Combining big ideas and the design principles allow history instruction that is truly challenging and equitable.

The findings of the *History Knowledge and Classroom Engagement Study* suggested that students with learning disabilities, behavioral disorders, and students who are at risk for failure were able to understand and use the history knowledge that had been organized by the big ideas. The increased engagement and decreased task-avoidance of these students when using the experimental textbook lends support to the notion that better-organized knowledge is more accessible to the learner (Prawat, 1989).

The *Field-Test Study on Writing* found that essays by students using the experimental textbook included more history information than comparison students even though the essays were not significantly superior on other writing traits. Further, the essays from the experimental group contained significantly more principles and concepts, as well as more facts.

More potent evidence of the acquisition of organized knowledge was seen in the *Essay Writing Study*. In this study, the big ideas in the text structure were used by all levels of students in their essays, even though the weaker students could not remember as many of the facts. Students organized the chapter material using the big ideas—they were able to use the chapter's big ideas as a way to structure their own writing and presumably their thinking.

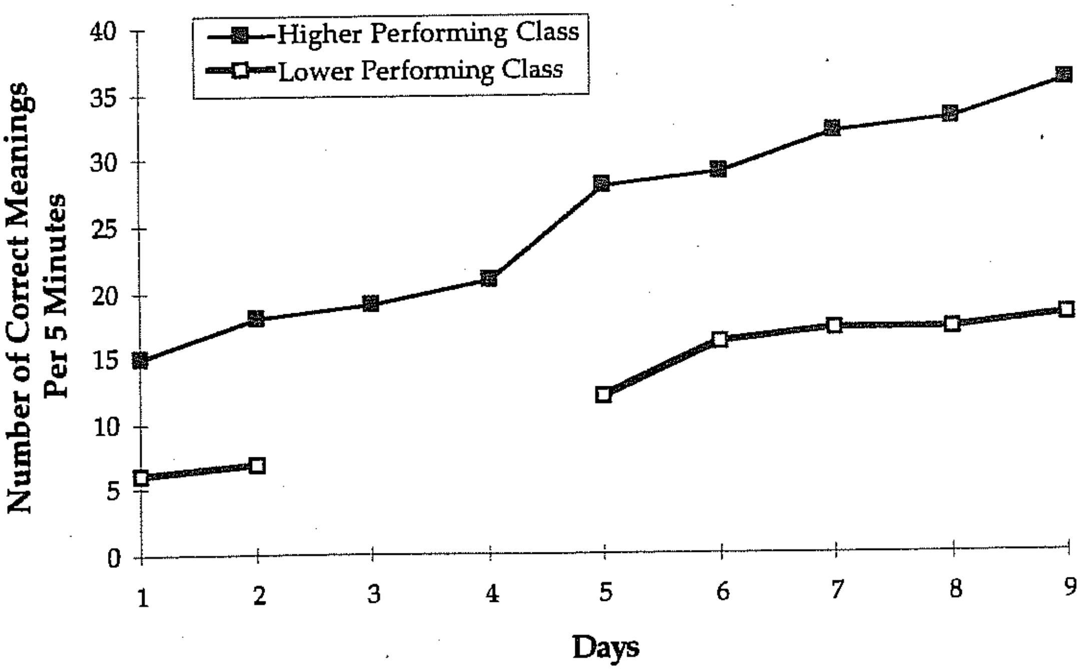


Figure 4. Vocabulary performance over 9 days.

The *Field-Test Study on History Knowledge* showed that students using the conceptually organized textbook learned more about history, even when measured by tests drawn on the competing curriculum. This wider generalization argues for the utility of the knowledge gained. It is extremely rare to find this in a study that has been controlled for teacher effect. Even with the same teacher, the classes of students who used the experimental text learned more.

Finally, the progress-monitoring approach of the two *Vocabulary Studies* found rapid growth in vocabulary learning in two very diverse populations. At the same time, comparison groups made little or no gains on vocabulary knowledge in a traditional curriculum.

Recently completed research (Winchester, 1996) further confirms the efficacy of the conceptually organized textbook for students with learning disabilities, compared with a composite of four traditional history programs. This traditional text group received group-oriented motivational activities and discussion for instruction in U.S. history. In both the conceptual and traditional texts, students were taught identical content, which included two units on the Civil War, each lasting two weeks.

Subjects were 44 students with learning disabilities in the 7th, 8th, and 9th grades from three junior high schools in central Alabama. Thirty-one students were African American and 13 were Caucasian.

Subjects in each of the three participating schools were randomly assigned to one of the two groups. Three graduate students in special education served as experimental teachers. To control for teacher bias, teachers were trained extensively in both instructional programs and taught at least one group from each treatment. In addition, the teachers were observed periodically by university supervisors to ensure that proper instructional techniques were utilized for both approaches. Instructional sessions lasted 50 minutes daily, 5 times a week for 4 weeks for a total of 20 days. A repeated measures design was used for this study.

There were five dependent measures used in this study. A pretest was given on day one of the investigation to determine whether students were functioning below average in the ability to read and comprehend textbook material. Students were asked to read a passage written on the same reading level as the material used in the study and respond to vocabulary and short answer items as well as questions requiring thematic responses.

Two unit tests comprised of vocabulary and discussion questions were administered. Unit Test One was given on day 11, and Unit Test Two was given on day 21. All questions came from the common content found in the texts and taught during the previous days. The analysis was done separately for vocabulary items and items requiring thematic responses.

On the last day of the intervention (day 22), a modified version of the NAEP history test was given to determine whether differences occurred between groups in the knowledge of the Civil War.

The students who were taught the conceptually organized text significantly out performed students taught the traditional text by 78% correct on the vocabulary measure while the traditional students scored at the 30% correct level. On the thematic measure, the students receiving the conceptually organized text performed in the average range (approximately 70%) while the traditional-text students performed poorly (20-25% range). The students in the group receiving the conceptually organized text also out performed the traditional-text students on the NAEP Test (80% vs. 35%).

Many researchers do not recommend textbook, teacher-directed, knowledge-focused interventions, but rather an application approach—experiential or hands-on—to learning history and social studies (Crabtree & Ravitch, 1988; Fuhler, 1992; Guzzetti, Kowalinski, & McGowan, 1992; Kobrin, Abbott, Ellinwood, & Horton, 1993; National Council for the Social Studies, 1991; Von Eschenbach & Ragsdale, 1989; Wisconsin Department of Public Instruction, 1983). They conclude that instruction in history and social studies, particularly at the middle school level, should no longer focus on mastery of textbook content but rather on "developmentally appropriate and thematically-integrated curricula, promoting cooperative discovery-oriented learning" (Lotan, Swanson, & LeTendre, 1992, p. 4). Such application methods often relegate the teacher to a role as facilitator of learning through discovery and relegate the textbook to occasional and peripheral use as a reference book (Fuhler, 1992).

In a recent review of the research on classroom organization for teaching social studies, Winitzky (1991) noted that cautions about textbooks and direct teaching were based upon the assumption that "lower teacher control would give students more opportunity to actively manufacture their own cognitive structures, thus fostering higher achievement" (p. 536). However, the research Winitzky reviewed indicated that only "affective outcomes, such as reduced dogmatism, tend to be enhanced by a less directive teacher, while achievement as measured by multiple choice tests is advanced by a more directive one" (p. 537). In other words, fact-based knowledge is better taught by more teacher-directed methods than a discovery-oriented, experiential approach to instruction.

Winitzky's points have been muted, because the calls for new methods of teaching have been joined by a concomitant attack on the traditional multiple-choice assessments used to assess results of social studies instruction. Recommendations abound for newer, less well-tested alternatives that focus on application, such as portfolio assessment, performance assessment, open-ended assessment, and authentic assessment (Adams & Hamm, 1992; Bartlett, 1992; Hymes, Chafin, & Gonder, 1991; Kon & Martin-Kniep, 1992; Mitchell, 1992; National Council for the Social Studies, 1991; Nickell, 1992; Palmquist, 1992; Wiggins, 1989a, 1989b, 1992).

Rather than engage in a circular debate over the relative value of applications and substantive knowledge and the related measurement issues, we would like to explain the present findings in the context of Shuell's notion of phases of meaningful learning (Shuell, 1990). Shuell's view is fundamentally connected to the research base on problem solving and the differences between experts and novices (e.g., Chi, Glaser, & Rees, 1982). Shuell's phases examine the progression "from the initial encounter with a complex body of knowledge to the point where the expert is able to demonstrate understanding of that knowledge in ways that are more or less automatic" (Shuell, 1990, p. 531).

Shuell hypothesizes three phases of learning complex and meaningful material, such as history. The first phase, initial learning, is primarily focused upon acquisition of information. The learner encounters this vast and complex body of knowledge and initially attempts to "... memorize facts and use preexisting schemata to interpret the isolated pieces of data" (Shuell, 1990, p. 541).

Shuell's second phase, the intermediate phase, focuses upon the organization of the information that has been acquired during the first phase. Gradually, as mastery of the isolated facts progresses, the learner begins to see the bigger picture. Here the learner strives to "... see similarities and relationships ... formed into higher order structures and networks. New schemata that provide the learner with more conceptual power are formed" (Shuell, 1990, p. 542).

Finally, during the third phase, the terminal phase, the learner focuses on applications by using the knowledge which has been internalized. Acquiring and organizing the knowledge has been completed, and the now learner can work on developing "... domain-specific strategies for solving problems and answering questions ... performance will be automatic, unconscious, and effortless because relevant knowledge structures now control behavior in a more direct manner" (Shuell, 1990, p. 543).

Unfortunately, novice learners cannot apply, problem solve, or ask interesting questions about a body of knowledge they have not yet acquired. Students can only reason, apply, and analyze information they have acquired from prior instruction. Ladwig and King (1992) cautioned that applications in and of themselves might be insufficient; they emphasized ". . . systematic inquiry that builds on relevant and accurate substantive knowledge" (p. 713). The more relevant, factual knowledge students possesses, the more complex the thinking process they can engage in conceptually. Ravitch & Finn (1987) assert that ". . . readers' abilities to think conceptually, to make judgments, to draw conclusions, and otherwise to engage in critical thinking are strengthened if they have prior knowledge [facts] of the material they are reading" (p. 21). Inadequate factual knowledge inhibits a student's ability to attend to ideas, principles, and issues underlying major historical concepts and events (Sinatra, Beck, & McKeown, 1992).

In contrast to beginning with applications, traditional history instruction has relied upon textbooks that never get beyond the facts, failing to show the coherent whole of history. Much traditional history instruction can be characterized as a meaningless "parade of facts" precisely because it fails to move beyond the first stage of learning. Shuell laments that our educational system "emphasizes the accumulation of more and more factual information" rather than moving students on to the intermediate phase by using "various organizational strategies, such as outlining and cognitive mapping" as well as using "the information to solve problems of various types" (Shuell, 1990, p. 542).

As the National Center for History notes, "it is important to remember that what is essential is not that students encounter every event, episode, and development in the political histories of the world, but that those they do explore be carefully selected to illuminate the deeper understandings identified in these themes, and that sufficient time be given to developing those basic understandings in depth" (Crabtree, Nash, Gagnon, & Waugh, 1992, p. 40).

White (1984) contended that while "the first measure of whether or not there is substantial knowledge in a textbook should be based on the presence of the conceptualization of big ideas" (p. 122), those big ideas then need "elaboration, specific, detailed local facts and truths" (p. 122). However, concept learning without factual application is "often nothing more than the memorization of social science vocabulary" (Ravitch & Finn, p. 16). Knowledge of "disconnected facts that are joined, related, or explained by no concept is without significance. . . . [Students must] learn particular facts in order to grasp ideas and develop generalizations" (Ravitch & Finn, p. 16). Thus knowledge of big ideas must have a basis in specific facts and examples, particularities of time and place. Ravitch and Finn state that any fact worth learning must minimally illustrate one important concept. For example, knowing about the Magna Carta clarifies the concept of central government limitation of power in the U.S. Constitution. In order for history to make sense, big ideas and facts must complement each other.

The present findings suggest that the text's content organization and design principles resulted in improved academic behavior and achievement. The findings support a middle ground between a model that sequentially progresses from facts to consolidation to application, and a model that begins with application.

This middle ground model attempts to address the need to move students more quickly toward applications that characterize the later phases of learning. The desired effect is to provide students with the organizational structures during initial learning that are normally part of the intermediate phase of learning. If instruction is successful, these structures would enable students to acquire an organized body of knowledge during the initial instruction—thereby streamlining the learning process considerably.

In short, organizing information around big ideas might collapse the fact-learning and consolidation stages, hastening substantive application while still providing the necessary background knowledge. The other design principles increase the likelihood of cognitive inclusion of vulnerable learners, such as students with disabilities and children of poverty.

As with any good theory, Shuell's phases lead to other implications. For example, viewing meaningful learning of history knowledge as something that proceeds in stages over a period of time resolves the false dichotomy between acquisition of facts and proponents of historiography. Proponents of historiography want students to model expert performance of historians who are in the terminal phase of history learning. Wineburg's (1991a, 1991b) work has highlighted the difference between honors high school students, intent upon factual acquisition, and historians. The historians, even when working out of their specialty era, can understand primary source materials better, although they might have less factual knowledge than the honors high school students.

The present intervention focuses on the understanding of big ideas as a precursor for developing the attitudes of a historian. Nevertheless, some of these attitudes are introduced, though on a modest scale. The experimental textbook explained that much historical data is not objective but reflects the interpretation of the person who collected the data. Volume 2 of the experimental textbook has a section in almost every chapter that illustrates how historians offer very different explanations of the same event. In addition the experimental textbook teaches students to view historical events from multiple perspectives; e.g., the colonial and British perspectives on the causes of the Revolutionary War.

The present intervention also applied the design principles to a textbook format. The principles could be applied in a variety of contexts and formats, such as in the design of a multimedia U.S. history course. The big ideas could even form a framework for a themes approach with a more hands-on experiential orientation. A primary reason for selecting the textbook format was its suitability for utilizing the design principles that have been shown to be effective in accommodating the learning needs of diverse learners. The relative success of these students on a variety of measures supports imbedding the design principles in a textbook format.

Strengths and Weaknesses of Our Research

Our research has two main strengths: (a) the use of multiple measures to assess student outcomes, and (b) the field-testing of our text and curriculum design features. Student outcomes across the various studies were measured through observation, curriculum-specific tests, vocabulary probes, and essay writing. Not only were multiple outcome measures utilized, they were employed with diverse student populations. Those multiple outcomes and diverse student populations augmented our curriculum's external validity. Because our research took place in both general and special education classrooms across the country that are dynamic, interactive environments, it enhances external validity. The classrooms used in the various research sites mirror most classrooms across the country.

These strengths also cause our research to suffer from internal validity problems. Alternative hypotheses could be generated to explain the results. However, the assessment data indicate that the students were able to incorporate our curricular design features into their outcome products. For instance, students were able to use the chapter's big ideas in their primary source writing as shown in the Hollenbeck (1996) study.

Moreover, effective teaching practices influence the curricular variables and vice-versa. Hudson, Lignugaris-Kraft, and Miller (1993) note that an integral component of student learning involves effective teaching practices like "checking homework, reviewing previous learning, activating prior knowledge, providing a rationale for the current lesson, stating lesson objectives, and communicating performance expectations" as well as "providing numerous opportunities for student responding, using corrective and positive feedback procedures, structuring instruction in small steps, and conducting the lesson at a brisk pace" (p. 106). While our curriculum manual strongly suggests that teachers employ these practices, actual implementation of them is conjectural on our part. In other words, even the best history curriculum requires excellent instructional techniques if *all* students are to benefit from the design principles.

The present research does not measure the long-term effects of the six curriculum design principles. Some researchers might wonder if the structured curriculum in a textbook format would dampen student interest in history and reduce their motivation to study history. In the absence of longitudinal findings, only anecdotes can be offered as answers. One fifth-grade class of economically disadvantaged African American students, not in the study, used the problem-solution effect analysis from the experimental textbook to critique a series of newspaper articles about the housing project in which they lived. The animated, thoughtful presentations and discussions indicated that the students were motivated to apply what they had learned to current events. In one of the experimental classrooms, some of the students with learning disabilities asked if they could have two periods to write their essay exams. For middle school special education students to ask to have almost two hours to write essay exams suggests strong motivation that might endure, if they continue to receive history instruction that allows them to understand and apply what is presented.

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Student comments about the *Understanding U.S. History* text

In general, high and low students expressed approximately the same attitudes about the experimental text, although the high students were more articulate.

There was uniform agreement among students that the experimental text was easier to read and understand than previously used texts. Many students said this was the feature they liked best about the book. As one of the more articulate students put it, "Easier [to understand]. Definitely easier. Actually I kind of thought that I was gaining a little bit more because you knew that you had learned something. I could remember beginning of the year stuff-I never did that before."

When asked if the questions were easier to answer, most students agreed that they were. One student noted that, "Maybe [they were] not easier questions, but they were easier to answer because the information was right there."

Another student said, "The book has more work because there were more questions, but also they were easier to answer and they taught you more." Another student said, "The work helped. This book was easier to understand than a textbook I had last year [on U.S. history]. Last year there were hard words I didn't know."

A majority of the interviewees also stated that they felt they had learned more from the causally organized text than they normally learned from topically organized textbooks. Several were able to distinguish that they were learning more because they were learning better. One of the low students said, "Usually I forget. I think I'll be able to remember."

Another suggested, "I probably learned more because it made it like, easier to understand. If it [the text] used big words it told what they [the big words] meant." One of the top students offered, "I learned about the same, but it was easier to recall."

Another one of the top students offered, "Other textbooks give a little more detail but it's harder to figure out the main idea 'cause it's wrapped in all the details." Another student pointed out, "Other books have more information, but this one you can remember a lot better."

One of the more poignant responses came from a low performer who said she liked the book because, "I could actually read it and understand it instead of having to ask the teacher over and over what does this mean and what does that mean?"

A Comparison of "Big Idea" Design in Reasoning and Writing with Constructivist Methods

Bonnie Grossen
Changnam Lee
Dan Johnston

University of Oregon

Knowledge consists primarily of generalizations and non-generalizable facts. Generalizations include concepts, rules, algorithms, heuristics, strategies, patterns, schemata, systems, and virtually anything that can be systematically applied to more than one event. Teaching students to derive or construct generalizations from events of experience and use them appropriately are major goals of education.

The knowledge required to construct generalizations, or reason, also consists of a set of generalizations. So generalizations can be classified as either content generalizations or reasoning generalizations. Reasoning generalizations used in the process of constructing knowledge generalizations are primarily inductive or deductive processes. One reasons inductively by studying events or examples to form a generalization. One reasons deductively by logically concluding a new generalization from known generalizations.

Current instructional approaches for improving reasoning can be categorized very roughly as "explicit" or "inquiry/constructivist." These labels refer to whether the targeted generalization is defined by the instruction (explicit) or not (inquiry/constructivist). Many research reviews conclude that inquiry/constructivist methods, though less effective in teaching content generalizations, result in better reasoning performance than explicit methods (Breddermann, 1983; Shayer & Adey, 1993; Shymansky, Kyle, & Alport, 1983; Staver & Small, 1990). However, these conclusions are misleading because of the way explicit instruction is usually defined; that is, the "explicit" treatments usually teach only content generalizations (e.g., volume displacement) and do not explicitly teach reasoning generalizations at all (e.g., scientific inquiry).

For example, several studies compared (a) an explicit treatment designed to teach the displacement principle (i.e., the amount of liquid displaced by an object is equal to the volume of the object) with (b) inquiry instruction designed to teach students to derive the principle of displacement through their own inquiry (e.g., Bay, Staver, Bryan, & Hale, 1992). Students were evaluated on their inquiry skills, that is, how well they derived new content generalizations in science. Explicit treatment conditions were rarely designed to teach these inquiry skills.

It is not surprising when studies with this design find that inquiry teaching methods result in better reasoning than "explicit" instruction. However, conclusions about explicit treatments for teaching reasoning cannot be based on observations of the effects of explicit instruction designed to teach only specific content generalizations.

A number of studies have compared inquiry instruction and explicit instruction more fairly, in the area of inductive reasoning, also called science inquiry. Ross (1988) comprehensively reviewed the results of a number of studies comparing the effects of inquiry instruction and explicit instruction designed to teach students how to control variables. Ross found that the more explicit instruction the instruction was, the more effective it was. Similarly, Rubin & Norman (1992) compared the effects of explicit and inquiry instruction on the science inquiry skills of special education students and found similar results. Special education students did better with explicit instruction. The present study involved a similar comparison in the area of deductive reasoning.

Not All Explicit Instruction Is Effective

Some argue that nonexplicit methods result in better "transfer," meaning they improve the learner's future ability to form their own generalizations, or learn (Frederickson, 1984; McDaniel & Schlager, 1990; Novak, 1990; Peat, Mulcahy, & Darko-Yeboah, 1989;

Salomon, Perkins, & Globerson, 1991). The term "transfer" is often used loosely in the literature both to refer to flexible application within the scope of the instructed material and to refer to transfer to new learning outside the scope of the instructed material. A more accurate golf stroke after building accuracy in ball batting would be within-scope application flexibility. Faster acquisition of skill in bicycle riding after being taught to bat a ball would be outside-scope transfer.

The scope of nonexplicit instruction is difficult to define, making within-scope and outside-scope distinctions difficult. In discussing explicit instruction, however, the distinction between within-scope flexibility and outside-scope transfer is important. The ability to reason effectively in a wide range of contexts is within the scope of instruction that explicitly teaches a widely applicable reasoning strategy, while the ability to reason and learn is not within the scope of instruction that explicitly teaches specific content generalizations. Instruction that explicitly teaches reasoning must only result in within-scope flexibility to demonstrate the desired behavior, the ability to reason and learn. Within-scope flexibility is a more attainable instructional objective than outside-scope transfer. In fact, transfer (e.g., faster acquisition of the skill of bicycle riding after being taught to bat a ball) does not seem to occur in learning to any measurable extent at all (Gick & Holyoak, 19xx; Salomon, Perkins, & Globerson, 1991)

Constructivists claim that flexibility results from meaningful learning. Many constructivists further claim that explicit instruction can never result in meaningful learning (DuCharme, Earl, & Poplin, 1989; Novak, 1990; Salomon & Perkins, 1989). Research shows this assertion is true for some forms of explicit instruction. Explicit instruction that presents only solved problems and no generalizable principle, or gives only a complicated statement of a generalizable principle with no guided application practice at all, often results in less meaningful or rote learning that is not used with flexibility (Catrambone & Holyoak, 1989; Hendrix, 1961; Katona, 1940, Kittell, 1957; Wittrock, 1963).

The National Center to Improve the Tools of Educators (NCITE) has distinguished effective explicit instruction from ineffective explicit instruction in their research reviews (Carnine & Shinn, in press). Effective instruction includes, among other things, making generalizable knowledge "conspicuous" to learners. Rather than simply verbalizing the steps in a strategy, the effective instructor would model the strategy and scaffold students' initial attempts to apply the strategy. The initial communication serves more to focus attention on critical aspects of the learning than to fully communicate meaning. Meaningful understanding is developed through the application practice. These guided applications are engineered to deepen understanding of the learning (Carnine & Kameenui, 1992). Furthermore, effective instruction is neither student-dominated nor teacher-dominated. Rather it is teacher-directed instruction seen as interaction between teacher and students. The theoretical basis for this type of explicit instruction has also been described by Rosenshine and Stevens (1986) and others (e.g., Brophy & Good, 1986; Pressley, Harris, & Marks, in press).

Conspicuous Strategy Instruction in Deductive Reasoning

Deductive reasoning involves deriving a new generalization from known generalizations or applying a generalization to a specific situation. A generalization can be stated as an <u>if</u> statement: If it is A, then it is B. The same rule can also be simply stated as "all A are B." For example, "if something cools, then it will contract" can be stated as "all things that cool contract." "If it is a cow, it is an animal" can be stated as "all cows are animals." Two generalizations can be combined deductively to result in the construction of a new generalization. For example, "All things that cool contract. All things that contract become more dense. Therefore, all things that cool become more dense." Or generalizations can be deductively applied to cases that either match the first part ("these are cows," so we know they are animals), or negate the second part ("these are not animals," so we know they cannot be cows).

For a conclusion to be valid, the evidence must rule out all other possibilities. The most common reasoning error seems to involve making conclusions when other possibilities are not fully ruled out by the evidence. For example, things identified as animals, or things identified as contracting could be situations to which the above generalizations might be applied: All cows are animals; this is an animal, so it must be a cow. Similarly, all things that cool contract; this thing is contracting, so it must be cooling. In both of these applications no definite conclusion can be made. Animals may or may not be cows; contracting objects may be contracting because they are under pressure, not necessarily because they are cooling. The evidence does not rule out these other possibilities. Generalizations formed in these situations, where no definite conclusion can be made, result from invalid deductive reasoning. The fact that most reasoning errors result from making conclusions (generalizations) where none can logically be made, has been well documented in all populations (Ceraso & Provitera, 1971; Chapman & Chapman, 1959; Haars & Mason, 1986; O'Brien, 1972; O'Brien, 1973; O'Brien & Shapiro, 1968; Roberge, 1970; Shapiro & O'Brien, 1970).

Ineffective explicit instruction. [s2] Two studies illustrate why explicit instruction in deductive reasoning is sometimes not effective. In a study by Bachus (1983), two explicit treatments were compared with a no treatment control. The scores of the control group were higher than those of the two treatment groups on all posttesting occasions.

In explaining the results, the author suggests that perhaps the instruction did not teach properly or was not long enough to have the necessary potency. (Each treatment was 3 hours long.) A closer look at the instructional tasks reveals that the instruction actually contradicted the learning measured by the posttest, the Cornell Conditional Reasoning Test (Ennis, Gardiner, Guzzetta, Morrow, Paulus, & Ringle, 1964). The posttest required a very remote type of transfer from the instruction rather than application. The strategy that was taught had few, if any, elements in common with the strategy that was tested. In fact, being a very contrived strategy with limited utility, it may have acted more as a buggy algorithm that interfered with performance on the posttest (Brown & Burton, 1978; Brown & VanLehn, 1980, 1982; Doyle, 1983; Engelmann & Carnine, 1991; Romberg & Carpenter, 1986).

One explicit treatment, the linguistic intervention, would result in a strategy which would interfere with performance on the posttest. For example, one of the 40 instructional items from the linguistic intervention follows:

> Premise: If there is a boy present then there is a girl present.
>
> Conclusion: There is only a girl present.
>
> YES NO MAYBE

In all the instructional problems there was no condition. Contrast the above instructional problem with the same one if it were rewritten in the format of an item from the posttest:

> Suppose you know that:
>
> Premise: If there is a boy present then there is a girl present.
>
> Condition: There is a girl present.
>
> Then would this be true?
>
> Conclusion: No boy is present.
>
> YES NO MAYBE

Without a condition the instructional items make little sense, and there is never a YES possibility. (MAYBE was a correct response on 30 instructional items, NO was a correct response on 10.) The instruction required subjects to practice a different reasoning strategy than the conditional reasoning strategy that was required by the posttest. The instructional strategy, besides having very contrived and limited applicability, also has few, if any, elements in common with the strategy required for conditional reasoning. To perform the transfer subjects would have to develop a new and unique strategy, a much more difficult task than applying or modifying an applicable reasoning strategy.

The other explicit intervention in the Bacchus study, the logic intervention, did not provide any practice discriminating valid from invalid conclusions. The logic intervention presented 20 logical puzzles for which there was always a valid conclusion. Invalid problems (those which require "maybe" as a correct response) did not occur. In contrast, half of the problems on the Cornell test require "maybe" as a correct response.

The fact that the treatment groups scored lower than the control group on the posttest is not surprising given that the reasoning strategies practiced in the instruction created expectations that would result in errors on the Cornell test. Extending the instructional time for these two interventions might predictably result in even lower scores as subjects would become more apt to give wrong answers, the types of answers learned in the interventions.

Besides the differences in the strategies, the linguistic intervention was not clear. For example, the answer given for the linguistic item presented above was as follows:

> The correct answer is *maybe* because if means supposing that; on condition that; or in case; and then means in that case; or therefore; so maybe there is only a girl present.

The answers were always explained using these definitions of *if* and *then* which were taken from a dictionary. These explanations would probably confuse most 7th and 11th graders. Explicit information can only be expected to add to instructional effectiveness if it is understandable.

Seidman (1989-90) found similar evidence that explicit instruction can interfere with learning when the instructed reasoning strategy is not generalizable. In that study instruction in the logic of computer programming interfered with subjects' logical thinking. Computers use only binary procedures, while the human mind can also use conditional reasoning. Subjects in Seidman's study who learned a computer programming language (LOGO), were more likely to interpret conditional statements as binary (also called biconditional interpretations), than subjects who had not learned LOGO. That is, the subjects learning programming would interpret a statement like "If it is a cow, it is an animal" to also mean "If it is not a cow, it is not an animal." With this reasoning, all animals end up being cows. Subjects had adopted the binary reasoning procedures of a computer as their own. Apparently, without some thoughtful alignment between the instruction and the outcome goals, it seems unlikely that explicit instruction in reasoning will improve reasoning.

The Importance of Depth of Processing

Using high school learning disabled subjects, Grossen and Carnine (1990) investigated the importance of requiring greater depth in processing the meaning of a strategy in class reasoning. The treatment group with the greater depth of processing was required to draw Euler-type diagrams to solve logic problems before viewing the multiple choices for response. Subjects in the other treatment group simply viewed the diagrams presented by the computer and selected their response. In all other aspects the strategy and the instructional design used in both treatments were identical. Because the instruction was delivered via computer and the criteria for remediation loops were identical for both treatments, instructional time was allowed to vary.

The strategy involved an explicit set of rules for syllogistic reasoning. Students drew one Euler-type diagram first to determine if a definite conclusion could be made and then to form that conclusion, when it existed. The Euler strategy can be called semantic, even though the classes themselves may be non-meaningful symbols, such as A or B. The only attribute of meaning that is relevant to logical operations is the inclusive or exclusive relationship between the classes in a logical statement. This relationship is made quite concrete in Euler diagrams.

The greater depth-of-processing provided by requiring subjects to illustrate each step in the process (diagram-drawing group) resulted in significantly higher scores on more difficult problem types–invalid arguments and arguments having a conclusion beginning with the word some–than the group with less depth-of-processing (screen-viewing group). Even though the instructional problems had been identical for both groups, performance varied between groups by problem type. In contrast to the screen-viewing group who was much less proficient with invalid arguments than with valid ones, the diagram-drawing group was as proficient with invalid arguments as they were with valid ones. There was no significant difference in instructional time (M = 13 hours); although drawing diagrams took additional time, subjects in that group required significantly fewer examples to reach criterion. Group differences maintained over a two-week interval of no instruction.

Overall the conspicuous strategy was effective. In a quasi-experimental comparison, the performance of the learning-disabled students in the diagram-drawing group was equivalent to that of a group of gifted peers and to that of a group of university students.

As a rough gauge of comparison with previous studies, scores on the problematic invalid syllogisms can be compared. The performance of the learning-disabled subjects drawing diagrams in the Grossen and Carnine study (1990) was 61% correct on invalid syllogisms, while the performance of college subjects in the Simpson and Johnson study (1966), where instruction focused on invalid syllogisms, was only 31% correct.

Subjects who were proficient in the reasoning strategy showed a tendency to creatively modify the strategy to solve problems with evidence in different forms from the forms the students had learned and to solve problems stated less formally than students had practiced. Five flexibility measures required subjects to use the reasoning strategy on tasks that were within the scope of the strategy, but outside the range of applications students had practiced during instruction. On three successive, parallel-form flexibility measures, flexibility seemed to improve spontaneously over time by simply doing the flexibility measures, without teacher feedback on the correctness of their work. The better performance on flexibility measures indicated that a conspicuous strategy could result in application flexibility. Grossen and Carnine (1990) hypothesized that if the instruction provided varied practice in the use of the reasoning strategy in practical contexts, the application flexibility of students would improve considerably. (See Grossen, 1992, for an explanation of the relevance of syllogistic reasoning in practical contexts.)

A Constructivist Alternative

Denying the need for conspicuous strategy instruction in reasoning, Wood and Stewart (1987) hypothesized that because most people can cope with the ordinary tasks of life, they possess a basic ability to reason. They reasoned that, therefore, students should learn to utilize better the logic skills they already possessed through playing a computer game, which required their use. Wood and Stewart (1987) used a computerized version of *Mastermind* for this purpose, in a study involving college age subjects and found positive effects on reasoning.

Mastermind is a two-person game, where one person is designated the "codemaker" (the computer) and the other is the "codebreaker" (the student). The codemaker's task is to create a "code" consisting of a set of two to six pegs, each of which may be one of five different colors. These are kept hidden from the codebreaker, whose task is to "break" the code by finding the correct combination of colored pegs in the designated positions. On each trial, the codebreaker chooses some combination of colors and positions for the pegs, and the codemaker provides feedback regarding the correctness of the codebreaker's choices. The object of the game is to break the code in the fewest number of trials.

Laughlin, Lange, and Adamapoulos (1982) determined that the feedback rules define *Mastermind* as a reasoning problem. The first choice by the codebreaker is essentially a guess, possibly based on a strategy for systematically ruling out possible combinations for the hidden code. However, after receiving feedback from the computer on that first choice, various classes of alternative codes can be eliminated by correct inferences until all but the correct code is eliminated.

Wood and Steward (1987) found the computerized *Mastermind* offered several advantages:

> First, because the game is devoid of concrete linguistic content, skills learned from playing it should not be bound to a particular set of materials, but could result in more general transfer of training. Second, assuming that people do possess some logical skills from previous experience, the game provided a mechanism for practicing those skills with immediate feedback and without the need for extensive, formal instruction in the principles of logic. Third, one can become relatively skilled at playing the game with just a few hours practice. Fourth, combinations of both inductive and deductive logic skills are required to play the gave efficiently and effectively. Fifth, the difficulty level can be increased in a step-wise fashion through a rather broad range as one becomes more proficient at playing. Finally, the game has motivational qualities (cf. Laughlin et al., 1982). (p. 50)

The Purpose of the Study

The present study was designed to evaluate the application flexibility effects of the same conspicuous strategy treatment used in the Grossen and Carnine (1990) study when a wider range of scaffolded application practice was provided as part of the instruction. The same conspicuous strategy was taught via computer to both special and general education students in a common classroom environment.

The effects of the conspicuous strategy treatment were experimentally compared with a constructivist treatment that was also delivered via computers in a game-like format. The primary game used in the constructivist treatment was a computerized version of *Mastermind.* The constructivist group received the same wide range of application practice.

Method

Subjects and Setting

This study was conducted in a rural high school. One hundred and twelve middle-school and high-school students (grades 7 to 12) participated in this study. Sixty four of these students were matched in pairs based on the pretest and randomly assigned to the following two experimental groups: (a) the Conspicuous Strategy Group (n = 37 including 9 special education students) and (b) the Constructivist Group (n = 23 including 5 special education students). These two groups did not differ on their GPA's and their Comprehensive Achievement Test scores, nor on their oral reading fluency test scores. Forty eight additional students who participated in the study were not randomly assigned. Twenty three of these students made up the Control Group, which received no special instruction in reasoning. The Control Group also included no special education students. A total of 30 special education students participated in this study including 4 teacher-identified at-risk students. Table 1 describes the subjects.

Procedures

This study had two treatment groups, the Conspicuous Strategy treatment and the Constructivist Strategy treatment, and a no treatment control group. Both of the treatments were designed to teach logic skills. In addition to the logic programs, both treatment groups received instruction in how to check the accuracy of facts using the New Grolier Electronic Encyclopedia CD-ROM (1991) and varied application practice. What follows are descriptions of the programs: their hardware requirements, instructional content, and classroom procedures.

Conspicuous Strategy Treatment: DIAL Logic

Hardware requirements

The Conspicuous Strategy treatment utilized the Direct Instruction Authoring Language (DIAL) Logic Program. DIAL Logic requires an IBM compatible running on an XT/8088 CPU or higher, 128K RAM, and a CGA, EGA, or VGA monitor.

DIAL Logic Program

DIAL Logic is a 64 lesson program developed by Grossen and Carnine, 1988. The program presents a question or statement on screen, and then the student does one of the following: (a) draws an Euler diagram to help determine an answer to the question; (b) selects an answer by typing in a number or letter; (c) types in a response; or (d) hits the space bar to move to the next frame in the program. If the student's answer is correct, the program praises the student and moves to the next question. If the student makes an incorrect response, the program provides immediate, elaborated, corrective feedback, then recycles the missed question to be presented later. Students who did not meet a mastery criterion of 80% on a lesson were branched to previously covered material for review. Students were notified by the program when they had high rates of first time success on lessons, thereby skipping remediation loops.

DIAL Logic incorporates many features from the mastery learning literature to improve student performance. For instance, the use of immediate corrective feedback was mentioned previously in this paper. Some other features include: short lessons, interspersed and cumulative reviews, and practice until mastery was demonstrated.

Instructional content

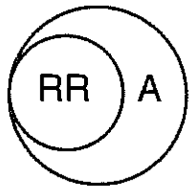
The DIAL Logic Program uses Euler diagrams to teach syllogistic reasoning. The strategy had students draw one Euler diagram to determine if a definite conclusion could be made, and then to form the conclusion if that was possible. The strategy was made "conspicuous" by directly teaching all of the steps in drawing Euler diagrams, rather than having students "discover" the rules through repeated exposure to problems.

Table 1. Groups and Their Compositions in This Study

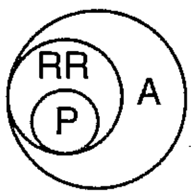
	n	Number in each age group						Gender	
		7th		8th		High School			
		*SpEd	**Gen	SpEd	Gen	SpEd	Gen	Boys	Girls
Experimental									
Conspicuous strategy	37	0	8	4	10	5	10	20	17
Constructivist	27	0	11	1	7	4	4	23	4
Total	64	0	19	5	17	9	14	43	21
Quasi-experimental									
Conspicuous strategy	62	10	8	4	10	11	19	36	26
Constructivist	27	0	11	1	7	4	4	23	4
Control	23	0	0	0	0	0	23	10	13
Total	112	10	18	5	17	15	46	69	43

*SpEd: Special education students
**Gen: General education students

For example, when presented with the evidence "All rhus are anacardiceae; All poisonoak are rhus," the students would draw one circle inside another and label the twice-stated class twice:

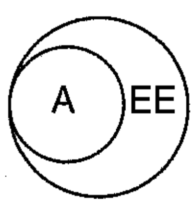


Rhus is stated twice, so it is labeled twice. The students learned to draw the last circle so as to make the second statement true. The circle for the last class, poisonoak, is drawn inside the circle for rhus, because the first word is all:

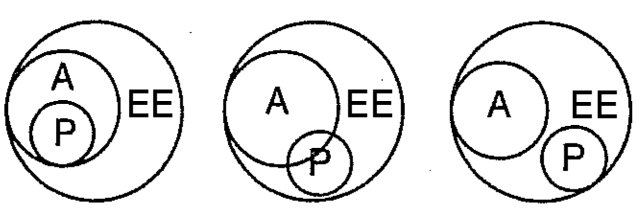


The conclusion is read by stating the relationship between the classes that are not labeled twice: All P(oisonoak) are A(nacardiceae).

In the following example, no definite conclusion can be made from the evidence: "all aves are eukaryotes; all plants are eukaryotes." The first step has the student draw aves inside eukaryotes, because the first word is all, and then label eukaryotes twice because it is stated twice:



The students then attempt to show the conclusion by drawing the last circle so as to make the second statement true. But the students find that they can draw the circle in more than one place and make the second statement true:



The students learned the rule that if you can show a conclusion with more than one possibility, then you have no definite conclusion. In this example, the conclusion can be drawn in 3 places, so there is no definite conclusion. See Figure 1 for an example of the DIAL Logic Program.

Classroom procedures

Each student had a floppy disk that contained their own program. After logging onto the network, the students inserted their floppy disks and began working on DIAL from the point where they had left off. The students kept track of their progress on a public poster by recording the number of lessons they had completed each day. The students also recorded the amount of time they worked each day on a log-in sheet next to their computer. Students from both the Conspicuous Strategy and Constructivist Strategy groups worked on their programs during the same period, but in adjacent rooms. There were at least three monitors to help students with the computers or with questions about the different programs. Both treatments lasted approximately 30 days, or 12 weeks. Students attended their respective treatments 3 days per week because of the school schedule. The instructional time for the different treatments was equivalent.

Constructivist Strategy Instruction: *Mastermind* and *Minesweeper*

Hardware requirements

A computerized version of *Mastermind*, called *MisterMind* and *Minesweeper* were used. Both *MisterMind* and *Minesweeper* require a Microsoft Windows 3.0 or 3.1, a hard disk, a mouse, an AT/286 or 386 computer, and an EGA or VGA monitor.

Instructional content

The Constructivist Group was provided with commercially available computerized programs designed to increase students' thinking skills. The primary program used was: (a) *MisterMind* (public domain). *Minesweeper* (packaged with Microsoft windows) was used in addition to MisterMind. These programs were selected because they required students to rule out possibilities, a fundamental skill in the Conspicuous Strategy treatment also.

MisterMind is a computer game similar to that used in the Wood and Stewart (1987). The computer ("the Code Maker") secretly makes a pattern of 4 pegs out of 6 available colors. The subject ("the Code Breaker") doesn't know what colors are selected and in what sequence. The object of the game is for the student to identify the sequence of colored pegs in as few moves as possible by efficiently ruling out impossible combinations. For each move, the computer provides clues indicating how many of the Code Breaker's pegs are placed in the correct position. See Figures 2 and 3 for an illustration of *MisterMind*. *MisterMind* provides more variations

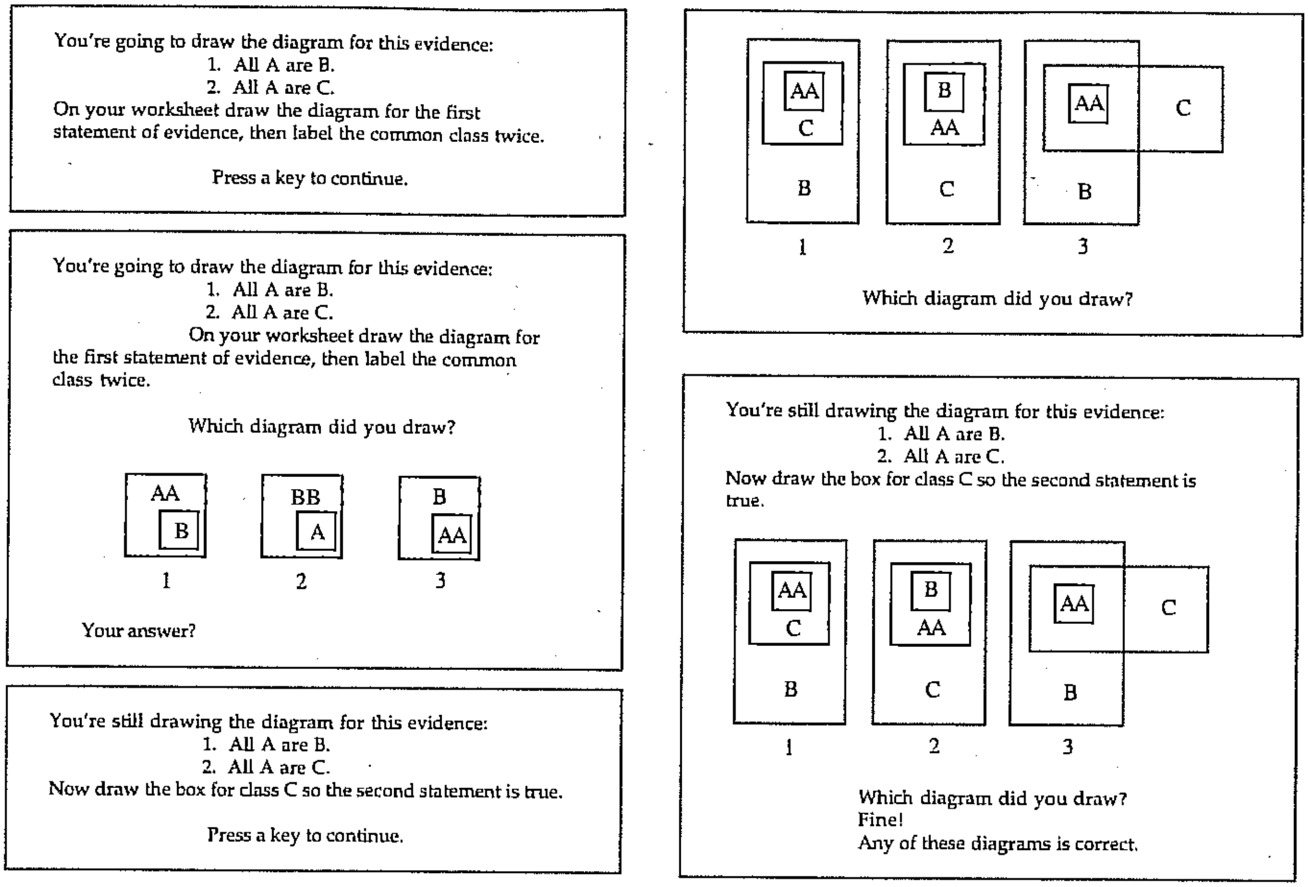


Figure 1. Sample of the DIAL Logic Program.

than the board game in terms of the number of pegs and colors. This variation allowed the researchers to set increasing levels of problem difficulty as daily challenges.

Minesweeper provides a designated number of covered squares among which a certain number of squares contain mines. Some squares, when uncovered, show numbers indicating the number of surrounding squares containing mines. Other squares contain mines, which end the game when uncovered. The objective of the game is to uncover all of the nonmine squares using the number clues. Subjects must use clues from more than one square to identify additional squares that do not contain mines and to provide more clues, thus allowing them to win the game. For example, a blank shows that none of the eight surrounding squares contain a mine. The objective of the game is to uncover all of the nonmine squares using the number clues.

Classroom procedures

The students worked individually, as well as in groups on *MisterMind* and *Minesweeper*. The students spent approximately 75% of the instructional time on *MisterMind*, and 25% on *Minesweeper*. The students were encouraged to share with one another their strategies for efficiently solving the puzzles. During each day, the experimenter set a "daily challenge" for the students to meet. The *MisterMind* challenge required students to break the code using an efficient strategy three times in a row, as was required in the Wood and Stewart study (1987). Students who wasted moves by contradicting or duplicating information given previously would be unable to meet the challenge. The goals and accomplishments were recorded on a poster in the classroom. The goals also added motivational interest, and it allowed the experimenter and students to identify students who needed assistance. Student peers then knew who to help. The experimenters and participating teachers also interviewed students regarding their strategies. The interviews were recorded on both video and audio tapes.

Conspicuous Strategy and Constructivist Strategy Groups: *Grolier Encyclopedia*

Hardware requirements

The New Grolier Electronic Encyclopedia, 1991, requires an IBM compatible computer running DOS

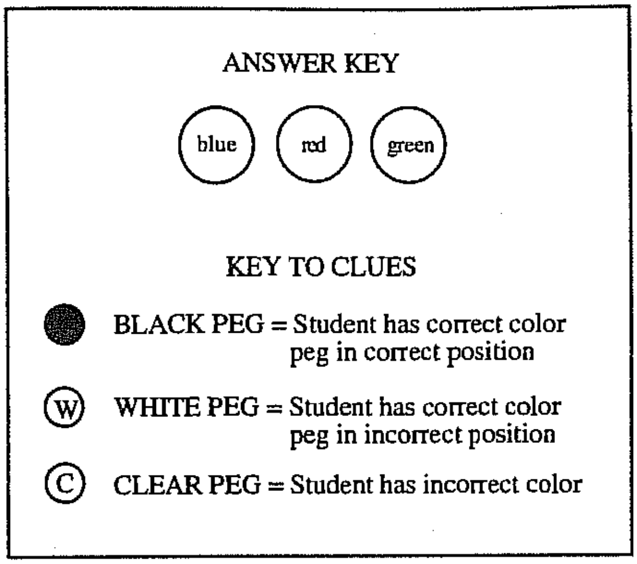


Figure 2. Graphic explanation of MisterMind. *Note that students do not see this explanation.*

version 3.0 or later, 512K of RAM, a CD ROM drive, and a VGA monitor.

Instructional content

Both the Conspicuous Strategy and the Constructivist Strategy groups used the *New Grolier Electronic Encyclopedia* CD ROM to check the accuracy of facts on experimenter designed worksheets. Students were presented with statements that were either true or false, arguments containing evidence that was either true or false, or opposing viewpoints. To determine the accuracy of facts, the students were directed to underline the key words in a statement or argument, and then to search the *Grolier's Encyclopedia.*

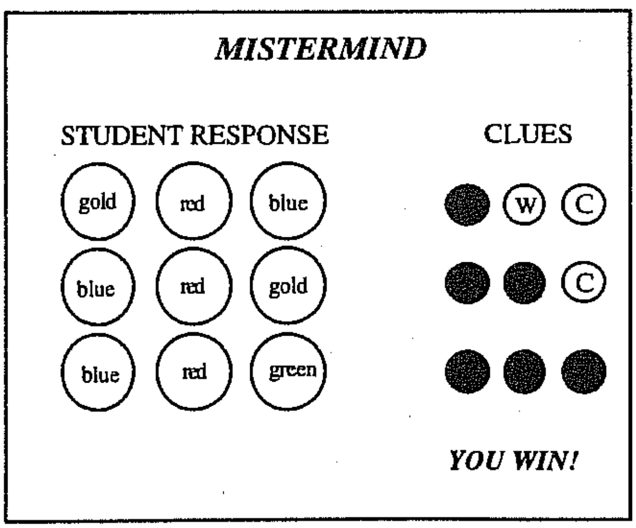


Figure 3. A black and white illustration of MisterMind. *Note that the computer version is in color.*

The Conspicuous Strategy students were taught a strategy on how to respond to inaccurate facts. For example, the Conspicuous Strategy students received the prompt illustrated in Figure 4. The Constructivist Strategy students did not receive the above prompt. The Constructivist students were instructed to "...decide whether the viewpoints agree or disagree. Use the CD Rom to figure out who is right."

Classroom procedures

During the class period, students from their respective treatments worked in pairs on the Grolier's Encyclopedia CD Rom. The students were placed in pairs of low and high performing students. All students were given instruction in how to efficiently search the encyclopedia.

Conspicuous Strategy and Constructivist Strategy Groups: Varied Practice in Reasoning

Both treatment groups received varied practice in reasoning for the final two weeks of the study. The activities included: class discussions; computer games; logic problems; debates on issues important to the local community; determining unstated assumptions from letters to the editor of the local newspaper; and using data from Consumer Reports (1994) to analyze products. For example, one debate was about having the Grateful Dead, a world renowned band, perform in the local civic arena. The town council and newspapers debate the pros and cons for weeks before and after the event (see Figure 5). Students worked on the following exercise individually, and then participated in a class discussion led by the classroom teacher or experimenters.

Your paragraphs will be written in regular paragraph form, like this:

(Name) and (name) disagree. (Name) claims ________.

On the other hand, (name) claims that ________.

According to *Grolier's*, (name) is wrong. *Grolier's* indicates

that ________.

Figure 4. Conspicuous strategy prompt for responding to inaccurate facts.

Measures

To evaluate mastery of the conspicuous strategy, we used the test of syllogistic reasoning developed for the Grossen and Carnine study (1990). To evaluate flexibility in reasoning, we used the New Jersey Test of Reasoning. Each of these measures are described below.

Mastery Measure: Syllogistic Reasoning Test

We used the 13-problem pencil-and-paper test (coefficient alpha = .86) used in the Grossen and Carnine study (1990). The test contained two problem formats that had been practiced in the instruction. Eight problems involved forming a conclusion from each of the eight basic forms of evidence. Five problems required subjects to critique given arguments (see Figure 6 for example problems). Critiquing arguments with incorrect conclusions required two responses (judging the conclusion incorrect and giving the correct conclusion); critiquing correct conclusions required only one response (agreement).

Flexibility Measure: The New Jersey Test of Reasoning

The 50-item New Jersey Test of Reasoning was used to assess flexibility in reasoning. The Institute for the Advancement of Philosophy for Children developed the test to assess the effectiveness of Philosophy for Children. The internal consistency reliability (coefficient alpha) was .91. An effort was made in creating the test "to construct a taxonomy in terms of the skills needed to perform the operations in the discipline of logic, both of the formal and informal variety, insofar as these relate to linguistic

Contrasting Viewpoints

Joe's viewpoint:

We should not allow the Grateful Dead to perform in our town. Whenever the Grateful Dead come to our town, their fans come from all over. These fans are the most despicable people. If we keep the Grateful Dead out of town, we can also keep their fans out of town.

David's viewpoint:

The Grateful Dead concerts are an asset for our town. The Grateful Dead promoters make large donations to the city to offset the costs of cleaning up after the concerts and to compensate for the extra on social services (for example, food stamps, clothing, etc.). Many businesses, make a lot of money when the Grateful Dead come to town. Our Police Department stated that the Grateful Dead and their fans are far less destructive than the college football fans.

Figure 5. Example of varied practice in reasoning exercise.

The following problem includes forming conclusions subscale.

You know that All B's are K's.
All N's are K's.

What else do you know?
A. All N's are B's.
B. All B's are N's.
C. Some B's are N's.
D. No B's are N's.
E. No definite conclusion.

The correct answer is E.

The following problem involves critiquing a given conclusion.

Here is George's evidence: All animals are heterotrophic.
All animals are eukaryotic.
Here is George's conclusion: All heterotrophes are eukaryotic.
Check George's conclusion. Is George's conclusion correct?________________
If not, what is the correct conclusion? ________________________________

George's conclusion is not correct. The correct conclusion is "some heterotrophes are eukaryotic."

Figure 6. Sample Items of the Syllogistic Reasoning Test.

usage....The taxonomy appears to be reasonably representative of the domain, and the items selected for the New Jersey Test appear to be reasonably representative of the taxonomy" (Shipman, 1983, p. 14; see Shipman, 1983 for taxonomy). Figure 7 illustrates these sample items.

For the pretest, we randomly selected 30 items from the original test. We investigated the discriminability of items using the procedures described by Nunnally (1964). Specifically, we identified the top 25% and the bottom 25% of all students in terms of total test scores. Next, for each test item, we determined the percent of students in the top quarter and the bottom quarter who selected the correct answer for the item. Finally, we subtracted this percentage of the bottom quarter who responded correctly from the percentage of the top quarter. The result showed that the differences in the percentages for all items were positive numbers, which means that responses to each item were consistent with the results of the total test. Nunnally (1964) proposed that a desired difference should be twenty percentage points or more. Twenty eight out of the thirty items (93% of the items) met this criteria with the differences ranging from 23 to 77 averaging 48. The percentage points of the remaining two items were both 18.

Results

Comparison of Experimental Groups

The means and standard deviations of the Conspicuous Strategy group and the Constructivist group on the pretests and the post-tests are shown in Table 2. Prior to treatment, these subjects had been matched in pairs and randomly assigned to form equivalent groups. After treatment, we conducted t-tests on the pretest scores of the remaining subjects to ensure the groups were still equivalent. There were no significant differences (Oral Reading Fluency, $t(56) = .52$; Syllogistic Reasoning Test, $t(62) = .80$; New Jersey Test, $t(62) = 1.02$).

We performed a multivariate analysis of variance (MANOVA) on the post-tests to compare the effects of the Conspicuous Strategy instruction and the Constructivist instruction. Results of the MANOVA showed a significant treatment difference favoring the Conspicuous Strategy group (Wilk's lambda =

- Jim remarked, "All bees are things that fly." But it doesn't follow," replied Donna, "that all things that fly are bees."

  a. Donna's wrong: from what Jim said, it does follow that all things that fly are bees.
  b. Donna's right: from what Jim said, it doesn't follow that all things that fly are bees.
  c. Donna's wrong: nothing follows from what Jim said.

- Steve learned in school that people born in the United States are Americans. When he was told that Alice was not born in the United States, he concluded, "Alice is not American."

  a. You cannot tell if Steve is right or wrong.
  b. Steve has to be right.
  c. Steve has to be wrong.

- The band leader said, "Carl, you are out of step." Carl wasn't sure what the band leader meant, because

  a. he wondered whether "out of step" meant not marching in time with the music.
  b. he wondered whether "out of step" meant not marching in time with the rest of the band.
  c. Steve has to be wrong.

Figure 7. Sample Items of the New Jersey Test of Reasoning.

.88, $F(2, 61) = 4.3$, $p < .05$). Univariate F-tests indicated that this difference was significant and favored the Conspicuous Strategy group on both the Syllogistic Reasoning Test ($F[1, 62] = 8.22$, $p < .01$) and the New Jersey Test ($F[1, 62] = 4.53$, $p <.05$).

Overall Quasi-Experimental Effects

We conducted a multivariate analysis of covariance (MANCOVA) on the two posttest measures for the entire sample using both pretests as covariates. The means and standard deviations for the Conspicuous Strategy, Constructivist, and Control groups are presented in Table 3. The Wilk's lambda of .83 and the associated F value of 5.13 with the degrees of freedom 4 and 212 indicated that the probability of exceeding the F value would be .001. (As Wilks' lambda approaches 1, the groups approach equivalence.) This result showed that overall, treatment effects were significantly different.

To determine which group(s) was (were) significantly different from the other group(s), we performed a MANCOVA for each combination of the groups. The MANCOVA with the Conspicuous Strategy group and the Control group showed a significant group difference favoring the Conspicuous Strategy group (Wilk's lambda = .36, $F[2, 80] = 26.8$, $p < .001$). Univariate F-tests indicated that significant differences occurred on both the Syllogistic Reasoning Test ($F[1, 81] = 15.3$, $p < .001$) and the New Jersey Test ($F[1, 81] = 10.2$, $p < .01$) and favored the Conspicuous Strategy Group.

A second MANCOVA comparing the Constructivist group and the Control group showed no significant group differences (Wilk's lambda = .97, $F[2, 45] = .70$).

The Performance of Special Education Students [s2]

Special education students in the conspicuous strategy treatment did not seem to perform as well on the syllogistic reasoning test as the special education students in the Grossen and Carnine study (1990). Age differences may explain this in part. Many special education students included in the present study were younger than the students in the Grossen and Carnine study. However, not one special education student in the present study achieved even the mean score of the group in the Grossen and Carnine study, indicating that age may not fully explain the poorer performance of the present group.

A more important variable affecting student performance may have been the scheduling of classes in the present study. Students in the present study were on a "block" schedule, where they were scheduled to receive instruction on Monday, Wednesday,

Table 2. Means and Standard Deviations of the Groups for Experimental Comparisons

TREATMENTS	New Jersey Pretest (Full Score = 30)	New Jersey Post-Test (Full Score = 50)	Class Reasoning Pretest (Full Score = 18)	Class Reasoning Post-test (Full Score = 18)
Conspicuous Strategy (n = 35)	20.4 (5.9)	37.2 (8.2)	6.4 (2.2)	9.1 (4.7)
Constructivist (n = 27)	18.8 (6.1)	32.2 (10.6)	5.9 (3.3)	5.9 (3.7)

Note. The numbers in parentheses are standard deviations.

and Friday. When the interruptions of snow days, special conference days, holidays, attendance, and other special events are considered, students often received even less frequent instruction. On the other hand, students in the Grossen and Carnine study were scheduled to receive instruction every day. One experimenter who participated in both studies sensed that much learning momentum was lost in the block schedule. Students in the block schedule seemed to require significantly more total time to complete the computer program than was required in the daily schedule. Most of the seventh grade special education students did not even complete the conspicuous strategy instructional program in a full semester. Further research should experimentally evaluate the effects of daily versus less frequent instruction on mastery and on overall time required to complete a course objective.

To evaluate the effects of the conspicuous strategy treatment on special education students, we compared the mean scores of the special education students who had completed or nearly completed the conspicuous strategy instructional program (N = 15) with the control group and with the constructivist group. There were no significant differences in the means of the special education conspicuous strategy group (M = 5.5, SD = 1.8) and the control group on the syllogistic reasoning test ($t[36]$ = 1.19). Neither were the mean scores of the special education conspicuous strategy group on the New Jersey test (M = 30.0, SD = 8.7) significantly different from those of the control group ($t[36]$ = 1.48). The scores the special education conspicuous strategy group also did not differ significantly from those of the constructivist group on the syllogistic reasoning test ($t[40]$ = .39) nor on the New Jersey test ($t[40]$ = .97).

Discussion

Instruction that taught a conspicuous strategy for syllogistic reasoning was compared with a constructivist intervention that did not teach syllogistic reasoning. Both groups received varied practice on problems requiring reasoning in different contexts and forms. The varied practice activities can be viewed as the kind of classroom activity that constructivists often recommend. The varied prac-

Table 3. Means and Standard Deviations of the Groups for the Quasi-Experimental Comparisons

TREATMENTS	New Jersey Pretest (Full Score = 30)	New Jersey Posttest (Full Score = 50)	Syllogistic Reasoning Pretest (Full Score = 18)	Syllogistic Reasoning Posttest (Full Score = 18)
Conspicuous Strategy (n = 62)	20.0 (5.7)	35.6 (8.7)	6.1 (2.2)	8.5 (4.2)
Constructivist (n = 27)	18.8 (6.1)	32.2 (10.6)	5.9 (3.3)	5.9 (3.7)
Control (n = 23)	22.1 (4.2)	33.7 (9.9)	7.3 (3.3)	6.7 (3.6)

Note. The numbers in parentheses are standard deviations.

tice activities involved discussion, computer games, logic problems, and other activities, all of which required the use of good reasoning strategies. Prior to working on these varied activities, the conspicuous strategy treatment learned via computer a well-defined strategy for reasoning. The constructivist treatment did not learn one well-defined strategy, but rather were required to invent their own strategies as they worked on two computer games that required students to eliminate alternatives to win. Teachers frequently questioned students in the constructivist treatment regarding their strategies and encouraged them to work strategically. Students shared their strategies with one another and modified their strategies as the challenges and the games changed. Interviews indicated that students in the constructivist treatment had in fact worked strategically. The strategies the students reported using to solve the computer games were varied and depended on the specific task or challenge they were attempting to meet. None of the students described a strategy resembling syllogistic reasoning.

Results on the mastery test (syllogistic reasoning) indicated that the computer-delivered instruction in syllogistic reasoning resulted in significantly better scores for the conspicuous strategy group. The strategies that the constructivist group invented did not seem to transfer to syllogisms. Their scores were significantly lower than those achieved by the conspicuous strategy group.

The New Jersey Test of Reasoning was used to determine whether the conspicuous strategy group could apply the well-defined strategy they had learned with flexibility in solving a wide range of reasoning problems in ill-defined contexts. The New Jersey Test of Reasoning samples a wide range of reasoning problem types that were derived from a complete taxonomy of reasoning. None of the problems were in forms the students had practiced during instruction.

Scores of the conspicuous strategy group were significantly higher on the flexibility measure (the New Jersey Test), indicating that they were able to apply the single strategy they had learned with sufficient flexibility to solve general reasoning problems. The constructivist group that had invented various, task-specific strategies did not seem to generalize them to solving general reasoning problems.

The well-defined strategy that the conspicuous strategy group learned was syllogistic reasoning. Since Aristotle's original argument that syllogistic reasoning was fundamental to all deductive reasoning, philosophers have differed concerning its relevance to practical reasoning tasks. The most common argument against syllogistic reasoning is that it does not resemble the strategies that people develop more naturally for solving reasoning problems (Cheng, Holyoak, Nisbett, & Oliver, 1986; Holyoak & Nisbett, 1988). In this study, constructivist subjects did not report nor demonstrate strategies resembling syllogistic reasoning. Observations of and interviews with the constructivist subjects provided no evidence that syllogistic reasoning strategies were developing. The observable strategies that students invented were very specific to the tasks they were completing. The strategies even changed within games as the challenge changed, though the game objective was still the same.

However, one should ask whether the strategies that develop naturally are the best strategies to teach. Grossen (1992) has argued that rather than develop reasoning models that describe the way people naturally reason, our task as educators should be to develop models that will help people reason more effectively. Grossen, Romance, and Vitale (in press) concluded in their review of the research on science instruction that the strategies that are worth teaching are those that are widely applicable. Grossen (1992) illustrated the broad applicability of syllogistic reasoning in a range of practical contexts.

The significantly better performance of the conspicuous strategy group on the flexibility measure (the New Jersey Test of Reasoning) seems to indicate that the students who learned the well-defined, but widely applicable strategy of syllogistic reasoning and applied it to varied contexts during instruction, achieved more generalized improvement in their reasoning ability, than the students who did not learn the well-defined strategy. Quasi-experimental comparisons with a control group indicated that the reasoning performance of the conspicuous strategy group improved significantly more than the control group, while the performance of the constructivist group did not.

Further research should explore the limits of the applicability of syllogistic reasoning as it was taught in the conspicuous strategy treatment. Additional applications should provide even wider ranging contexts in content-specific problem forms, such as designing a scientific experiment or evaluating the alternative solutions to a current social problem. More studies are also needed to compare the effects of other forms of constructivist interventions on reasoning and compare these with the effects of the conspicuous strategy instruction as designed in this study.

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Meta-analysis of Studies of Mathematics Curricula Designed around Big Ideas

Thomas A. Fischer
Sara G. Tarver

University of Wisconsin-Madison

In this meta-analysis study, effect sizes were computed for seven studies in which mathematics instruction using a Core Concepts in Mathematics videodisc series was compared to mathematics instruction using other mathematics curricula. Both special education and general education students participated as subjects. A variety of effect sizes were computed, including separate effect sizes for 22 comparisons made in the seven studies. The average effect size using the Glass technique and a single effect size for each study was 1.01. The average effect size using the Hunter-Schmidt technique and a single effect size for each study was 1.17. Average effect sizes for the 22 separate comparisons were 0.96 using the Glass technique and 1.09 using the Hunter-Schmidt. These unusually large effect sizes suggest that the Core Concepts videodisc programs merit the serious attention of educators who are attempting to reform mathematics instruction and increase mathematics achievement of diverse students.

When the laserdisc technology was introduced in the 1970s, educators began to look for ways to use the new medium for educational purposes. One group of researchers, mainly from Utah State University and the University of Oregon, developed the first of what would become a series of videodisc programs called Core Concepts in Math and Science. The first set of discs, introduced in the early 1980s, covered fractions. Later discs would expand the series to decimals and percents, ratios and proportions, earth science, chemistry, prealgebra, geometry, addition, subtraction, and tables and graphs.

Concurrent with the development of this Core Concepts series has been a growing group of research studies investigating the effectiveness of the programs that constitute the series. In most of the early studies, the fractions program was evaluated. In more recent studies, the problem solving and ratios, prealgebra, and geometry programs have been evaluated. In our search, we found at least seven studies in which Core Concepts math programs were compared to other math curricula using experimental or quasi-experimental methods.

In the same time period but in the field of social science statistics, Gene Glass of the University of Colorado coined the term "meta-analysis". Glass (1976) referred to a set of procedures, many already in use, that were to be used to quantitatively summarize the effect sizes of a body of studies about a particular method. Glass envisioned meta-analysis as a way of reducing the subjectivity of many literature reviews. Instead of selectively choosing some studies to emphasize while ignoring others, as was the case for some literature reviews, Glass sought to cast as wide a net as possible in finding studies related to a method and then to use a common metric to quantitatively measure the overall effect of that particular approach. Since Glass coined the term, meta-analysis has been used extensively in fields including psychology, medicine, economics, and education.

Although Glass's early works with meta-analysis often involved hundreds of studies, such as the 475 studies of psychotherapy analyzed by Smith and Glass (1977), meta-analysis is now applied to much smaller accumulations of educational studies. Mullen (1989) notes that meta-analytic methods can be used with as few as two studies:

Clearly, a larger number of hypothesis tests may increase our intuitive confidence in an analysis. However, readers of meta-analyses have to become sufficiently familiar with meta-analytic techniques to understand that the size of the database does not necessarily have anything to do with the appropriateness of the statistical techniques...If the results of a small number of studies are sufficiently significant and strong, then the combined effects will reveal combinations of significance that are significant, and combinations of effect size that are strong. (p. 123)

In this study, the techniques of meta-analysis were used to compute effect sizes of existing studies of Core Concepts math programs. Seven studies involving 22 comparisons between achievement levels of students receiving videodisc instruction and students receiving more traditional basal instruction or non-basal instruction based on National Council of Teachers of Mathematics (NCTM) standards provided the data for the meta-analysis.

The information provided by this meta-analysis can serve two purposes. First, it can help educators to make achievement-wise and economically-sound decisions when confronted with the difficult task of making curricular adoptions. Both videodiscs and textbooks can be costly. To ensure that monies are invested in programs that will yield the highest achievement returns, educators need comparative information about program effectiveness.

A second purpose has to do with the current trend to educate increasingly diverse groups of students in integrated classrooms. The videodisc technology, because of its capacity for individualized remedial loops and differentiated amounts of practice, appears to be a medium that teachers can use to teach diverse students successfully in general education classrooms. A meta-analysis of the accumulated body of videodisc studies can serve to either validate or refute that prima facie conclusion.

Method

Selection of Studies

Abstracts of studies were obtained by first searching the ERIC database with the Silver Platter Compact Disc system, using the descriptor "videodisc" and checking the years 1980 to 1995. The resulting list of abstracts was then narrowed down to studies in which instructional videodisc programs were compared to other instructional programs. A similar search was made with the Psychology Literature and Dissertation Abstracts compact disc databases, using the same criteria. Obtained studies then were cross-checked for other possible references.

This search revealed six studies that had been published in national journals. The seventh study included in this meta-analysis is referenced as an unpublished manuscript being revised for submission to a journal (Fischer et al., 1995). In all seven studies, experimental or quasi-experimental methods were used to compare videodisc math programs to basal math instruction or to non-basal NCTM math instruction. The following programs from the Core Concepts in Math videodisc series were used as experimental treatments in the seven studies: *Mastering Fractions* (Systems Impact, 1986), *Mastering Decimals and Percents* (Systems Impact, 1987), *Mastering Ratios and Word Problems* (Systems Impact, 1991), *Mastering Equations, Roots, and Exponents* (Systems Impact, 1989), and *Mastering Informal Geometry* (Systems Impact, 1993). The *Mastering Equations, Roots, and Exponents* program will be referred to as a prealgebra program.

Two studies involving the Core Concepts videodiscs were excluded from this meta-analysis because neither involved a direct comparison with another math curriculum. In one of those studies, Thorkildsen and Lowry (1987) analyzed achievement differences based on differences in implementation levels (how closely the teacher followed recommended procedures for implementing the videodisc curriculum). The comparison here was not videodisc versus non-videodisc instruction, but high- versus low-implementation of videodisc instruction. Thorkildsen and Lowry found that high implementation did have a significant positive effect on student math achievement.

The second excluded study was a quasi-experimental, nonequivalent control group study in which all fifth grade classrooms in a school district used the fractions and the decimals and percents videodisc programs. The comparison made here was the previous year's fifth grade California Test of Basic Skills (CTBS) math scores (without videodisc instruction) with the current year's CTBS math scores (with videodisc instruction). An increase in the number of students achieving mastery was reported; however, effect sizes could not be computed because standard deviations were not reported. Reports of each of the seven studies included in this meta-analysis contained posttest means and standard deviations for control and experimental groups; therefore, effect sizes could be computed directly without using transformations from significance tests.

Descriptive information about the seven studies is summarized in Table 1. Student labels, number of students, grades, geographic location, and lessons completed in the study are included. Both general education (including low-performing students) and special education students were involved in five of the seven studies. One study involved only high- and average-ability general education students and one involved only students with learning disabilities. Grade levels ranged from fifth to college. Num-

Table 1. Descriptive Information for Seven Studies

Study	Student Labels and Number (*N*)	Grade	Geographic Location	Lessons Completed
Kelly et al. (1986)	SE, LP, LD (26, 28)	HS	Oregon	10
Kelly et al. (1990)	GE, LP, LD (26, 28)	HS	Oregon	10
Hasselbring et al. (1987-88)	HA, AA (83)	6th	South	39
Moore & Carnine (1989)	LP, SE (29)	HS	Northwest	20
Grossen & Ewing (1994)	GE, SE (60)	5th–6th	Rockies	100
Fischer et al. (1995)	GE, SE (25)	9th	Wisconsin	15
Kitz & Thorpe (1995)	LD (26)	College	Wisconsin	28

GE: General Education
LP: Low-performing
LD: Learning Disabilities
HA: High-ability
AA: Average-ability
SE: Special Education
HS: High School

ber of lessons completed ranged from 10 to 100. Following are more detailed descriptions of the seven studies.

Kelly, Carnine, Gersten, and Grossen (1986). In this study of short duration, ten lessons from the fractions videodisc program were delivered to a treatment group and comparable lessons from a basal text were delivered to a control group. Subjects were 28 high school students from one general and one remedial math class. Of the 28, 17 were labeled learning disabled and the remaining 11 had no special education label. Students were matched on performance level and randomly assigned to treatment and control groups. Two posttests were administered, one immediately following the instructional period (N=28) and a maintenance test two weeks later (N=26). Results of both posttests showed a significant difference in favor of the videodisc group, with the margin increasing on the maintenance test.

Kelly, Gersten, and Carnine (1990). Data from the 1986 Kelly et al. study were reanalyzed to focus on three types of test items that reflect three design characteristics of the videodisc program: items that assess discrimination among problem types, items that assess separation of confusing concepts and terminology, and items that assess application to an appropriate range of examples. As expected, raw score differences for the videodisc and basal groups were higher for these selected items than for other test items. The videodisc group outscored the basal group 96% to 77% on discrimination items, 92% to 69% on separation of confusing elements items, and 94% to 39% on range of examples items.

Hasselbring, Sherwood, Bransford, Fleenor, Griffith, and Goin (1987-88). A noteworthy aspect of this study of the fractions program is the investigators' control for the novelty effect of the videodisc medium. Control was accomplished by having the videodisc presentations transferred to overhead transparencies and presented via overhead projector. This allowed for comparisons of two experimental groups (videodisc delivery group and overhead delivery group) with a control group that received traditional fractions instruction contained in basal materials. Results showed no significant difference between the two experimental groups receiving the videodisc and overhead presentations. Moreover, both of the experimental groups had significantly higher scores than the basal control group. These findings were interpreted as evidence that the design of the fractions instruction is at least as important as the medium of delivery and that the design contained in the fractions videodisc program (regardless of medium of delivery) is superior to that contained in traditional basal materials.

In this quasi-experimental study involving four intact sixth-grade classes, two classes were described as high-ability and two as average-ability. One class of each ability level constituted the control group that received basal instruction. The other two classes, one high- and one average-ability class, were divided into two subgroups, with one subgroup receiving the videodisc medium and the other receiving the overhead medium.

Moore and Carnine (1989). In this first study of the ratios and word problems videodisc program, investigators compared videodisc instruction to basal instruction delivered to low performing and special education students in high school. The videodisc group had significantly higher scores on a posttest. On a maintenance test, scores were still higher for the videodisc group but the difference was not significant.

In an attempt to control for other teaching variables, investigators required teachers of both the videodisc and basal groups to use the "active teaching" principles elaborated by Good and Grouws (1979). Active teaching practices such as daily and weekly review and extensive independent practice are inherent components of the Core Concepts videodisc programs. Extensive revision of the basal curriculum was required in order to incorporate these principles. Equating teaching variables in this way is likely to have lessened the effect size; nontheless, a significant difference on the immediate posttest favored the videodisc group.

Grossen and Ewing (1994). In this study of a year-and-a-half duration, subjects were students in their fifth-grade year and half of their sixth-grade year. The videodisc curriculum consisted of the fractions and the percents and decimals programs in the fifth grade and the ratios and word problems, prealgebra, and geometry programs in the sixth grade. The videodisc curriculum was compared to a curriculum based on the NCTM standards which emphasized the use of manipulatives in small-group activities. Because NCTM teaching practices had already been implemented as part of a district-wide program, teachers of the NCTM comparison group had experience using those practices. Teachers of the experimental videodisc curriculum had no previous experience with the videodisc curriculum. The experimental and control treatments also differed on homework. Students in the NCTM classes were assigned mathematics projects for homework; students in the videodisc classes were assigned no homework. Despite these differences in teacher experience and homework that might have favored the NCTM group, the videodisc students scored significantly higher on five of six posttest measures. The NCTM students scored higher on one posttest that was based on NCTM materials.

Fischer, Kitz, and Tarver (1995). In this study using the informal geometry program, subjects were 25 ninth-grade students in a public school on a Native American reservation in the Midwest. Subjects included both regular and special education students. Subjects were randomly assigned to videodisc and basal groups, with stratification according to special or regular education category. Scores were compared by overall group as well as by educational category. Significant differences in favor of videodisc instruction were found for both the overall group and for special education students. Although the regular education students scored 20% higher with videodisc instruction compared to basal, the difference was not statistically significant.

Kitz and Thorpe (1995). To compare the effectiveness of two approaches to providing remedial math instruction for entering college students with learning disabilities, Kitz and Thorpe randomly assigned entering students with learning disabilities to either a treatment group to receive instruction using the prealgebra videodisc program or a control group to receive comparable prealgebra instruction from a textbook used in the first algebra course that the students would later be required to take. The remedial instruction was delivered during the summer prior to the students' first semester of college courses. Scores of the videodisc group were significantly higher than those of the textbook group on both a posttest based on the videodisc materials and a posttest based on textbook materials.

Kitz and Thorpe also tracked the students' grades in their first college algebra course, a course in which all students used the same textbook that had been used by the textbook control group during summer remediation. They reported a grade average of 2.5 on a four-point scale for the videodisc remediation group and a grade average of 1.5 for the textbook remediation group.

Methods of Computing Effect Sizes

Four different sets of effect sizes were computed using methods that differed according to what standard deviation was used and whether single or multiple effect sizes were computed for each study. The computational method recommended by Glass, McGaw, and Smith (1981) involves finding the difference between the means for control and treatment groups and dividing by the standard deviation of the control group. They prefer the use of the control group standard deviation because it is unaffected by the treatment. In contrast, the pooled standard deviation is used with the Hunter-Schmidt (1990) method; the pooled standard deviation is preferred because it has less sampling error and because it better estimates the population parameter. Hough and Hall (1994) compared the two methods and found no significant difference in effect sizes using the different standard deviations; nonetheless, the results of both methods are included in this report.

Hunter-Schmidt also recommends a correction factor based on the reliability of the independent variable (effect size divided by the square root of the reliability score). This correction procedure tends to increase effect sizes slightly. The correction procedure was not applied in this meta-analysis study because not all authors reported reliability figures for their independent variables.

In all of the seven studies included in this meta-analysis, investigators computed and reported more than one comparison between videodisc and control groups. Comparisons for both high- and average-ability subgroups (Hasselbring et al., 1987-88), both general and special education subgroups (Fischer et al., 1995), different posttests (Grossen & Ewing, 1994; Kitz and Thorpe, 1995) and maintenance as well as immediate posttests (Kelly et al., 1986; Moore & Carnine, 1989) yielded a total of 22 comparisons.

Researchers recommend different ways of reporting effect sizes for multiple comparisons. Both Glass and Hunter-Schmidt recommend computing effect sizes for each individual comparison. Other researchers (Kulik, Kulik, & Cohen, 1979; and Rosenthal, 1976) recommend averaging the effect sizes within each study to produce a single overall effect size. Both overall effect sizes and individual comparison effect sizes were computed and are reported in Table 2 of this report. In accord with the recommendations of Wolf (1986), the following statistics were also computed and are reported in Table 2 for both the overall effect size distribution (N=7) and the individual comparison effect size distribution (N=22): (a) average effect size (b) standard deviation, and (c) 95% confidence interval.

Results

Overall Effect Sizes

In all seven studies, videodisc instruction produced higher overall mean scores than the other forms of instruction to which it was compared. As shown in Table 2, overall effect sizes for the seven studies ranged from 0.44 to 1.60 using the control group standard deviation and from 0.45 to 1.66 using the pooled standard deviation. The average of the seven overall effect sizes was 1.01 using the control group standard deviation method and 1.17 using the pooled standard deviation method. Other statistics for the overall effect size distribution were: (a) standard deviations of 0.39 and 0.43 using the control group and pooled standard deviations, respectively, and (b) 95% confidence intervals of 0.25 - 1.77 and 0.33 - 2.01 using the control group and pooled standard deviations, respectively.

Individual Comparison Effect Sizes

For 21 of the 22 individual comparisons, videodisc instruction produced higher mean scores. The single comparison that yielded a lower mean score for videodisc instruction was Grossen and Ewing's (1994) NCTM nonroutine problems comparison. As shown in Table 2, individual comparison effect sizes for the 22 comparisons ranged from -0.12 to 2.11 using the control group standard deviation and from -0.12 to 2.32 using the pooled standard deviation. The average of the 22 individual comparison effect sizes was 0.96 using the control group standard deviation and 1.09 using the pooled standard deviation. Other statistics for the individual comparison effect size distribution were: (a) standard deviations of 0.56 and 0.65 using the control group and pooled standard deviations, respectively, and (b) 95% confidence intervals of -0.14 - 2.06 and -0.18 - 2.36, using the control group and pooled standard deviations, respectively.

Comparison of the Glass and Hunter-Schmidt Methods

As shown in Table 2 (following page), the Hunter-Schmidt method (pooled standard deviation) yielded larger effect sizes than the Glass method (control group standard deviation) for 19 of the 22 individual comparisons and all seven of the overall comparisons. In all cases where the Hunter-Schmidt method produced larger effect sizes, the standard deviation of the control group was greater than that of the experimental treatment group. Thus, the pooled variation of the two groups was less than the standard deviation of the control group. To put it another way, the experimental videodisc treatment produced less variation among scores in nearly all studies. Larger mean scores in combination with less variation among scores for the videodisc treatment group produced unusually large effect sizes for most of the comparisons.

Discussion

The results of this meta-analysis provide strong support for Core Concepts mathematics programs as an effective means of increasing the mathematics achievement of diverse groups of students. Consistently large effect sizes across the seven videodisc studies suggest strongly that these programs are instructional tools that teachers can use to communicate effectively a wide variety of mathematics concepts, operations, and problem solving strate-

Table 2. Effect Sizes of 7 Studies (Overall) and 22 Individual Comparisons

Study	Type of Comparison	Effect Size: Control SD	Effect Size: Pooled SD
Kelly et al. (1986)	Overall	1.18	1.46
	Immediate Posttest	0.83	1.15
	Maintenance Posttest	1.53	1.76
Kelly et al. (1990)	Overall	1.02	1.39
	Discrimination of Problem Types	0.88	1.30
	Separation of Confusing Elements	0.46	0.56
	Application to Range of Examples	1.73	2.32
Hasselbring et al. (1987-88)	Overall	1.15	1.32
	High-ability, Videodisc	1.30	1.49
	High-ability, Overhead	0.82	0.70
	Average-ability, Videodisc	1.29	1.72
	Average-ability, Overhead	1.20	1.35
Moore & Carnine (1989)	Overall	0.57	0.71
	Immediate Posttest	0.85	1.09
	Maintenance Posttest	0.29	0.32
Grossen & Ewing (1994)	Overall	0.44	0.45
	NCTM Nonroutine Problems	-0.12	-0.12
	Routine Word Problems	0.93	0.94
	Woodcock Johnson Applications	0.43	0.46
	ITBS Concepts	0.37	0.42
	ITBS Problem Solving	0.10	0.11
	ITBS Operations	0.92	0.87
Fischer et al. (1995)	Overall	1.14	1.21
	Special Education Students	1.65	1.54
	Regular Education Students	0.88	0.99
Kitz & Thorpe (1995)	Overall	1.60	1.66
	Videodisc Posttest	2.11	2.20
	Basal Posttest	1.26	1.63
	Grade in Algebra Course	1.43	1.14
Overall Effect Sizes:	Average	1.01	1.17
	SD	0.39	0.43
	95% Confidence Interval	0.25 - 1.77	0.33 - 2.01
Individual Comparisons Effect Sizes:	Average	0.96	1.09
	SD	0.56	0.65
	95% Confidence Interval	-0.14 - 2.06	-0.18 - 2.36

gies. Because effectiveness has been demonstrated with a variety of students in both special and general education settings (e.g., special education, low-performing general education, average-ability, high-ability students), the Core Concepts programs should be particularly appealing to educators attempting to make achievement-wise and economically-sound decisions about curriculum adoptions.

The effect sizes reported in Table 2 are impressive by any standards. Cohen (1977) categorizes an effect size of 0.2 as a small effect, 0.5 as a medium effect, and 0.8 as a large effect. Rossi and Wright (1977) suggest that an effect size of 0.5 has practical significance. The National Institute of Education's Joint Dissemination Review Panel states that effect sizes of 0.33, and sometimes as low as 0.25, can be considered educationally significant (Tallmadge, 1977).

Another way to consider effect sizes (Wolf, 1986) is to look at how a typical member of the treatment group would rank in the treatment group based on using effect size as a type of z score. With an effect size of 1.0, a typical member of the treatment group would rank in the 84th percentile of the control group. The overall averages for the seven studies analyzed here exceeded 1.0 when using the Glass method (1.01) and when using the Hunter-Schmidt method (1.17). That means that under either method the typical child in the videodisc group would rank higher than the 84th percentile of the control group. Even the smallest effect sizes of 0.44 and 0.45 reported by Grossen and Ewing (1994) are judged educationally significant by most standards.

Slavin (1990) noted that it is unusual to get an effect size as large as 1.0. Of 60 studies of his Student Teams-Achievement Division model of cooperative learning, just eight had an effect size larger than 1.0. The mean effect size for the 60 studies was 0.27. Effect sizes for other forms of cooperative learning have ranged from 0.00 to 0.38. Slavin (1990) concluded that few educational interventions, with the possible exception of one-to-one tutoring, produce effect sizes as great as 1.0 and that effect sizes of + 0.25 are generally considered educationally significant.

Slavin's conclusions are consistent with Walberg's (1984) report of a meta-analysis of some 3,000 educational studies. This meta-analysis yielded effect sizes ranging from -0.12 (for mainstreaming) to +1.17 (for Skinnerian reinforcement). Just two of 27 educational interventions had effect sizes of 1.0 or greater. For mathematics interventions, effect sizes included 0.32 for individualized mathematics, 0.24 for computer-assisted instruction, and 0.18 for "new mathematics curricula". In contrast, the seven overall effect sizes reported in Table 2 of this meta-analysis range from a low of 0.44 or 0.45 to a high of 1.60 or 1.66. Under any of the computational methods used in this meta-analysis of videodisc studies, the Core Concepts programs would stand at the top of a list of Walberg's mathematics approaches and near the top of a list of all educational approaches. Even when considering effect sizes for the 22 individual comparisons, we see only two that failed to exceed the 0.18 effect size reported by Walberg for "new mathematics curricula."

Kitz and Thorpe's (1995) effect sizes for college students with learning disabilities are particularly noteworthy. The extraordinarily large effect sizes for the posttest based on videodisc program materials (2.11 and 2.20) are impressive. Even more impressive, however, are the effect sizes for the posttest based on basal materials (1.26 and 1.63) and subsequent algebra grades (1.43 and 1.14). Taking into account the fact that the basal control group received remediation using the same textbook that was later used in the algebra course with both the videodisc-remediated students and the basal-remediated students, the 1.43 and 1.14 effect sizes for algebra grades are indeed remarkable. Clearly, the prealgebra videodisc program offers hope for the increasing numbers of students in need of mathematics remediation when they enter our colleges and universities.

Interesting information about the features of the videodisc curriculum that might account for such high levels of effectiveness can be gleaned from the findings of Hasselbring et al. (1987-88) and Moore and Carnine (1989). By comparing two experimental conditions–overhead projector delivery as well as videodisc delivery of the same instruction–to a basal instruction condition, Hasselbring et al. demonstrated that the effectiveness of the videodisc curriculum cannot be attributed to the videodisc technology alone. As mentioned earlier, posttest scores of neither high- nor average-ability students differed significantly under the two delivery conditions. However, both the videodisc delivery group and the overhead projector delivery group had significantly higher posttest scores than a basal control group. These findings suggest strongly that other instructional design components contribute as least as much, possibly more, to the effectiveness of the Core Concepts programs than does the videodisc technology itself.

The Moore and Carnine (1989) findings shed some light on particular instructional design features that contribute to the effectiveness of the Core Concepts programs. To control for certain active teaching practices that are inherent components of the Core Concepts videodisc programs (e.g., daily and weekly review, extensive independent practice), Moore and Carnine (1989) incorporated these practices into the basal curriculum and required the teacher of the basal control group to use the practices. That this control had the effect of reducing the difference between the groups is indicated by effect sizes lower than those found for most of the other videodisc studies. Of the seven studies included in this meta-analysis, the Moore and Carnine (1989) study had the next to lowest effect sizes and was one of only two studies that had overall effect sizes of less than 1.0. These findings can be interpreted as evidence that active teaching practices do contribute to the effectiveness of the videodisc programs. It is important to note, however, that the Moore and Carnine (1989) overall effect sizes were medium to large effect sizes (0.57 and 0.71) that appear small only in relation to the exceptionally large effect sizes for other studies of the Core Concepts videodisc programs. Effect sizes of 0.57 to 0.71 are considered to be educationally significant by any of the standards described earlier. In short, the Moore and Carnine (1989) findings seem to indicate that design features such as review and practice do contribute to the effectiveness of the videodisc programs but that other design variables contribute also.

Instructional design features that contribute to the effectiveness of printed instructional programs based on the same principles that underlie the videodisc instructional programs have been discussed at some length in a book edited by Carnine and Kameenui (1992) and a special issue of *School Psychology Review* guest-edited by Carnine (1994). In those publications, authors explain that the more easily observed features of effective instructional programs–features such as frequent student-teacher interactions, corrective feedback, reinforcement, monitoring of student performance, review, and practice–play important roles but that some not-so-easy-to-observe features play equally important roles. In the 1992 book, a critical hard-to-detect feature that underlies the development of effective instructional programs is called "sameness analysis." Sameness analysis is essential to the identification of critical connections or relationships among the elements of a knowledge domain. How to design curriculum around samenesses is elaborated for the domains of mathematics, science, history, and spelling.

In the 1994 publication, Carnine summarizes four critical curriculum design features as big ideas, explicit strategies, scaffolding, and review. He explains that identifying major, important concepts (i.e., "big ideas") and teaching them thoroughly (via explicit strategies, scaffolding, and review) promotes deep understanding, enhances fluency and retention, and promotes instructional efficiency. Identifying "big ideas" is somewhat like identifying critical "samenesses". Effective curriculum development starts with and is dependent upon the identification of critical samenesses and big ideas. Communication of big ideas and critical samenesses enables learners to engage in higher order thinking that involves generalizing appropriately, understanding relationships among elements, and reorganizing or recombining elements to construct new cognitive structures. The results of this meta-analysis support strongly the contention that the Core Concepts videodisc curriculum, a mathematics curriculum based on samenesss analysis and the identification of big ideas, is an effective means of promoting higher order learning in mathematics.

Goal #4 of the National Education Goals contained in Goals 2000 legislation (National Education Goals Panel, 1992) states: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement." International comparisons indicate that we have a long way to go to accomplish that lofty goal and most mathematics educators doubt that we can reach that goal by the year 2000 or even shortly thereafter. Nonetheless, the findings of our meta-analysis suggest that we have the tools to move in the direction of more effective mathematics instruction for increasingly diverse groups of students. Let us hope that educators will move forward with all deliberate speed toward the utilization of those effective tools. U.S. students, including students with and without disabilities, deserve no less.

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A Review of Several Studies of *Corrective Reading*

Gail Coulter
University of Oregon

Campbell, M. L. (1984). *A study of corrective reading as an effective and appropriate program for reading disabled, learning handicapped secondary students.* Report presented to the Faculty of the School of Education, San Diego State University.

Summary: This study compared 7th and 8th grade low achieving students who were taught Corrective Reading (Decoding B) with 7th and 8th grade low achieving students who were placed in a regular English classes. The results of pre and posttest scores on the *Woodcock Mastery Reading Test* showed that students in the Corrective Reading group gained 2.2 years in 9 months of instruction while students in the regular English control group gained .4 months. Significance for the total reading score was $p < .0001$. Students who were reading initially at fourth grade level made much greater gains than students who were reading initially at second grade level. Figure 1 shows the results for these non-special education students.

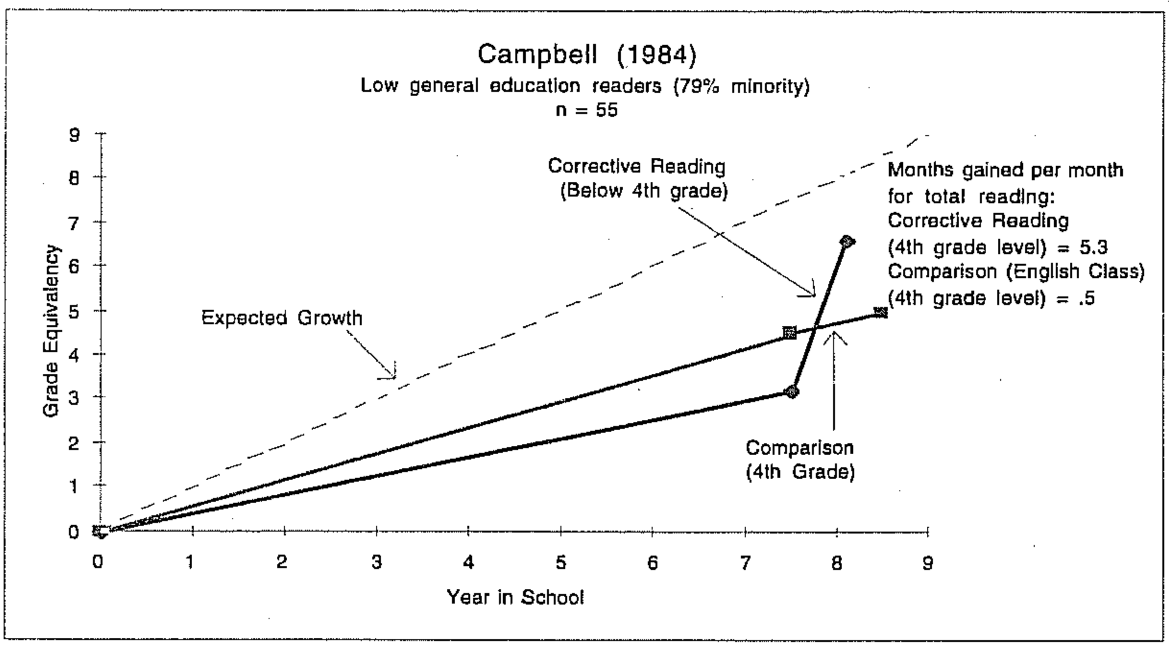

Figure 1.

Gregory, R. P., Hackney, C., & Gregory, N. M., (1982). *Corrective Reading Programme*: An evaluation. *British Journal Educational Psychology, 52*, 33 - 50.

Summary: Gregory et al. (1982) compared two groups of 6th grade regular education low readers. Thirty-six percent of the students in the experimental group were low income. The experimental group received the Decoding B program and the comparison group received the current remedial program that was a composite of various published programs. Results showed the Corrective Reading group increased on the Daniels and Diack Test of Reading Experience from a beginning mean score of 3.3 to the ending mean score of 5.1 (converted to grade level score from age scores); whereas the comparison group beginning mean score was 2.8 and the ending mean score was 3.08. Analysis of covariance showed that Corrective Reading was significantly more effective than the remedial reading program on reading measures ($p < .001$). In addition the Corrective Reading group gained 3.6 months per month for decoding and language comprehension while the comparison group gained .04 months per month of instruction. One further finding was that the Corrective Reading group showed statistical significance over the comparison group for attendance ($p < .05$) and for behavior as measured by Rutter's Behavioral Questionnaire ($p < .01$).

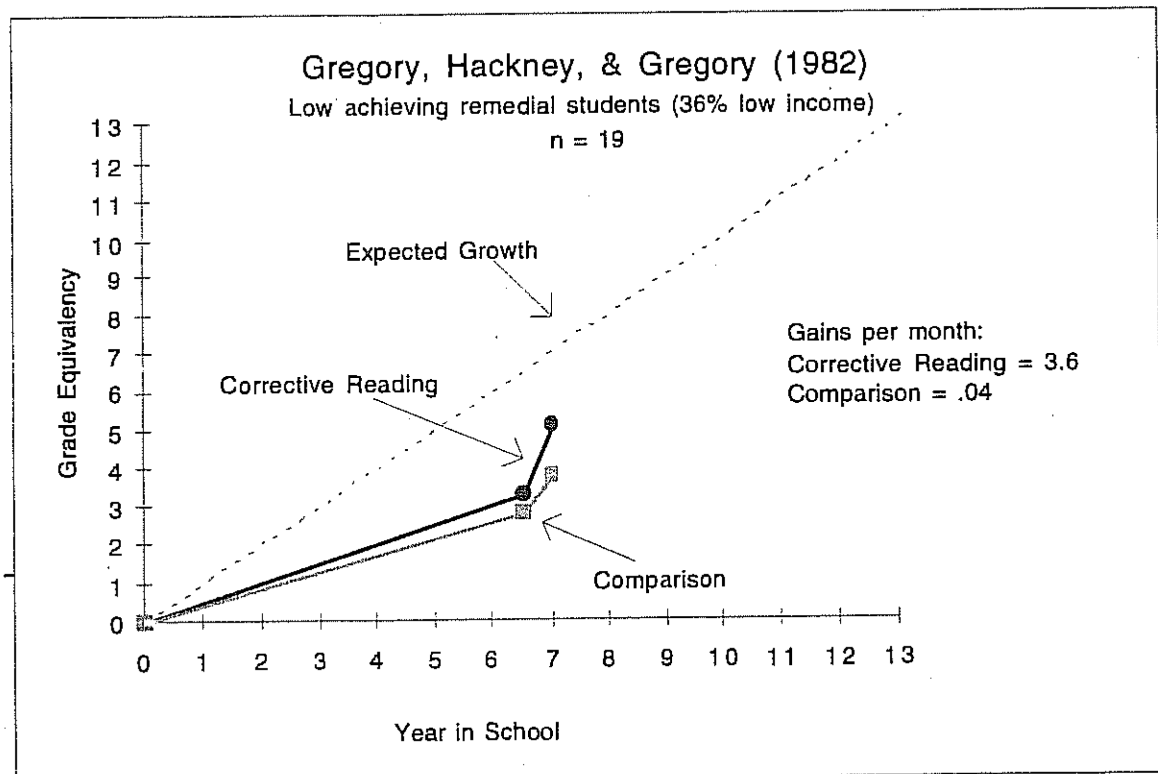

Figure 2.

RESEARCH EVALUATING CURRICULA WITH "BIG IDEA" DESIGNS

Kasendorf, S. J., & McQuaid, P. (1986). *Corrective Reading Evaluation Study.* Lottery Project, Direct Instruction for Low Achieving and Special Education Students (East County Special Education Region), San Diego County.

Summary: San Diego county implemented Corrective Reading in 14 regular and special education classrooms that served low achieving students. Thirty-six students were selected at random from the classrooms and were tested in the fall using *Woodcock Reading Mastery Test.* Thirty-two of the original thirty-six were tested again in May. Results showed that students on the average increased in word attack skills 2.38 grade levels and increased .75 grade levels in comprehension. In addition three of the students gained over 7 years on the *Word Attack* subtest while they made average progress in comprehension. Fifteen of the 32 students gained 2 years or more in word attack skills while maintaining average comprehension growth. Teachers in the study had positive comments about the program.

Holdsworth, P. (1984, Winter). *Corrective Reading* tested in U.K. *ADI News,* 4.

Summary: Corrective Reading was implemented for 9 students with mild learning difficulties in the United Kingdom. The children were enthusiastic about learning. Parents were pleased with students' reading progress. Teachers had initial reservations about the reading program, but these reservations disappeared after they gained knowledge and received daily feedback from the students. The average student gains for four months of instruction was 10.7 months for reading accuracy and 16 months for reading comprehension.

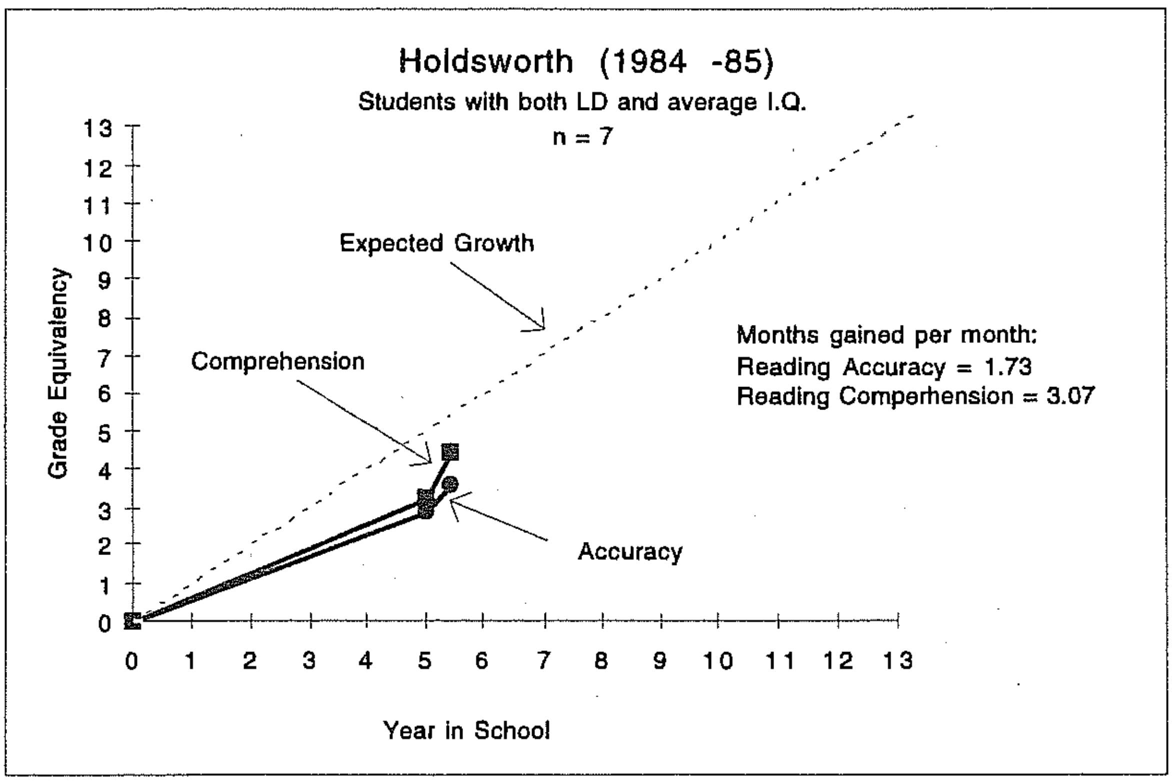

Figure 3.

Clunies-Ross, G. (Spring 1990). Some effects of direct instruction in comprehension skills on intellectual performance. *Direct Instruction News*, 18-21.

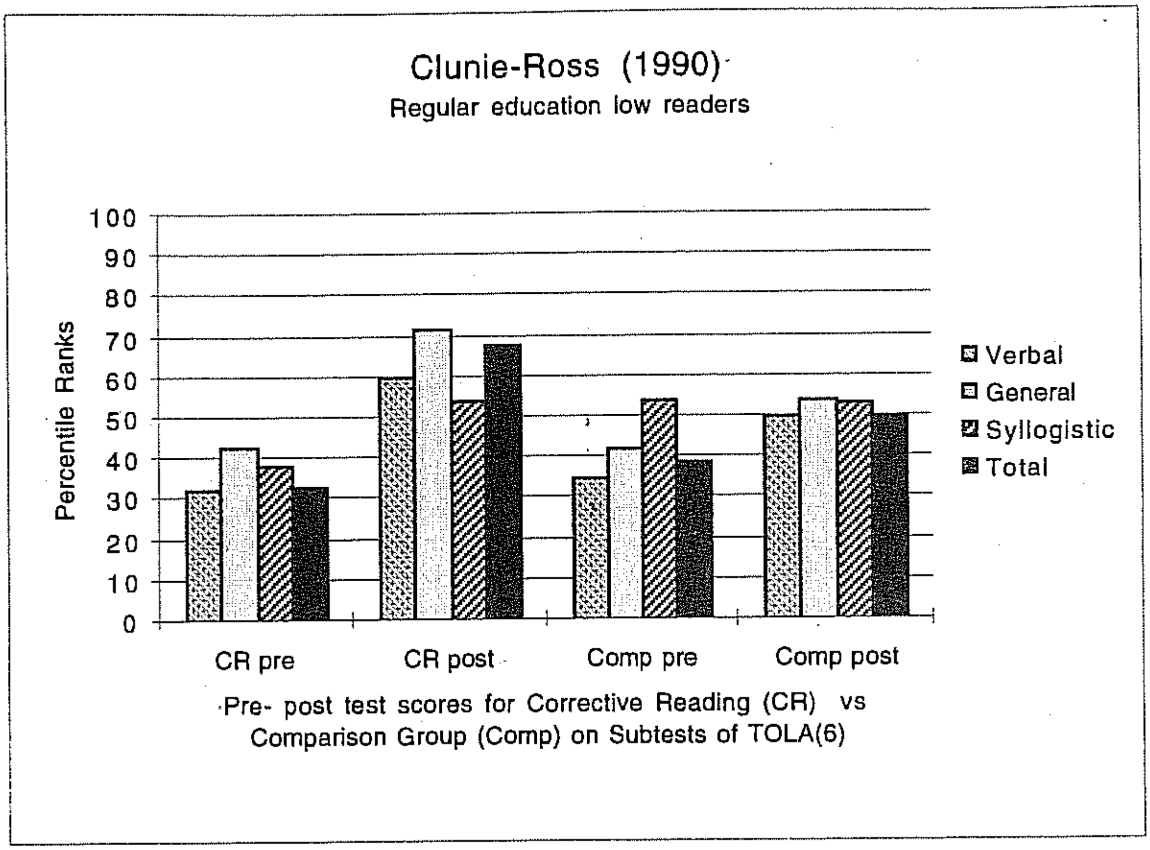

Figure 4.

Chamberlain, L. A., (Fall 1987). Using DI in a Victoria, B. C. resource room. *Direct Instruction News*, 7 - 9.

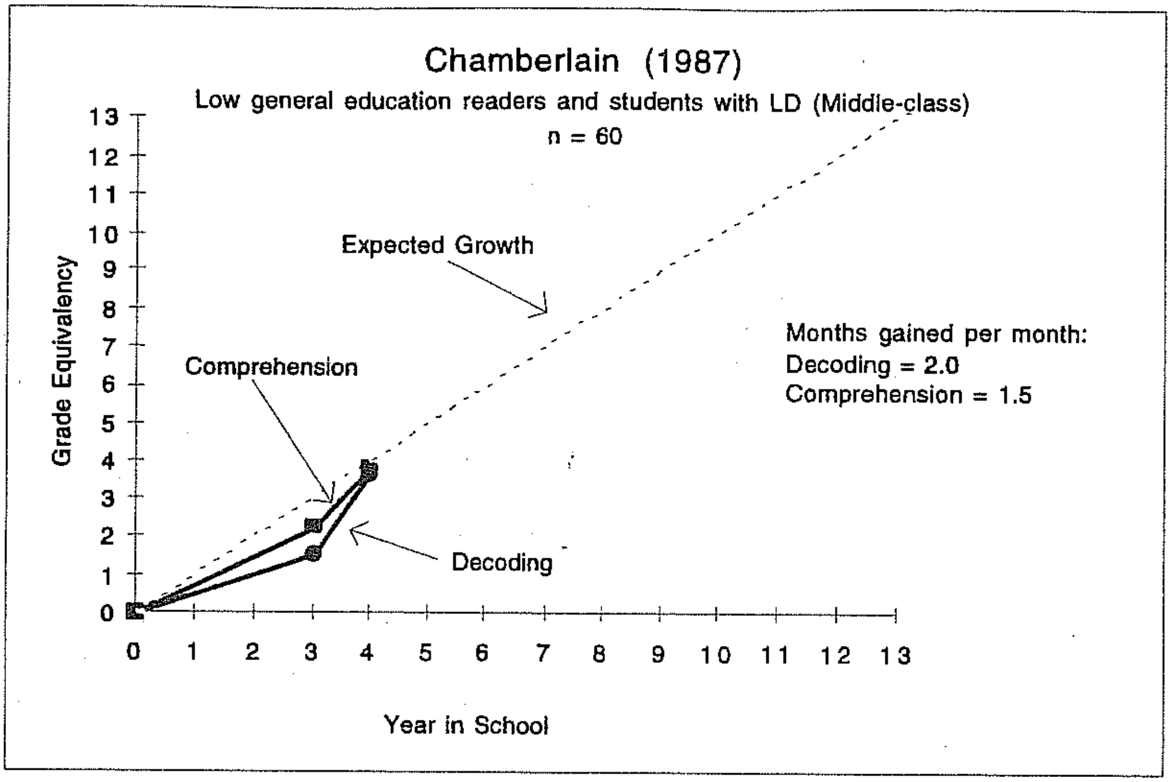

Figure 5

"Our teachers have been heartened by recent results using the Corrective Reading program with students whose reading ability was below grade level. Assessments show that these students have made significant gains in reading skills as well as an increase in self confidence."

Susan Carlile
Principal, Fowler Middle School,
Tigard-Tualatin School District, Oregon
scarlile@ttsd.k12.or.us

High Performing Schools

Applying Benchmark Practices to Create Benchmark Schools

PURPOSE To apply the best practices to accelerate the learning of all middle school students, especially at-risk students, to benchmark levels of academic performance.

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Gail Coulter, 541-744-1395
805 Lincoln
Eugene, OR 97401

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Carolyn Cittamlet
1422 S. 13th St.
Philadelphi, PA 19147
Fax: 215-551-9790

Susan Kandell
212 S. Woodhams St.
Plainwell, MI 49080-1753

Kathleen Schaefer
2668 Tareyton Cr.
Stoughton, WI 53589

Patti Clark
Phoenix Academy
11032 Oak St.
Omaha, NE 68144

Paul Koeltzow
10318 Fern Dale Rd.
Dallas, TX 75238
214-341-5373

Diana Morgan/Thaddeus Lott
Wesley Elementary
800 Dillard St
Houston, TX 77091

Ardena Harris
5309 Vineyard Lane
Flushing, MI 48433

Clark Walker
300 West 100700
Ftu Green UT 84632

Ken Traupman
248 Nutmeg St.
San Diego, CA 92103

Anna Mae Gazo
3027 Ellen Ct.
Marina, CA 93933

Cathy Watkins
1956 La Linda Ct.
Turlock, CA 95380
cwatkins@koko.csustan.edu

Ursula Garrett
PO Box 241, Apt 169
Kahuku, Hawaii 96731

Chuck Main
PO Box 8
Silverdale, WA 98303

Betty Williams
Dept. of Special Education
AD Box 25

Gonzaga University
Spokane, WA 99258

Babette Engel
343 Dungeness Meadows
Sequim, WA 98382

Helen Munson, Tricia Walsh-Caughlan
1603 NW 41st Circle
Camas, WA 98607

Larry Chamberlain
1063 Stelly's X Rd.
Brentwood 1324,
Vosiao, BC

Chuck Baxter
1085 Taugh
Ithaca, NY 14850
(607) 272-7957

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ABSTRACT: Research has documented discriminatory effects for two popular school reforms: whole language and "developmentally appropriate practice" as it has been defined by the National Association for the Education of Young Children. This edition summarizes the research evaluating effects of these reforms on the upward mobility and learning of economically disadvantaged children, minority children, and special education children. These diverse learners in programs incorporating the popular "child-centered" pedagogies are less likely to acquire the tools they will need for economic success and have lower self-esteem than children in traditional programs.

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Listing of Effective Programs $5.00
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ABSTRACT: This issue features a complete annotated listing of Direct Instruction, programs authored by Zig Engelmann and his colleagues. Also included are procedures for obtaining funding, addresses of funding sources, and a model proposal.

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ABSTRACT: The historical series reprint highlight articles and contributions from earlier editions. The featured articles in this edition are divided into the following sections: (1) Implementation strategies and issues, (2) Direct Instruction research studies, and (3) Research related to DI's goals. Russell Gersten's response to a study that is widely discussed among promoters of the current child-directed instruction reform is reprinted in this edition. That study by Schweinhart, Weikart, and Larner is highly critical of DI preschool programs. Gersten criticizes that study primarily for using self-report data to evaluate delinquency and for interpreting nonsignificant differences as if they were significant.

Historical Issue I $5.00
ADI News, Volume 7, No. 4.

ABSTRACT: The featured articles in this issue are divided into the following sections: (1) Introduction, (2) Research studies, and (3) Management strategies. These include a classic essay by Zig Engelmann "On Observing Learning," a high school follow-up study on Follow Through children in Uvalde TX, a meta-analysis of the effects of DI in special education by W.A.T. White, and other studies reporting the effects of DI in teaching English as a Second Language, poverty level preschoolers, secondary students, and moderately retarded children. Also included are classroom management tips from Randy Sprick and Geoff Colvin, along with a school-wide discipline plan.

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ISBN: 0-921912-48-X
Price: $19.95 from Macfarlane Walter & Ross
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Toronto, CA M5R 2E3
Ask for it at your local bookstore.

If Learning Is So Natural, Why Am I Going To School? (1994) by Andrew Nikiforuk.
Price: $16.99 from Penguin
ISBN: 0-14-02.4264-3
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Beginning to Read: Thinking and Learning About Print (1990) by Marilyn Jager Adams (A summary by the Center on Reading).
Price: $7.50
Mail orders to: Center for the Study of Reading
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Champaign, IL 61820

Becoming a Nation of Readers (1985)
The Report of the Commission on Reading.
Price: $7.50
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Direct Instruction Reading (Revised, 1990)
by Douglas Carnine, Jerry Silbert, & Ed Kameenui.
Price: $40.00
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Direct Instruction Mathematics (Revised, 1990) by Jerry Silbert, Douglas Carnine, & Marcy Stein.
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