When conducting a meta-analysis, a researcher translates the results of a given study into a unit of measurement referred to as an *effect size*. An effect size expresses the increase or decrease in achievement of the experimental group (the group of students who are exposed to a specific instructional technique) in standard deviation units. To illustrate, assume that the effect size computed for a specific study is 1.0. This means that the average score for students in the experimental group is 1.0 standard deviation higher than the average scores of students in the control group. Another way of saying this is that a student at the 50th percentile in the experimental group would be one standard deviation higher than a student at the 50th percentile in the control group.
Researcher Jacob Cohen (1988) presents still another way of interpreting effect sizes. He explains that an effect size of .20 can be considered small; an effect size of .50 can be considered medium; and an effect size of .80 can be considered large
Briefly, based on a survey of thousands of comparisons between experimental and control groups, using a wide variety of instructional strategies in K-12 classrooms, across a variety of subject areas, we were able to identify nine categories of instructional strategies proven to improve student achievement:

1. Identifying similarities and differences
2. Summarizing and note taking
3. Reinforcing effort and providing recognition
4. Homework and practice
5. Representing knowledge (nonlinguistic representation)
6. Learning groups
7. Setting objectives and providing feedback
8. Generating and testing hypotheses
9. Cues, questions, and advance organizers
Average Effect Size Using Higher-Level Questions
<table>
<thead>
<tr>
<th>Category</th>
<th>Ave. Effect Size (ES)</th>
<th>Percentile Gain</th>
<th>No. of ESs</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying similarities and differences</td>
<td>1.61</td>
<td>45</td>
<td>31</td>
<td>.31</td>
</tr>
<tr>
<td>Summarizing and note taking</td>
<td>1.00</td>
<td>34</td>
<td>179</td>
<td>.50</td>
</tr>
<tr>
<td>Reinforcing effort and providing recognition</td>
<td>.80</td>
<td>29</td>
<td>21</td>
<td>.35</td>
</tr>
<tr>
<td>Homework and practice</td>
<td>.77</td>
<td>28</td>
<td>134</td>
<td>.36</td>
</tr>
<tr>
<td>Nonlinguistic representations</td>
<td>.75</td>
<td>27</td>
<td>246</td>
<td>.40</td>
</tr>
<tr>
<td>Cooperative learning</td>
<td>.73</td>
<td>27</td>
<td>122</td>
<td>.40</td>
</tr>
<tr>
<td>Setting objectives and providing feedback</td>
<td>.61</td>
<td>23</td>
<td>408</td>
<td>.28</td>
</tr>
<tr>
<td>Generating and testing hypotheses</td>
<td>.61</td>
<td>23</td>
<td>63</td>
<td>.79</td>
</tr>
<tr>
<td>Questions, cues, and advance organizers</td>
<td>.59</td>
<td>22</td>
<td>1,251</td>
<td>.26</td>
</tr>
</tbody>
</table>
This handbook is organized into 11 sections. Sections 1 through 9 address the nine categories of instructional strategies listed. These strategies can be applied to all types of content, at all grade levels, with all types of students. Section 10 addresses instructional strategies that are most appropriate with specific types of knowledge, such as vocabulary terms, generalizations, and processes. Finally, Section 11 presents a framework for using the instructional strategies to improve your effectiveness in unit planning.
The introduction in each section of the handbook is followed by one or more "modules" that specifically address the strategies within the section. Each module contains eight components:

1. Introduction - Each module begins with a brief introduction to the strategies presented in the module. It explains why the specific strategies in the module have been grouped together.
2. Reflecting on My Current Beliefs and Practices - This component asks you to reflect on how and why you currently use strategies that you will be studying in the module. The intent is to stimulate your thinking about your use of the strategies so that you will have a basis of comparison as you read about the strategies in the module.
3. Recommendations for Classroom Practice - The heart of each module is a set of recommendations for classroom practice. These recommendations may deal with specific strategies and techniques or they may be generalizations about classroom practice. Each strategy or recommendation is discussed and exemplified.
4. Checking My Understanding - After the discussion of recommended classroom practices, a hypothetical situation or problem is presented. The intent is to give you an opportunity to apply what you have learned in the previous discussion. If you find it difficult to complete this hypothetical situation or problem, we recommend that you reread the content in "Recommendations for Classroom Practice."
5. Assessing the Impact on Students - Each module contains rubrics that can be used to assess how the strategies affect students' learning.
6. Planning My Classroom Activities - A series of questions is presented that, when answered, help you determine how you might use the strategies presented in the module in the context of your current practice.
7. Assessing Myself - A series of questions helps you assess how effectively you use the strategies presented in the module.
8. Module Reflection - A series of questions asks you to reflect on what you have learned about the strategies presented in the module and what you have learned about yourself as a teacher and a learner.
Let’s begin with Module 11 on page 143

• Reflect on your current practices on page 144
Research indicates that each of the following activities enhances the development of nonlinguistic representations in students and, therefore, enhances their understanding of that content:

*Creating graphic representations*
*Making physical models (pictoral)*
*Generating mental pictures*
*Drawing pictures and pictographs*
*Engaging in kinesthetic activity*

**Nonlinguistic representations should elaborate on knowledge.** In simple terms, elaboration involves "adding to" knowledge. That is, when a student generates a nonlinguistic representation of knowledge, by definition, she has elaborated on it. Finally, the power of elaboration can be enhanced by asking students to explain and justify their elaborations.
Creating Graphic Organizers

Graphic organizers are perhaps the most common way to help students generate nonlinguistic representations.

Actually, graphic organizers combine the *linguistic mode* in that they use words and phrases, and the nonlinguistic mode in that they use symbols and arrows to represent relationships. The following six graphic organizers have great utility in the classroom because they correspond to six common patterns into which most information can be organized:

*descriptive patterns,*
*time-sequence patterns,*
*process/cause-effect patterns,*
*episode patterns,*
*generalization/principle patterns,* and
*concept patterns.*
Descriptive Patterns. Descriptive patterns can be used to represent facts about specific persons, places, things, and events. The information organized into a descriptive pattern does not need to be in any particular order.
**Time-Sequence Patterns.** Time-sequence patterns organize events in a specific chronological order. For example, information about the development of the Apollo space program can be organized as a sequence pattern.
Process/Cause-Effect Patterns. Process/cause-effect patterns organize information into a causal network leading to a specific outcome or into a sequence of steps leading to a specific product. For example, information about the factors that typically lead to the development of a healthy body might be organized as a process/cause-effect pattern. Figure 6.4 shows a graphic representation of a process/cause-effect pattern.
**Episode Patterns.** Episode patterns organize information about specific events, including (1) a setting (time and place), (2) specific people, (3) a specific duration, (4) a specific sequence of events, and (5) a particular cause and effect.
Generalization/Principle Patterns. Generalization/principle patterns organize information into general statements with supporting examples. For instance, for the statement, "A mathematics function is a relationship where the value of one variable depends on the value of another variable," students can provide and represent examples in a graphic form.
Concept Patterns. Concept patterns, the most general of all patterns, organize information around a word or phrase that represents entire classes or categories of persons, places, things, and events. The characteristics or attributes of the concept, along with examples of each, should be included in this pattern.
The following example shows how a student might use more than one graphic organizer with a single topic.

When Ty Crocker studied for his test on Law and the Legal System, he found a good way to remember the three common methods for solving disputes out of court. He matched each of the three methods, arbitration, negotiation, and voluntary mediation, to a different kind of graphic organizer he had learned in his English class. For the topic of arbitration, he used a "time-sequence pattern." For negotiation, he used a "process or cause-effect pattern." He created a "concept pattern" for voluntary mediation.
### Time-Sequence Pattern in Arbitration

<table>
<thead>
<tr>
<th>Step 1:</th>
<th>A dispute originates between two parties.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2:</td>
<td>Both parties agree to have another person listen to their arguments and make a decision for them.</td>
</tr>
<tr>
<td>Step 3:</td>
<td>The court appoints an arbitrator.</td>
</tr>
<tr>
<td>Step 4:</td>
<td>In a setting much less formal than a trial, the arbitrator listens to both sides.</td>
</tr>
<tr>
<td>Step 5:</td>
<td>The arbitrator makes his or her final decision, and the parties must abide by it.</td>
</tr>
</tbody>
</table>
Process/Cause-Effect Pattern for Negotiation

A dispute arises between two parties. → Each side shares important facts. → A settlement is reached.

Party One Behavior

A third party (attorney) works out the settlement terms.

Party Two Behavior
Concept Pattern for Voluntary Mediation

- Landlords and tenants
- Consumers and businesses
- Neighborhood Justice Centers
- Better Business Bureau
- Schools
- Husbands and wives

Voluntary Mediation

- Led by a variety of people
  - Peer Mediators
  - Ombudsperson
    - Investigates complaints
    - Helps reach an agreement
    - Neutral third party
    - Suggests alternatives
  - Local resource networks
  - Courts
  - District Attorney's Office
  - Social Services
Using Other Nonlinguistic Representations
Making Physical Models. As the name implies, physical models are concrete representations of the knowledge that is being learned. Mathematics and science teachers commonly refer to the use of concrete representations as "manipulatives." The very act of generating a concrete representation establishes an "image" of the knowledge in students' minds.
Generating Mental Pictures. The most direct way to generate nonlinguistic representations is to simply construct (i.e., imagine) a mental picture of knowledge being learned. For abstract content, these mental pictures might be highly symbolic. To illustrate, psychologist John Hayes (1981) provides an example of how a student might generate a mental picture for the following equation from physics:

\[
(M_1 M_2)G
\]

\[
F = \____________________
\]

\[
r^2
\]

The equation states that force \((F)\) is equal to the product of the masses of two objects \((M_1 \text{ and } M_2)\) times a constant \((G)\) divided by the square of the distance between them \(r^2\).
Drawing Pictures and Pictographs. Drawing pictures or pictographs (i.e., symbolic pictures) to represent knowledge is a powerful way to generate nonlinguistic representations in the mind. For example, most students have either drawn or colored the human skeletal system or have seen a picture of one in the classroom. Similarly, most students have drawn or colored a representation of the solar system. A variation of a picture is the pictograph, which is a drawing that uses symbols or symbolic pictures to represent information. The following example shows how a 1st grade teacher uses symbolic pictures in a geography lesson.
Student Pictograph

- Spring
- Summer
- Fall
- Winter
- March 20 Equinox
- June 21
- Sept 23 Equinox
- Dec 22

Zach
Engaging in Kinesthetic Activity. Kinesthetic activities are those that involve physical movement. By definition, physical movement associated with specific knowledge generates a mental image of the knowledge in the mind of the learner. (Recall from the previous discussion that mental images include physical sensations.) Most children find this both a natural and enjoyable way to express their knowledge. The following example below illustrates this in the context of a math class.
Often, to take a brief pause in math class, Ms. Jenkins asks her 4th grade students to think of ways they can represent what they are learning. For example, during the lesson on radius, diameter, and circumference of circles, Barry uses his left arm outstretched to show radius, both arms outstretched to show diameter, and both arms forming a circle to show circumference. During a different lesson on angles, Devon depicts obtuse and acute angles by making wide and not-so-wide "Vs" with her arms as the children yell out the degrees. They even have ways to show fractions, mixed numbers, and turning fractions into their simplest forms.

Ms. Jenkins started the activity she called *Body Math* just to give the students a break from the routine of doing math drills, but then realized that it was a powerful way for students to show whether or not they understood the concept behind the problems. Once the word got around, other students could be seen peeking in the classroom to see what they were doing that day with body math.
A Study Team Scenario

Handout
Identifying Similarities and Differences

• Research tells us that students need explicit structure when they first begin identifying similarities and differences. As they progress, however, students can use the process on their own to stimulate a wide-ranging exchange of ideas.

• Research also shows graphic and symbolic representations can help students to understand and effectively use processes for identifying similarities and differences.
Modules for Identifying Similarities and Differences

• Comparing
• Classifying

• Metaphors
• Analogies
Comparing

• To compare is to identify similarities and differences between or among things or ideas.
• Comparing is a complex process that students will need to learn about and practice.

Approaches for classroom use include:
• Giving students a model for the process
• Using familiar content to teach students the steps for comparing
• Giving students graphic organizers for comparing
• Guiding students as needed
Venn Diagrams

See page 13
• Show similarities and differences for two different items based on one characteristic.

Rainforest and Desert Animals

Amazon Rain Forest
- Spider monkey
- Fer-de-lance pit viper
- Three-toed sloth
- Jaguar
- Giant river otter

Mojave Desert
- Bats
- Iguana
- Ants
- Big horn sheep
- Tarantula
- Coyote
- Desert tortoise
- Mohave rattlesnake
Comparison Matrix

• Used to graphically represent similarities and differences between multiple items

• Students need more detailed instruction to use

• Include a space for students to write their conclusions, which helps to bring together the pieces of comparison and reflect on what they have learned
## Sample Comparison Matrix

See Page 14

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>1 cm square</th>
<th>2 cm square</th>
<th>Rectangle: width 4 cm length 6 cm</th>
<th>Rectangle: width 3 cm length 7 cm</th>
<th>Rectangle: width 3 cm length 8 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter</td>
<td>4 cm</td>
<td>8 cm</td>
<td>20 cm</td>
<td>20 cm</td>
<td>22 cm</td>
</tr>
<tr>
<td>Area</td>
<td>1 sq cm</td>
<td>4 sq cm</td>
<td>24 sq cm</td>
<td>21 sq cm</td>
<td>24 sq cm</td>
</tr>
<tr>
<td>Conclusions</td>
<td>Two rectangles can have the same perimeter but different areas. That also means that a square and a rectangle could have the same perimeter but different areas. Also, two rectangles can have the same area, but different perimeters. If you double the size of a square, the perimeter doubles, but the area increases 4 times.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Classifying

• Classifying involves grouping things into definable categories based on like characteristics

Approaches for classroom use include:
• Giving students a model for the process
• Using familiar content to teach students the steps in classifying
• Giving students graphic organizers for classifying
• Guiding students as needed

**Classifying involves the critical step of determining the rules that govern the classification process
Thinking about what defines a particular group and why an item fits into the group helps students learn more about the content they are studying.**
Model for Classifying

Steps for Classifying

• Identify the items you want to classify
• Select what seems to be an important item, describe its key attributes, and identify other items that have the same attributes
• Create the category by specifying the attributes that the items must have for membership in the category
• Select another item, describe its key attributes, and identify other items that have the same attributes
• Create the second category by specifying the attributes that the items must have for membership in the category
• Repeat the previous two steps until all items are classified and the specific attributes have been identified for membership in each category
• If necessary, combine categories or split them into smaller categories and specify the attributes that determine membership in the category.

(See page 23 for Younger Student Model)
## Classification Organizer

### FIGURE 2.4

**Classification Organizer—Art Materials, Techniques, and Processes**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Art Materials</th>
<th>Art Techniques</th>
<th>Art Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plum</td>
<td>Overlapping</td>
<td>Adding in sculpture</td>
</tr>
<tr>
<td></td>
<td>Clay</td>
<td>Shading</td>
<td>Subtracting in sculpture</td>
</tr>
<tr>
<td></td>
<td>Charcoal</td>
<td>Varying Size</td>
<td>Casting jewelry</td>
</tr>
<tr>
<td></td>
<td>Pencil</td>
<td>Varying Color</td>
<td>Constructing jewelry</td>
</tr>
<tr>
<td></td>
<td>Wood</td>
<td>Collage</td>
<td>Mixing color</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perspective</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stippling</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glaze</td>
<td><strong>Blackline master available, p. 354</strong></td>
</tr>
</tbody>
</table>
Creating Metaphors

When we create metaphors, we identify a general or basic pattern in a specific topic and then find another topic that seems quite different at the literal level but has the same general pattern.

Approaches for classroom use include:
• Giving students a model for the process
• Using familiar content to teach students the steps in creating metaphors
• Giving students graphic organizers for creating metaphors
• Giving students guidance as needed
Model for Metaphors

Steps for Creating Metaphors

1. Identify the important or basic elements of the information or situation with which you are working
2. Write that basic information as a general pattern by:
   • Replacing words for specific things with words for more general things
   • Summarizing information whenever possible
3. Find new information or a situation to which the general pattern applies.

Steps for Creating Metaphors for Younger Students

1. What is important here?
2. How can I say the same thing in a more general way?
3. What else has the same general pattern?
Sample Metaphor Organizer
Analogies

• Creating analogies is the process of identifying relationships between pairs of concepts.
• Analogies help us make connections between things that seem very different.
• Analogies help explain unfamiliar concepts by making a comparison to something that we understand.

Examples
A:B::C:D
happy:sad::big:small
one:trillion::one square inch:the area of the city of Chicago
Analogies

Approaches for classroom use include:

• Giving students a model for the process
• Using familiar content to teach students the steps in creating analogies
• Giving students graphic organizers for creating analogies
• Giving students guidance as needed
A Model for Analogies

Steps for Creating Analogies
1. Identify how the two elements in the first pair are related
2. State their relationship in a general way
3. Identify another pair of elements that share a similar relationship

Steps for Creating Analogies for Younger Students
1. What is the connection between the first two things?
2. How can I describe this connection?
3. Do the second two things have a connection like the first two?
Summarizing and Note Taking
Summarizing

• Something we do automatically
• We pick and choose what is important
• Restate information in a brief, synthesized fashion
• Find the main pattern
Two Elements to Summarizing

1. Filling in Missing Parts
   - Making inferences

2. Translating information into a synthesized form
   - Restating information in our own terms
Recommendations for Classroom Practice

- Teaching students the rule-based summarizing strategy
- Using summary frames
- Teaching students reciprocal teaching and the group-enhanced summary
Rule-based Summarizing Strategy

Steps to follow:

1. Take out material that is not important for your understanding.
2. Take out words that repeat information.
3. Replace a list of things with the word that describes the things in the list.
4. Find or invent a topic sentence.
Summary Frames

What are summary frames?
They are a series of questions designed to highlight the important elements of specific patterns commonly found in the text.
Examples of Summary Frames

• Narrative Frame (p. 64)
• Topic-Restriction Illustration Frame (p. 65)
• Definition Frame (p. 66)
• Argumentation Frame (p. 67)
• Problem or Solution Frame (p. 69)
• Conversation Frame (p. 71)
Teach Reciprocal Teaching and Group-Enhanced Summary

Steps

1. Summarizing: After reading a short section or passage, a student leader summarizes text. Other students in group add to summary or teacher may point out clues.

2. Questioning: The student leader asks questions to which group responds.

3. Clarifying: The student leader tries to clarify confusing parts of passage either by asking questions or by asking another student to clarify. Re-reading material may be necessary.

4. Predicting: The student leader asks for predictions of what may happen next.
Notetaking

- One of the most useful study skills a student can cultivate
- Students need to think about and shape information they are recording.
- Not often taught by teachers
- Simply recording information verbatim is not effective.
Each of us has our own personal style
- Arrows, bullets, capitals and indentations, underlines, flowcharts and doodles.

The goal of the teacher
- Give students note-taking strategies in order to design their own styles.
Note-taking Formats

1. Informal Outline
   - Uses indentation to indicate major ideas and details

2. Web
   - Uses circles to indicate importance of ideas and lines to indicate relationships.
   - Disadvantage: limits the amount of information a student can record.

3. Combination Notes
   - Each page is divided into two parts. One side is informal outlining and other side use webbing or pictures.
   - May take extra time but more useful for students.
Helpful Tips for Students

1. Provide students with teacher-prepared notes.
   - Models note-taking skills and gives the students a clear idea.

2. Remind students to review their notes, especially before a quiz or test.
Belief that hard work and determination—effort—will lead to success has the greatest effect on achievement.
GUIDELINES FOR PRAISE – PAGE 110

FOSTER THAT THE STUDENTS ENJOY THE TASK

SPONTANEITY IS DELIVERED SPECIFICALLY CONTINGENTLY DIRECTED
THE PAUSE, PROMPT, AND PRAISE TECHNIQUE
Connecting a token to the attainment of an identified performance standard makes the recognition concrete and contingent on achieving a goal. Avoid rewarding students for simply completing an activity.