Effects of Three Multimedia Instructional Presentation Formats Containing Animation and Narration on Recall and Problem-Solving Performance

by

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(ABSTRACT)

The use of multimedia in instruction is becoming increasingly popular. A large wealth of multimedia products are now available to teachers. Products such as interactive books, multimedia encyclopedias, computer-based instructional programs, and CD-ROMs are being incorporated into classroom instruction. Most recently, improvements in hardware and software have made it possible for educators to design and develop instructional multimedia presentations for their own use. Despite the increased use of multimedia instructional materials, there is still relatively little research investigating the effects of multimedia attributes, such as animation and narration, upon the learning outcomes of recall and problem-solving.

The purpose of this study was to examine the effects of three different formats of instructional multimedia presentations on the recall and problem-solving performance of novice-level learners. In this study, participants were randomly assigned to view computer-based presentations covering two topics. Participants receiving the words-before-pictures treatments viewed programs containing narration followed by animation; participants receiving the pictures-before-words treatments viewed programs containing animation followed by narration; participants receiving the words-with-pictures treatments viewed programs containing animation and narration, simultaneously.
Recall and problem-solving tests were administered immediately following the treatments to measure recall and problem-solving performance. There were no significant differences among the three treatment groups. Further investigation also revealed that participants taking the recall test first scored higher in recall than participants taking the problem-solving test first.
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# TABLE OF CONTENTS

ABSTRACT .................................................................................................................. ii
ACKNOWLEDGMENTS ........................................................................................... iv
TABLE OF CONTENTS .............................................................................................. v
LIST OF TABLES ....................................................................................................... viii
LIST OF FIGURES .................................................................................................... ix

CHAPTER I: INTRODUCTION

Background ............................................................................................................... 1
Need for the Study ................................................................................................. 1
Purpose of the Study ............................................................................................ 2
Contributions of the Study .................................................................................. 3
Organization of the Study ................................................................................... 3

CHAPTER II: REVIEW OF THE LITERATURE

Introduction .......................................................................................................... 4
Visual Verbal Relationships ............................................................................... 6
Categories ........................................................................................................... 7
Combinations ....................................................................................................... 9
Degrees .................................................................................................................. 9
Roles ....................................................................................................................... 14
Theory .................................................................................................................... 17
Dual Coding ......................................................................................................... 17
   Processing Operations ....................................................................................... 19
   Relations Between Systems ........................................................................... 20
   Representational Processing ......................................................................... 20
   Opposing Views to Dual-Coding .................................................................. 21
Advance Organizers ......................................................................................... 24
   Constructing Advance Organizers ............................................................... 26
Conceptual Models ............................................................................................ 27
   Constructing Conceptual Models ................................................................. 30
Research on Visuals and Verbals ................................................................. 30
Static Visuals ....................................................................................................... 31
CHAPTER III: METHODOLOGY
Introduction ........................................................................ 43
  Population and Sample .................................................. 42
Materials and Apparatus .................................................... 44
  Selection Measures ....................................................... 44
  Questionnaires and Tests .............................................. 45
Procedure .......................................................................... 46
  Presentation ................................................................. 47
  Testing .......................................................................... 50
  Scoring .......................................................................... 53
Pilot Study ......................................................................... 54
Method of Analysis .......................................................... 56

CHAPTER IV: RESULTS OF THE STUDY
Description of Participants ................................................. 57
Results ............................................................................. 57
  Primary Analysis .......................................................... 58
    Hypothesis One ......................................................... 58
    Hypothesis Two ......................................................... 59
Secondary Analysis .......................................................... 60
Summary ........................................................................... 61

CHAPTER V: SUMMARY, DISCUSSION, AND CONCLUSION
Summary ........................................................................... 63
Discussion ......................................................................... 66
LIST OF TABLES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functions of Text Illustrations</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>Symbolic Systems</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Presentation Combinations</td>
<td>48</td>
</tr>
<tr>
<td>4</td>
<td>Test Formats</td>
<td>48</td>
</tr>
<tr>
<td>5</td>
<td>Mean Problem-Solving Scores as a Function of Presentation Type</td>
<td>59</td>
</tr>
<tr>
<td>6</td>
<td>Mean Recall Scores as a Function of Presentation Type</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>Mean Problem-Solving Scores as a Function of Test Order</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>Mean Recall Scores as a Function of Test Order</td>
<td>61</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Review of the Literature Model</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>Visual Categories</td>
<td>8</td>
</tr>
<tr>
<td>3.</td>
<td>Two Major Classes of Verbals</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Degrees of Visuals and Verbals</td>
<td>10</td>
</tr>
<tr>
<td>5.</td>
<td>Typology of Visual and Verbal Relationships</td>
<td>13</td>
</tr>
<tr>
<td>6.</td>
<td>Orchestration of Visual and Verbal Roles</td>
<td>15</td>
</tr>
<tr>
<td>7.</td>
<td>Dual-Coding Model</td>
<td>21</td>
</tr>
<tr>
<td>8.</td>
<td>Propositional Representation Model</td>
<td>24</td>
</tr>
<tr>
<td>9.</td>
<td>Roles of the Advance Organizer</td>
<td>26</td>
</tr>
<tr>
<td>10.</td>
<td>Three Presentation Design</td>
<td>38</td>
</tr>
<tr>
<td>11.</td>
<td>Two Presentation Design</td>
<td>47</td>
</tr>
<tr>
<td>12.</td>
<td>Schematic Design of the Research Procedure</td>
<td>53</td>
</tr>
<tr>
<td>13.</td>
<td>One Presentation Design</td>
<td>56</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Background

Educators have often deliberated over ways to explain new material to their students in an understandable way. Most recently, educators have inquired how multimedia instruction can promote understanding through the presentation of sound, graphics, animation, video, and text. Perhaps, some of the most dynamic features of multimedia are digital animation and sound. Many software developers are now incorporating these features into their instructional products. Programs such as multimedia encyclopedias and interactive books allow the user to not only see, but also to hear sounds and narration associated with their topic of interest. Like multimedia encyclopedias and books, multimedia instructional presentations often combine the use of text, graphics, sound, animation, and video. With the introduction of multimedia authoring systems, these instructional presentations are now being designed and developed by teachers.

Need for the Study

Better understanding of the relationships between animation and narration, and the learning outcomes of recall and problem-solving, is one of the keys to sound design of instructional multimedia materials. Although educators have embraced multimedia with optimism, there is still relatively little research on how to effectively design multimedia instruction. The use of attributes such as animation and narration has continued to
increase due to the wide-spread availability of computers, authoring systems, and video/graphics tools. This availability has made it possible for educators to design and develop their own instructional presentations using visuals such as animation. Theories such as Paivio's (1979) dual-coding theory and frameworks such as Ausubel's (1980) advance organizers and Mayer's (1989) conceptual models of systems are often cited as underlying principles for the use of animation and multichannel instruction. The question of whether animation can be accepted as an extension of these theories and models must be researched further (Rieber & Kini, 1991). Educators must look at these attributes of narration and animation and their relationships with outcomes such as recall and problem-solving performance so that they might learn how to better-design multimedia instructional materials.

**Purpose of the Study**

This study was designed to investigate the relationships between animation and narration and recall and problem-solving performance, thus shedding light on how educators can better design instructional multimedia presentations. The purpose of this study was to determine the effects of presentation type on recall and problem-solving test performance. In this study, three types of computer-based multimedia presentations were compared to each other in terms of recall and problem-solving performance. In the experiment, there were three groups receiving the following types of presentations: words-and-pictures, words-before-pictures, and pictures-before-words. The groups receiving words-and-pictures presentations received narration and animation together; the groups receiving words-before-pictures received narration before animation; and the
groups receiving pictures-before-words received animation before narration. The content of each of the presentations involved either the mechanics of a bicycle pump or sound production on a musical brass instrument.

**Contributions of the Study**

It is the intent of this researcher to contribute more empirical data on the use of words and pictures in instructional multimedia presentations. Only by investigating the relationships between multimedia and outcomes such as problem-solving and recall can we hope to fully understand the possibilities of instructional multimedia presentations. It is hoped that this will, in turn, help educators to develop more appropriate and instructionally sound presentations using animation and narration.

**Organization of the Study**

The subsequent chapters are organized as follows:

1. Chapter 2 contains a review of the literature and research related to visual-verbal relationships, dual coding, advance organizers, conceptual models, static visuals, animation, animation and narration, and design considerations.

2. Chapter 3 contains procedures followed in conducting the study and the research methodology used in treating the data.

3. Chapter 4 presents the results of the study.

4. Chapter 5 includes the summary, discussion, and conclusion
CHAPTER II
REVIEW OF THE LITERATURE

Introduction

This review of the literature is organized after a model which establishes order to the overwhelming task of compiling, organizing, and prioritizing theory and research (see Figure 1). It is hoped that this organizer will help the reader as much as it has helped me in understanding the framework for the review of the literature leading to this study. The beginning of this literature review, as depicted in the model, starts with a broad spectrum of relationships. This review begins with visual verbal relationships - how the visual world interacts with the verbal world. These relationships can be classified into four groups: 1) categories of visuals and verbals, 2) combinations of visuals and verbals, 3) degrees of visuals and verbals, and 4) roles of visual and verbals. Categories of visuals and verbals investigates the different classifications of visual and verbal information based upon factors such as size, content, and intended audience. Combinations of visuals and verbals looks at the many different combinations which are possible when using visual and verbal information. Degrees of visuals and verbals describes the degrees to which presentations use visual (pictorial and graphic) and verbal information. Roles of visuals and verbals investigates the many different roles and functions of visuals when accompanying verbal information.

Moving inward toward the center of the model, we find some of the theories directly involved in the use of visual and verbal information. These theories include: 1) dual-coding theory, 2) the use of advance organizers, and 3) the use of conceptual models which act as organizers. The section on dual-coding theory examines the assumptions
behind Allen Paivio's dual-coding theory: processing operations, relations between the
systems, and representational processing. Also described are the views by researchers
opposing dual-coding theory. The advance organizers section describes Ausubel's theory
of cognitive structures, the role of advance organizers in learning, and how to properly
construct advance organizers. The section on conceptual models extends the use of the
advance organizer into Mayer's conceptual models which are made up of words and/or
diagrams which aid the learner in formulating mental models of new material. Also
included, are ways of constructing conceptual models.

As we move inward again in the model, we come to research. The research on
visuals and verbals section describes studies on 1) static visuals, 2) animation, and 3)
amination and narration. Static visuals details the findings of researchers such as Rieber
on the use of static visuals in instruction. Animation investigates the use of animation in
instruction, as well as describes guidelines in developing instructional sequences using
animation. The animation and narration section concentrates on the studies of Baggett
and Ehrenfeucht (1983), Baggett (1984), and Mayer and Anderson (1991, 1992) which
provide the main focus for this study.

The inner-most circle in the model depicts the design of a study investigating
learning. According to Mayer (1993), to properly investigate learning we must define
four properties of the learning situation to be studied. These four properties are: 1)
instructional method, 2) learning outcome, 3) learner characteristics, and 4) instructional
material. In this section, each of these properties are defined in terms of this study.
When interpreting this review of the literature, the reader is encouraged to refer back to
the model. It is hoped that the use of the model will help the reader synthesize the many
aspects of the literature resulting in this study.
Visual-Verbal Relationships

When discussing visual-verbal relationships, one must first come to an understanding of the terms visual and verbal. When we use the term visual we describe items such as charts, pictures, graphs, drawings, and other visible things which are used in communication other than printed words (Braden, 1994). On the other hand, when we
use the term verbal (used as a descriptive noun in this case), we describe words which are written or spoken. It is important to note that visuals use only the visual senses, whereas verbals use both visual and auditory senses. With the definitions of visual and verbal information understood we can now investigate the relationships between the two.

**Categories**

There are several different ways to understand the relationships between visual and verbal information. Perhaps the simplest way is to categorize the characteristics of visuals and verbals separately. Visuals can be categorized by size, intended audience, content, and numerous other ways. However, visuals most naturally fall into categories according to the visuals' own characteristics. Braden (1994) reports how visuals easily fall into three basic categories: static, dynamic, and personal (see Figure 2). Static visuals include drawings, pictures, computer graphics, and any other visuals which do not move. Dynamic visuals include film, animation (including computer animation), video, and other forms of moving visuals. In what he calls personal visuals, Braden (1994) describes sign language, pantomime, body gestures, and any other forms of communication which use the body. Obviously, each of the different categories can be, and are most often, intertwined with each other.
Like their visual counterparts, verbals can also be categorized according to their characteristics. Braden discusses two major classes of verbals: written (static) and spoken (dynamic) (see Figure 3). Written verbals include textual items such as written words. These static verbals can be printed, displayed on a computer monitor, or projected on a screen. Spoken verbals include the language form of communication such as spoken words and animated forms of text. These verbals are defined by their dynamic attributes.
Combinations

When we merge visual and verbal information, the result is a matrix showing the different possible combinations. Braden (1994) depicts a chart which helps to illustrate the many combinations. Braden shows the many variations and combinations obtainable when using visuals and verbals. For example, dynamic verbals can be complimented by dynamic visuals. Or, for another example, static visuals can be accompanied by dynamic verbals. The main point, however, is not to identify each of the possibilities, but to understand that visuals and verbals have numerous groupings when being presented in an instructional setting.

Pettersson (1989) describes linguistic combinations of visual and verbal language such as: audio-verbal, verbo-visual, oral-visual, lexi-visual, audio-visual, and even verbo-audio-visual. Once again, use of this type of designation helps us to see the many possible combinations of visual verbal information.

Degrees

Not only can visuals and verbals be used in different combinations, they can also be used in different degrees. For example, some forms of presentations utilize almost exclusively textual (verbal) information, such as many textbooks. Comic books, on the other hand, are mostly visual, with verbal information presented in the form of dialogue bubbles. Likewise, television advertisements, often use strong visual images, with occasional text to emphasize the visuals. In an attempt to organize the different degrees
of the use of visuals and verbals, Wileman (1980) outlined three basic ways to describe objects: 1) pictorial symbols, 2) graphic symbols, and 3) verbal symbols (see Figure 4).

Figure 4 Degrees of Visuals and Verbals (Wileman, 1980)

Pictorial symbols can be produced as 3-D models, sculptures, drawings, illustrations, and photographs. Graphic symbols can be produced in three ways: as image related graphics, concept-related graphics, or as arbitrary graphics (Wileman, 1980). Image related graphics are constructed as silhouettes or profiles of the desired subject. Concept-related graphics are constructed as the image related object, but with less detail. Wileman (1980) states that concept-related graphics are the essence of the object. The most abstract of the graphics are the arbitrary graphics. These graphics often take the form of geometric shapes and are unrelated to the true shape of the original object. Verbal
symbols are produced ranging from: 1) whole sentences to 2) single words. Whole sentences can be used to describe an object to the audience or single words, such as nouns and labels can be used to name the object. It is important to note however, that in order for verbal symbols to be used successfully, the audience must have at least a basic understanding of the verbal language which is used.

Although she does not address verbal symbols, Alesandrini (1984) divides graphics and illustrations into three types: representational, analogical, and abstract. Like Wileman's pictorial symbols, representational graphics include visuals which are a realistic depiction of the original object. These visuals can range from actual pictures to line drawings. Analogical graphics make use of analogies in the display of graphics. A concept is explained by implying similarities between the concept and something familiar (Alesandrini, 1985). The last types of graphics discussed by Alesandrini are the abstract graphics. This category can be compared to Wileman's graphic symbols category. Abstract graphics might make use of charts, maps, and diagrams, as well as abstract renditions of objects such as geometric shapes.

Pettersson (1989), extends his earlier descriptions to outline what he calls infography, or the structured combinations of text and graphics. These information graphics can be classified into seven forms, based upon their content:

1) instruction graphics
2) presentation graphics
3) explanatory graphics
4) news graphics
5) signal graphics
6) locating graphics
7) expo graphics
In his typology of visual and verbal image relationships, Wileman (1980) describes seven types of images (or presentation slides). Wileman begins with what he calls the type I reader frame, which contains purely verbal information, then moves to the type VII pictorial or graphic frame, which contains purely visual information (see Figure 5). Each of the frame types between these two extremes contains varying degrees of visual and verbal information. Typologies such as Wileman's help us to categorize the many visual-verbal relationships.
In his article, *Illustrating instructional texts*, Duchastel (1978) attempted to "systematically consider illustrative strategies which will enhance learning" (p. 37). This framework focuses on the purposes of an illustration when accompanying text. Duchastel stresses that, most often, educators are more concerned with the looks of the illustration than the what the illustration should be expected to accomplish. His approach
focuses on the questions: "What should the illustration do?" and "What kind of illustration is needed where?"

**Roles**

In addressing these questions, Duchastel (1978) identified three roles of illustrations when accompanying text. They are attentional, explicative, and retentional. The attentional role of illustrations is meant to do precisely what the descriptive term means - to get the attention of the reader. The illustration should motivate the reader to look through the book or article and to further investigate its contents. Once this is achieved, the next type of illustration carries an explicative role. The explicative illustration's goal is to explain or teach something to the reader. This can be accomplished in the form of charts, graphs, diagrams, pictures, or other informative illustrations. The third and most complex role of illustrations is the retentional role. The retentional role of illustrations is to assure that the instructional text can be recalled at a later time. This illustrative role is supported by the research of Paivio (1979) and Duchastel (1978). Iconically and verbally encoded information will improve recall. The attentional, explicative, and retentional roles of an illustration can occur individually or simultaneously. For example, certain illustrations can have a more explicative and retentional role with little or no attentional role. This orchestration of roles can be seen in Figure 6.
In their article, *Pictorial illustration in instructional texts*, Duchastel and Waller (1979) extended Duchastel's earlier explanation of illustration roles by identifying seven functions of explicative illustrations. The first function, descriptive, is used to simply show what a certain object looks like. This can be illustrated in the form of a photograph or drawing. The second function, expressive, is used to make an emotional impact, beyond that of the descriptive illustration. An example of an expressive illustration would be the showing of animals in a dog pound. This type of image would most-likely elicit emotions from the reader. The third function of explicative illustration, constructional, is used to show the construction of an object, with the various components of the object. This is would be most useful in explaining an assembly task. Functional illustrations, the fourth type of explicative illustrations, may be used to show
the systematic functions of a process, such as an illustration of the food chain. In the fifth function of explicative illustration, logico-mathematical diagrams such as graphs are used to relay a mathematical or scientific idea to the reader. The sixth function of explicative illustrations, algorithmic, is used to display diagrams similar to flow-charts which show a procedure with numerous possible courses of action. The seventh and final function of explicative illustrations, data-display, allows the reader to make quick comparisons of data and to draw conclusions from that data. Data-display illustrations most-commonly come in the form of illustrations such as histograms, bar-graphs, and pie charts.

The relationship between visuals and verbals may best be summarized by what Levie and Lentz (1989) describe as their "functional approach" to the effects of text illustrations. Levie and Lentz point to four major functions of text illustrations:

1) attentional functions
2) affective functions
3) cognitive functions
4) compensatory functions

Attentional functions include the purposes of attracting attention and directing attention to important information. Affective functions include the purposes of reader enjoyment and the affecting of emotions and attitudes. Cognitive functions include the purposes of facilitating comprehension and retention. The compensatory functions of illustrations are for the purpose of helping poor readers (see Table 1). Once again, illustrations can have functions from one or all of the types categorized.
Table 1  Functions of Text Illustrations (Levie & Lentz, 1989)

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attentional</td>
<td>• Attracting attention to the material</td>
</tr>
<tr>
<td></td>
<td>• Directing attention to within the material</td>
</tr>
<tr>
<td>Affective</td>
<td>• Enhancing enjoyment</td>
</tr>
<tr>
<td></td>
<td>• Affecting emotions and attitudes</td>
</tr>
<tr>
<td>Cognitive</td>
<td>• Facilitating learning text content via:</td>
</tr>
<tr>
<td></td>
<td>• improving comprehension</td>
</tr>
<tr>
<td></td>
<td>• improving retention</td>
</tr>
<tr>
<td></td>
<td>• Providing additional information</td>
</tr>
<tr>
<td>Compensatory</td>
<td>• Accommodating poor readers</td>
</tr>
</tbody>
</table>

As one can easily see, visual verbal relationships take on many shapes and forms. The designer must ultimately look at the intended purpose of the visuals and text to decide upon their appropriate use. Models such as those stated above can serve as guidelines for the construction of visual verbal instruction.

Theory

The following sections describe the theories which drive the research on the use of visual and verbal information in instruction. By investigating these theories, we can hope to better understand the relationship between visuals/verbals and learning.

Dual Coding

After almost 30 years, research on imagery and verbal processes has yielded continued support of Paivio's dual-coding theory (Paivio, 1991). This theory of memory
and cognition remains to be the most widely accepted theory for the recall of concrete nouns. The main assumption which sets dual-coding theory apart from other theories is that, in dual coding, mental representations are multimodal and concrete (Paivio, 1991). According to Paivio, many opposing views assume that thought is unimodal. This section will attempt to investigate the assumptions behind Paivio's dual coding theory, while also addressing the opposing views to his theory.

In its broadest sense, Paivio's theory assumes that there are relationships between symbolic systems and sensorimotor systems (Paivio, 1986). Each of these systems and subsystems comprise an integrated whole, while at the same time, they are separate integrated parts which can function independently (see Table 2).

<table>
<thead>
<tr>
<th>Sensorimotor</th>
<th>Verbal</th>
<th>Nonverbal</th>
</tr>
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<tbody>
<tr>
<td>Visual</td>
<td>Visual words</td>
<td>Visual objects</td>
</tr>
<tr>
<td>Auditory</td>
<td>Auditory words</td>
<td>Environmental sounds</td>
</tr>
<tr>
<td>Haptic</td>
<td>Writing patterns</td>
<td>&quot;Feel&quot; of objects</td>
</tr>
<tr>
<td>Taste</td>
<td></td>
<td>Taste memories</td>
</tr>
<tr>
<td>Smell</td>
<td></td>
<td>Olfactory memories</td>
</tr>
</tbody>
</table>

Dual-coding theory is based upon the assumption that there are two distinct and separate symbolic systems. One system specializes in verbal information and the other system specializes in nonverbal information (Paivio & Lambert, 1981). Dual-coding theory places specific emphasis upon the contrast between the verbal and nonverbal symbolic systems. These verbal and nonverbal systems are made up of verbal and imaginal representations. In 1979, Paivio used the terms logogens and imagens to identify
verbal and imaginal representations, respectively. Information can be coded into one or both of these systems at the same time. The verbal system is used to store words and the nonverbal system stores images.

**Processing operations.** First, we will take a look at the processing of verbal representations known as logogens and their characteristics:

1) Logogens are sequentially organized
2) Logogens vary in size
3) Smaller units are organized into larger units in a successive fashion

An example of this structure is best detailed in the description of language. Phonemes are organized into syllables, which are combined into words, then sentences, then ultimately a piece of literature such as a poem or a story:

Phonemes -> Syllables -> Words -> Sentences -> Poems

When investigating imaginal or nonverbal representations, we see differences in structure from those of logogens:

1) Imagens are synchronously organized
2) Imagens have a hierarchical structure

An example of synchronous and hierarchical organization of imagens can be easily illustrated in the form of a human face. When a person sees a face, they see the entire face made up of many different parts; two eyes, a nose, lips, and even smaller parts like the
iris, pupils, nostrils, etc.. All of these parts come together at one time, however to form the imaginal representation known as the face.

**Relations between systems.** Imagens and logogens each have their own unique properties and, as stated earlier, they can function separately without each other. However, most processing involves connections between the two systems and the sensory systems. The next step in looking at dual coding investigates these representational processes. Further explanation of Paivio’s dual coding theory necessitates the use of the graphic in Figure 7.

![Diagram](image)

**Figure 7** Dual-Coding Model (Paivio, 1986)

**Representational processing.** As one can see from the Figure, verbal and nonverbal stimuli pass through our sensory systems. These stimuli then travel into the
verbal and visual systems by way of representational connections. This activation of verbal and visual representations begins the dual-coding process. When stimuli reach the verbal and visual system, they trigger representations unique to that system. The linguistic stimuli directly activate the logogens and the nonverbal stimuli directly activate the imagens. The word "chair" activates the chair logogen in the verbal system and, likewise, a picture of a chair activates the chair imagen in the nonverbal system. Once this processing has occurred, referential and associative processing are ready to transpire.

The representations present in referential and associative processing are one-to-many (Paivio, 1986). A single word or picture can trigger many different referents in the verbal and visual systems. When a person sees the word "table" for example, "table," through referential processing, triggers visual referents in the visual system, which in turn activate the process of association, resulting in representations dining tables, picnic tables, card tables, etc.. Likewise, when a person sees a picture of a table, that picture triggers the word "table" in the verbal system. This referential activity also activates associative processing within the verbal system, resulting in representations such as the words dining table, picnic table, and card table. Thus, verbal stimuli precipitate visual representations, and visual stimuli set off verbal representations.

**Opposing views to dual-coding.** In *Dual coding theory: Retrospect and current status*, Paivio (1991) identifies some of the opposing views of his theory. Two alternative views of Paivio’s processing model are described by Kieras (1978). They are the mental picture position and the propositional representation position. The mental picture model assumes that word and sentence meanings are depicted by images. These subjective images are represented in the mind as mental pictures. Each person formulates
his or her own unique mental picture according to the words or sentences which are encountered. This theory is one of the weakest of the processing models, as Kieras (1978) states: "The problem presented by the mental picture position is that although few people take it seriously, much effort has been spent refuting it (p.533). This article avoids a similar waste and does not consider this position any further." Therefore, the writer will take Kieras’ advice and move on to a more accepted alternative model.

In his article, *What the mind's eye tells the mind's brain: A critique of mental imagery*, Pylyshyn (1981), discusses three models of representations: propositional representations, data-structure representations, and procedural representations. In procedural representations, concepts are represented in the mind as rules and procedures. These rules and procedures are used to indicate the meanings of words. Rules and procedures are used as a check for verification of the appropriate meaning of words. When the procedural representation model is used, facts and those actions relevant to the facts play a crucial role in representation.

The data-structure/representations philosophy believes in the use of data and symbol structures. An appropriate data-structure representation, according to Pylyshyn (1981):

1) contains symbols which designate the functionality important and most invariant aspects of the environment which is being represented, and

2) gives the process access to a variety of units of data, from individual primitive symbols through overlapping subsets of related symbols up to the entire representation.

The other model described by Kieras (1978) and Pylyshyn (1981) is the propositional representation model. In this model, it is assumed that all perception is
reduced to one common amodal form. All information is coded in the same way and there is no difference in how verbal and visual information is processed into memory. As Kieras states, “All knowledge, regardless of its source modality, can be expressed in a single, uniform abstract type of representation, the proposition.” (see Figure 8).

Figure 8  Propositional Representation Model
(Mayer & Anderson, 1991)

The main difference between the dual-coding model and the propositional representation model is in the different ways visual and verbal information is represented in the mind. How can information be organized to facilitate these different representations in the mind? How can we link what a person already knows with new material which is to be learned? These questions can be answered with the investigation of advance organizers.
Advance Organizers

In *Learners and learning*, Anderson (1989) stresses the value of the cognitive-mediational approach to teaching and explains the rationale for adopting a cognitive-mediational perspective. A major part of the cognitive-mediational perspective is based upon two cognitive characteristics: knowledge and capacity for self-regulation (Anderson, 1989). In the first of her organizing ideas supporting the cognitive-mediational perspective on instruction, Anderson (1989) claims that all knowledge is organized and that different people organized their knowledge in different ways. Knowledge is a complex and interrelated highway of concepts and propositions which have been described in various ways. Many different names have been given to these webs of knowledge, each having some variations from the other. Ausubel (1980) called them cognitive structures, others called them schemata, scripts, and frames. Regardless of the names that are given to these cognitive structures, the crucial thing to remember is that, as Anderson stated, knowledge is organized. This idea of organized knowledge forms the basis for David Ausubel's theory of advance organizers.

Ausubel (1968) states:

> If we had to reduce all of educational psychology to just one principle, we would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly. (p. 32)

According to Joyce, Weil, and Showers (1992), Ausubel's advance organizer theory has three fundamental concerns:

1) how knowledge (curriculum content) is organized
2) how the mind works to process new information (learning)
3) how teachers can apply these ideas about curriculum and learning when they present new material to students (instruction).

Advance organizers play basically a two-fold role in the quest for learning. Those roles are to prepare the learner and organize the material to be learned. If these goals are accomplished, then meaningful learning should occur (see Figure 9).

![Figure 9](image)

**Figure 9** Roles of the Advance Organizer

The role of preparing the learner begins with the process of making the organizer meaningful to the learner. This must be accomplished by using concepts and propositions which already fit into the learners existing cognitive structure. This strengthening of the learner's cognitive structure thus facilitates the acquisition and retention of new information (Joyce, Weil, & Showers, 1992).

The second role of advance organizers in the pursuit of meaningful learning is that of an organizer of new material to be learned. This stage in the development of advance organizers is the most complex in the advance organizer role. To better understand the proper organization of materials, we must first take a closer look into the hierarchy of cognitive structures and, for that matter, the hierarchy of different academic disciplines. Ausubel believes that cognitive structures are organized in the same way that different subject matter is organized. That is, broad and abstract concepts form the top of a hierarchy of even more concepts and propositions. This ever-changing hierarchy contains
pre-existing cognitive structures which may be linked to possible cognitive structures, with the right instruction. By using the term "right instruction" we mean that new material must fit into an already existing structure. This can be accomplished by linking the new material to pre-existing structures, or the new material may be taught through the use of sequencing, in which new structures are purposefully made in order to reach a specific goal.

**Constructing advance organizers.** Because Ausubel has never given an operational definition of an advance organizer in any of the literature, the actual make-up of the advance organizer tends to be rather vague. Ausubel (1967), however gives us several characteristics of advance organizers:

1) They should be more inclusive, abstract, and general than the learning material they precede in order to provide a framework for the stable incorporation and retention of the more detailed material to be learned.

2) They must take into account the relevant existing ideas that learners have about the topic.

3) They must demonstrate the relationship between the ideas learners already have and the new ideas to be learned.

4) If the learners have few relevant existing ideas, the advance organizer needs to be more expository in nature.
5) If the new material can be related to a cognitive framework already possessed by the learners, the advance organizer should be comparative in nature.

What makes up an advance organizer? This question has been addressed repeatedly in much of the literature and can be best answered by examining a four-item checklist developed by Mayer (1979) used in determining the effectiveness of an organizer:

1) Does the organizer allow one to generate all or some of the logical relationships in the to-be-learned material?

2) Does the organizer provide a means of relating unfamiliar material to familiar, existing knowledge?

3) Is the organizer learnable, i.e., is it easy for the particular learner to acquire and use it?

4) Would the learner normally fail to use an organizing assimilative set for this material, e.g., due to stress or inexperience?

How can we use this theory of advance organizers to construct models which will facilitate understanding? In what type of learning situation and with what types of learners will these models be most useful? To answer these questions, we must investigate conceptual models.

**Conceptual Models**

In his 1989 article entitled *Models for Understanding*, Mayer examined the feasibility of using conceptual models to improve students' understanding of scientific explanations. Mayer defines a conceptual model as "words and/or diagrams that are
intended to help learners build mental models of the system being studied. The conceptual model highlights the major objects and actions in a system as well as the causal relations among them") (p. 43). In order to further examine these models, Mayer defines the parts of the teaching/learning process as: learner characteristics, to-be-learned material, instructional method, learning processes, learning outcomes, performance.

When examining the characteristics of the learner, Mayer stresses the use of novices as participants. Because novices' cognitive structures are less elaborate on the subject matter, these students should benefit most from the use of models. The subject matter or to-be-learned material for the study of models should be explanatory material in the workings of a system, such as a braking system, camera, or bicycle pump. In each of these examples, the whole system is made up of a compilation many interconnecting parts. The instructional method chosen for models would obviously be models themselves which illustrate major parts, states, and actions in systems (Mayer, 1989). Mayer used models as his chosen method because models have been shown to help in the facilitation of transfer.

The learning processes which occur when using the model type of instruction are selecting, organizing, and integrating. Models are used to aid in the selection of appropriate lesson information. With a model's highlighting of major parts and actions of the system, the learner should be directed and focused to those aspects. The model also serves as an organizer of new material. This organizing of new material will help the learner to assemble new information with other pieces of new information. These internal connections, are best formulated by the use a conceptual model (Mayer, 1989). The process of integrating new material into the pre-existing cognitive structure of the learner completes the learning process as outlined by Mayer.
After looking at his own experiments with models, Mayer came up with three predictions for his further research. The first was that students who have the model as the instructional method will recall more conceptual information than those from the control group. The second prediction was that model students would be less likely to retain verbatim information than control students. The third prediction was that students using the model would outperform the control group on problem solving. In an effort to investigate his predictions on how conceptual models help in student understanding, Mayer (1989) reviewed much of the research on the use of models in instruction. In some of the experiments, the conceptual model was presented before the lesson and in other experiments the conceptual model was presented within the lesson itself.

Mayer found that, as predicted in each of the model before the lesson studies, model students consistently recalled more conceptual information than the control students. Model students also produced more correct problem solving answers than the control students. And, as Mayer predicted, model students scored lower on verbatim retention than control students. In the model within the lesson studies, model students also recalled more conceptual information and produced more correct problem solving responses than the control students. And, as in the model before the lesson studies, model students scored lower on verbatim retention.

The model's ability to improve students' conceptual retention can be attributed to the model's function to direct students' attention to relevant aspects of the lesson. Improved problem-solving transfer in students can best be explained by the ability of models to illustrate systematic processes. This type of systematic thinking improves the students' abilities to generate more problem solving solutions. The reduced verbatim retention of model students is due to the model's facilitation of the organization of new
material into existing cognitive structures. This activity may cause model students to lose track of the presentation’s original format and structure.

**Constructing conceptual models.** From his studies, Mayer (1989) developed five questions which may be helpful when constructing a conceptual model: a) What is a good model? b) Where should models be used? c) When should a model be used? d) Who is a model good for? and e) Why use models? (pp. 59-60):

What is a good model? A good model contains seven aspects. A good model is:

- **Complete** - containing all of the parts
- **Concise** - at an appropriate level of detail
- **Coherent** - intuitive to the learner
- **Concrete** - at an appropriate level of familiarity
- **Conceptual** - based on potentially meaningful material
- **Correct** - true to the actual object or event
- **Considerate** - using appropriate vocabulary and organization

In answering the other four questions, Mayer suggests that models should be placed before or during instruction but, not after instruction. Models should be used with novice learners who have low prior knowledge of the subject. And, models should be used to foster student understanding of systems and processes.

**Research on Visuals and Verbals**

When designing multimedia materials for instruction, one question often arises: “Why use animation instead of still pictures?” This question can be answered by examining previous research using still pictures and animation. Although much research
has been conducted on the use of animation and static graphics, Reiber (1990) states that "the few serious attempts to study the instructional attributes of animation have reported inconsistent results" (p. 15). This review will concentrate on the studies supporting the use of still pictures and animation and the conclusions derived from the findings. After investigating these findings, the strengths of animation and static pictures will become evident, allowing us to formulate guidelines for the appropriate use of still pictures and animation in instruction.

**Static Visuals**

The use of still pictures or static visuals has received much attention from researchers. Before 1970, most research concluded that static visuals did not help learners process textual material (Reiber, 1990). These disappointing and inconsistent findings can be attributed to factors ranging from lack of content validity and test reliability to phenomenon such as Underwood’s (1963) principle of least effort. Recently however, researchers have found that using static visuals can indeed help in the processing of text (Reiber, 1990; Siribodhi, 1995). Pictures have been found to be especially useful for the young and for novices who have not yet formed the necessary and appropriate mental images (Rieber, 1990). As we grow older and more experienced, we become less dependent on pictures, allowing us to produce our own mental pictures from our previous experiences (Pressley, 1977). Therefore, persons with little or no experience with a given subject stand to gain more from the use of graphics.

Static visuals have been found to be most helpful when they are congruent to the text (Willows, 1978). Visuals which are not highly-related to the text can be distracting to the learner. This incongruency between text and visuals can create a distracting learning
situation in which the learner is confused about making the connections between the visual and verbal information.

Visuals which are too complex can also present a problem to the learner. In his review of the use of visuals, Dwyer (1978) found that pictures which are too complex require the learner to search extensively for appropriate learning cues which may result in the ignoring of the visuals entirely. Caution must be taken when developing visuals so that the visuals do not contain information which is too complex or detailed for the learner. Over-complexity of visuals results in a lack of focus on the part of the learner. Visuals with appropriate levels of complexity help the learner in focusing on those parts of the visual which are most helpful. The conclusions from these findings stress the importance of using the appropriate complexity for illustrations.

From his extensive review of the research conducted on static visuals, Rieber (1990) makes several conclusions about their use:

1) Pictures are superior over words for recall tasks.

2) Adding pictures to prose learning facilitates learning assuming that the pictures are congruent to the learning task.

3) Children, up to about the age of nine or ten, rely more heavily on externally provided pictures than older children.

4) Children do not automatically or spontaneously form mental images when reading.

**Animation**

Research has shown that animation should be used when the learner needs those attributes associated with animation to complete the instructional task (Rieber, 1990).
Those attributes associated with animation are 1) visualization, 2) motion, and 3) trajectory (Klein, 1987). Efficacy of animation depends on the learner’s need for one or more of these attributes to successfully complete a task. For example, animation (using visualization, motion, and trajectory) would be appropriate when describing the workings of a pump system such as a bicycle pump. If only visualization were necessary for the desired instructional task to be completed, using only static visuals would be sufficient. Animation is also needed to illustrate the trajectory or direction of an event or system. Therefore, animation is desired when all three attributes (visualization, motion, and trajectory) are needed.

Novice-learners must have cues which direct them to the animation. Reiber (1990) addressed this factor in his research, finding that learners were able to better focus on the animation when the instructional animation was broken down into pieces and chunks of information, (text only, static visuals only, animation only). In other words, the learner must be directed to the animation, separate from text or static visuals.

Once the learner is directed toward the animation, he/she still may not know which specific details should get the attention. Novice learners especially need to focus on the appropriate features of an animation. Without this direction, learners may fail to pick out the details desired by the designer. Reed (1985) found that if novice learners are only asked to view an animated sequence, they may not be able to differentiate between the different features of the animation. When the learners’ focus was directed to specific details of the animation through interactive strategies, the learners were able to grasp the features desired by the designer. Baek and Layne (1988) also found that direction to specific details, through the design of the instruction, resulted in better performance.
Studies have shown that interactive animation provides the learner with opportunities for practice, which in turn, increases learning. Studies such as Rieber’s (1989) experiment showed that, when elementary school learners were allowed to control an animated starship, they outscored the control group that did not have the interactive practice. In their study, Collins, Adams, and Pew (1978) found that adult learners using an interactive map with blinking dots outperformed those learners using a map with labels-only (no blinking dots) and those learners using a map with no labels. From this research we can see that the interactivity involved with practice can make a difference in performance when using animation.

Motivation can also play an important role in the use of interactive animation. Reiber (1989) found that adult learners using interactive animation were able to encode and retrieve information better than those using traditional questioning techniques. The motivation achieved by using interactive animation can in-turn improve the performance of the learner.

Based upon the previous research, Reiber (1990) makes three recommendations when designing animation:

1) Animation should be incorporated only when its attributes are congruent to the learning task.

2) Evidence suggests that when learners are novices in the content area, they may not know how to attend to relevent cues or details provided by animation.

3) Animation’s greatest contributions to computer based instruction (CBI) may lie in interactive graphic applications (e.g., interactive dynamics).
In light of all that we have learned about the use of animation, Rieber (1990) cautions future designers and developers:

CBI designers are faced with the a curious dilemma. They must resist incorporating special effects like animation, when no rationale exists, yet must try to elude creative and innovative applications from the computer medium. (p. 84)

Now that we have examined the research dealing with the coding of verbal and visual information, the organization of that information, and the research on static visuals and animation, we can now review research which involves the use of animation and narration.

**Animation and Narration**

Previous research has examined the many relationships between pictures and words in an instructional setting using films and static illustrations (Baggett, 1984; Baggett & Ehrenfeucht, 1983; Mayer, 1989; Mayer & Gallini, 1990). In their study, Baggett and Ehrenfeucht (1983) had students watch an educational movie while being presented with visual and verbal auditory information. They concluded that there is no competition for resources. Encoding in one medium (verbal) does not hinder encoding in another (visual). Furthermore, it was shown that the simultaneous presentation of verbal/visual information promotes recall beyond that of sequential presentation of verbal and visual information. Simultaneous verbal/visual presentation was shown to surpass sequential verbal-visual presentation by 18%. However, Baggett found that simultaneous verbal/visual presentation was only 8% better than a sequential visual-verbal presentation.
In 1984, Baggett extended her research by having participants watch a 30-minute film, before, after, or in synchrony with narration. She found that students in the synchronous visuals/narration group and the sequential visuals-narration group scored higher than the narration-visuals group on an immediate recall test. Thus, it was concluded that when recall is desired, information should be presented in a visual-narration or visual/narration format.

Mayer and Anderson (1991) went one step further in their study entitled *Animations need narrations: An experimental test of a dual-coding hypothesis*. In their study, Mayer and Anderson systematically tested a single-code hypothesis, a separate dual-code hypothesis, and Paivio's dual-code hypothesis. In the first experiment, Mayer and Anderson compared the effects of viewing an animation of a bicycle tire pump with narration (words-with-pictures) with the effects of narration followed by animation (words-before-pictures). A problem-solving test was used to determine performance of the participants. In the study, participants viewed three back-to-back presentations of the same material in a words-before-pictures (W-P) (W-P) (W-P) or simultaneous words-and-pictures (W&P) (W&P) (W&P) format. Results showed that participants in the words-and-pictures group scored significantly higher on the problem-solving test than participants in the words-before-pictures group. When tested on recall of verbal information, there was no significant difference between the words-and-pictures and words-before-pictures groups.

As earlier research suggests (Baggett, 1984; Baggett & Ehrenfuecht, 1983), pictures-before-words (P-W) presentations promote recall at virtually the same level of words-and-pictures (W&P) presentations. It should be noted that Mayer and Anderson (1991) did not study a pictures-before-words combination in either recall performance or problem-solving performance. Initially, it was this writer's intent to simply replicate
Mayer and Anderson's study, adding a pictures-before-words group. However, upon closer investigation, this researcher came to the conclusion that three back-to-back presentations of the same material could present a problem in the validity of the experiment. In a (W-P) (W-P) (W-P) presentation, not only does the desired words before pictures combination occur, but also a combination of pictures preceding words occurs on two of the presentations. Likewise, in a (P-W) (P-W) (P-W) presentation, words preceding pictures on two of the three presentations (see Figure 10). If we are to truly make any conclusions about the effects of presentation type (pictures-before-words vs. words-before-pictures), we must eliminate the unwanted combinations within the same presentation content.

![Figure 10](image)

**Figure 10**  Three Presentation Design

In an attempt to extend their research from the above experiment, Mayer and Anderson (1992) changed their design while investigating what they call the contiguity principle. This instructional design principle states that "the effectiveness of multimedia instruction increases when words and pictures are presented contiguously." In this study, Mayer and Anderson included control groups and presented participants with concurrent (A+N), successive (AN or NA), animation-only (A), and narration-only (N)
presentations. In the control group, participants received no instruction. The concurrent group was presented with three concurrent animation and narration presentations of the same instructional material (A+N, A+N, A+N). The three successive groups were presented with three types of presentations (ANANAN, NANANA, or AAANNN). The animation-only group received presentations in the form of AAA, and the narration-only group received presentations in the form of NNN. In support of their contiguity principle, their first experiment’s results showed that the control group performed worse in retention than all other groups and that there was no significant difference in the performance of those other groups. In measuring problem-solving, the concurrent groups performed significantly better than the successive, animation-only, narration-only, and the control groups, which did not differ significantly from one another.

In the second experiment, Mayer and Anderson replicated the first experiment. The only difference was the use of different subject matter. In this experiment each of the treatment groups except the AAA group, scored significantly higher than the control group on retention. All other treatment groups, other than the animation-only (AAA) group did not score significantly different from each other. Like in the first experiment, the concurrent groups were shown to perform significantly better than all of the other groups when measuring problem-solving. The other groups, once again, were shown to have no significant difference between one another. Although a pictures-before-words group was added from their previous research in 1991, the unwanted combinations illustrated in Figure 10 still arose.

Although the factors involved in the presentation of the instructional material play an important role in this research, other factors come into play. Sometimes, how we study teaching and learning can have equal importance to what we study. And,
by understanding how we are conducting a study, we can better-understand what we are actually studying. The design of the research on learning gains even more significance.

Design

In his chapter entitled *Illustrations that instruct*, Richard Mayer (1993) states the question which has driven over 20 years of his research. That question is: How can one teach in ways that result in meaningful learning? Mayer then outlines the three tasks related to answering this question: 1) reformulating the question to allow scientific testing, 2) developing a theoretical base to guide a research program, and 3) developing a research base through experimentation and observation to test hypotheses. In addressing the first task of reformulating the question to allow scientific questioning, Mayer broke the task into four parts: 1) instructional method, 2) learning outcome, 3) learner characteristics, and 4) instructional material. These parts eventually lead to the question "Which instructional methods lead to which learning outcomes for which students using which materials?" By understanding these questions, we can better define the focus of this research. Below, are the four parts of scientific questioning, as related to this research.

Instructional Methods

As described in the research of Atkinson (1975), Bower (1972), Levin (1981), and Paivio (1986), memory for word lists and paired associates can be improved by using illustrations. And, as stated earlier, studies listed by Reiber (1990) support the effectiveness of animation when used properly. The instructional method chosen by this researcher is that of illustration or, to be more specific, animation.
Learning Outcomes

Mayer (1993) points out, that the use of recall and overall attention takes an oversimplified viewpoint that learning only deals with how many associations are built, thus how much is learned. The question of meaningless versus meaningful learning arises, calling for the outcome of problem-solving transfer as a measure of meaningful learning. Thus, the best measure of overall learning can be achieved by using the outcomes of recall and problem-solving transfer. The learning outcomes chosen by the researcher are those of recall and problem-solving transfer. Recall is chosen because of its traditional use as a measure of learning. Problem-solving is chosen because of its intend measure of meaningful learning.

Learner Characteristics

It is the less-skilled learner who gains most from the structure provided by advance organizers, conceptual models, and animation. Learners who are lacking prior knowledge in the subject matter stand to gain most from instructional multimedia presentations using animation. Like those chosen by Mayer (1991), the learner characteristics chosen by the researcher are those of the less-skilled novice learner.

Instructional Materials

Unlike descriptive materials, explanatory materials show how things work and function. In his research, Mayer began with explanatory text and then moved on in later years to explanatory narration used in conjunction with illustration or animation (Mayer,
1991; Mayer & Anderson, 1993). In developing materials according to learner characteristics, we find that learners lacking prior knowledge have the most to gain from explanatory narration and illustration. The instructional materials chosen by the researcher are those of an explanatory nature.

**Summary and Hypotheses**

The relationships, theories, research, and design considerations discussed in this chapter all play an important role in understanding how and why we study the use of verbal and visual information to learn and teach others. The research into the use of static visuals, animation, and the combination of animation and narration has shown the value of having multiple representations of information.

Based upon previous research involving words and pictures, and animation and narration, novice learners who are presented with information in a simultaneous words-with-pictures format should perform better in *problem-solving* than novice learners who are presented information in a sequential words-before-pictures or pictures-before-words format (Mayer, 1989, 1993; Mayer & Anderson, 1991, 1992; Mayer & Gallini, 1990). If this is the case, then the first research hypothesis should be true:

1. Novice-level participants in the words-with-pictures group will perform significantly better than novice-level participants in the words-before-pictures, and pictures-before-words groups in problem-solving performance.

Researchers such as Mayer and Anderson (1992, 1993) have also concluded that learners *recall* virtually the same amount of information regardless of whether the information is
presented in a words-with-pictures, words-before-pictures, or pictures-before-words format. As outlined earlier, possible errors in the research design cause some speculation into the validity of their conclusions. The research of Baggett and Ehrenfeucht (1983) and Baggett (1984), however lead to the conclusion that learners viewing instruction in a words-with-pictures and pictures-before-words format scored higher in recall than learners viewing instruction in a words-before-pictures format. Based upon the design problems in the Mayer and Anderson studies, and the research findings of the Baggett and Ehrenfeucht, the second research hypothesis was generated:

2. Novice-level participants in the words-with-pictures and pictures-before-words groups will perform significantly better than novice-level participants in the words-before-pictures groups in recall performance.
CHAPTER III
METHODOLOGY

Introduction

This chapter discusses the methodology used for the development of the computer presentations (see Appendix A) and the research used in the data collection. Also included are a description of the population and sample, materials and apparatus, and data analysis procedures used in this study. The purpose of this study was to examine the effect of three different types of instructional multimedia presentations on the recall and problem-solving performance of novice-level learners.

Population and Sample

Participants for this study were a group of 106 college students enrolled in two southwest Virginia universities. The participants were chosen because of their inclusion in a wide range of academic backgrounds, ease of access, and size of classes. The total number of participants consisted of 86 females and 20 males. Participants ranged in age from 19 to 50. The mean age was 22.377 and the mode was 21. Participants were given a set of questions designed to determine the level of knowledge in the topics of the presentations. Only the participants shown to be "naive" in the subject matter (bicycle pumps or brass instruments) were included in the primary and secondary analyses. Of the 106 participants in the study, 21 participants were excluded, leaving 85 novice-level learners for the analyses.
Materials and Apparatus

Computer-based materials consisted of six computer presentations showing a bicycle pump mechanism or the playing of a brass musical instrument. Presentations were developed in HyperCard 2.1. Animation and narration were presented in the form of QuickTime movies played through the HyperCard stacks. The source for video and narration for the brass topic was an animation of the playing of a brass instrument from the Encyclopedia Britannica Education Corporation’s videodisc Instruments of the Symphony Orchestra. Permission was obtained from Encyclopedia Britannica for the use of the videodisc segment. Color video from the source videodisc was digitized and edited through Premiere and saved as QuickTime movies. Narration for both examples were recorded with SoundEdit 16. The source for video for the second topic was a color animation of a bicycle pump constructed in Director. Video and narration were then edited through Premiere into QuickTime movies. All development of the presentation software (HyperCard stacks), digitizing and editing were performed by me, on a Macintosh Quadra 660 AV computer. All presentations were made on Macintosh LC computers with a 40-megabyte hard drive and a color 14-inch high resolution monitor. Stereo headphones were provided for participants to enable them to hear the narration portion of the presentation without outside interference.

Selection Measures

Prior to seeing the bicycle pump or brass instrument presentations, each participant answered a series of questions on a questionnaire related to their knowledge of bicycle pumps or brass instruments. The answers given on the questionnaires determined
whether or not the participant was a novice in the subject matter of the presentations. Participants scoring above novice-level (21 participants) were excluded from the analyses. The criteria used in this study were the same used in Mayer’s 1991 study on animation and narration. Those participants checking average or less knowledge in the topic of presentation or those participants checking 2 or less items in the experience portion of the questionnaire were determined to be of novice-level. For example, a participant checking less than average in the first portion of the questionnaire and checking 2 items in the second portion of the questionnaire would be included in the novice category. These novice-level participants were used in the primary analyses of the hypotheses and in the secondary analyses.

**Questionnaires and Tests**

Paper-and-pencil materials included subject questionnaires and test sheets, each printed on 8.5" X 11.0" sheets of paper. The subject questionnaire for bicycle pump knowledge was a replica of the questionnaire used by Mayer in his 1991 study (see Appendix B). The subject questionnaire for brass instrument knowledge was developed from the same framework as the bicycle pump questionnaire and was made to conform as closely as possible to the bicycle pump questionnaire (see Appendix C). The recall and problem-solving tests for the bicycle pump presentations were replicas of those used in Mayer’s 1991 study (see Appendix D). Brass instrument recall and problem-solving tests were developed with the same specifications to closely match the format and intent of Mayer’s bicycle pump tests (see Appendix E).
Procedure

In this experiment, there were three treatment groups: words-and-pictures, words-before-pictures, and pictures-before-words. The words-with-pictures groups received a simultaneous words-with-pictures presentation, followed by either a words-before-pictures or pictures-before-words presentation covering a topic other than the first presentation; the words-before-pictures groups received sequential words-before-pictures presentation, followed by either a pictures-before-words or words-with-pictures presentation covering a topic other than the first topic; the pictures-before-words groups received a sequential pictures-before-words presentation, followed by either a words-before-pictures or words-with-pictures presentation covering a topic other than the first topic (see Figure 11).

<table>
<thead>
<tr>
<th>Group 1</th>
<th>1st Presentation</th>
<th>2nd Presentation (Diff. Content)</th>
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<tbody>
<tr>
<td></td>
<td>Words &amp; Pictures</td>
<td>Pictures &amp; Words</td>
</tr>
<tr>
<td>Group 2</td>
<td>Words &amp; Pictures</td>
<td>Words &amp; Pictures</td>
</tr>
<tr>
<td>Group 3</td>
<td>Pictures &amp; Words</td>
<td>Words &amp; Pictures</td>
</tr>
</tbody>
</table>

Figure 11 Two Presentation Design

Participants were randomly assigned to treatments and were tested individually. A list of random numbers was generated in Excel. Each of the participants were randomly assigned to a presentation/testing group according to the generated random number.
Participants were randomly assigned to one of the following six possible presentation combinations as seen in table 3.

Table 3  Presentation Combinations

<table>
<thead>
<tr>
<th>Pres.</th>
<th>Topic</th>
<th>Format</th>
<th>Topic</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Brass</td>
<td>Words-with-Pictures</td>
<td>Pump</td>
<td>Pictures-before-Words</td>
</tr>
<tr>
<td>2.</td>
<td>Brass</td>
<td>Words-before-Pictures.</td>
<td>Pump</td>
<td>Words-with-Pictures</td>
</tr>
<tr>
<td>4.</td>
<td>Pump</td>
<td>Words-with-Pictures</td>
<td>Brass</td>
<td>Pictures-before-Words</td>
</tr>
<tr>
<td>5.</td>
<td>Pump</td>
<td>Words-before-Pictures.</td>
<td>Brass</td>
<td>Words-with-Pictures</td>
</tr>
</tbody>
</table>

Participants were also randomly assigned to one of the four following test formats (see table 4):

Table 4  Test Formats

<table>
<thead>
<tr>
<th>1.</th>
<th>Problem-Solving/Recall</th>
<th>Problem-Solving/Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Recall/Problem-Solving</td>
<td>Recall/Problem-Solving</td>
</tr>
<tr>
<td>3.</td>
<td>Problem-Solving/Recall</td>
<td>Recall/Problem-Solving</td>
</tr>
<tr>
<td>4.</td>
<td>Recall/Problem-Solving</td>
<td>Problem-Solving/Recall</td>
</tr>
</tbody>
</table>

Presentation

Participants first signed a consent form (see Appendix F) and completed the questionnaires determining their level of knowledge in the areas of the presentations.
Participants then viewed either the brass instrument presentation or the bicycle pump presentation. The computer programs in the study began by informing the participant that "You are about to see/hear a presentation. When finished, please notify the assistant." The participant was then prompted to "Click here to begin." Upon the clicking of the mouse, the participant viewed a color, digitized video of either 1) how a brass instrument produces a sound or 2) how a bicycle pump works (narration presented before video in the words-before-pictures groups, video presented before narration in the pictures-before-words groups, and narration presented simultaneously with video in the words-with-pictures group). The words-with-pictures group viewed a presentation lasting 40 seconds. The pictures-before-words and words-before pictures presentations lasted 80 seconds. Differences in length of presentation were due to the fact that the words-before-pictures and pictures-before-words groups viewed the presentation sequentially, while the words-with-pictures group view the presentation with simultaneous words and pictures. This resulted in the words-with-pictures presentation lasting half the length (40 seconds) as the other groups.

The narration for the brass instrument presentation follows:

When a player buzzes into the mouthpiece, each air burst from the vibrating lips causes the molecules in the tube to crowd together and push against each other. The pushing and shoving creates a wave-like ripple that moves rapidly out toward the bell, where it leaves the tube and continues through open air until your ear hears it as sound.

The narration for the bicycle pump presentation follows:

When the handle is pulled up, the piston moves up, the inlet valve opens, the outlet valve closes, and air enters the lower
part of the cylinder. When the handle is pushed down, the piston moves down, the inlet valve closes, the outlet valve opens, and air moves out through the hose. When the handle is pulled up, the piston moves up, the inlet valve opens, the outlet valve closes, and air enters the lower part of the cylinder. When the handle is pushed down, the piston moves down, the inlet valve closes, the outlet valve opens, and air moves out through the hose.

**Words-with-Pictures/Words-before-Pictures Format**

Step 1: Answered questionnaires which determined the level of knowledge in the subject matter.

Step 2: Viewed a presentation in a words-with-pictures format.

Step 3: Completed recall and problem-solving tests (order determined randomly).

Step 4: Viewed a presentation in a words-before-pictures format.

Step 5: Completed recall and problem-solving tests (order determined randomly).

**Words-before-Pictures/Words-with-Pictures Format**

Step 1: Answered questionnaires which determined the level of knowledge in the subject matter.

Step 2: Viewed a presentation in a words-before-pictures format.

Step 3: Completed recall and problem-solving tests (order determined randomly).

Step 4: Viewed a presentation in a words-with-pictures format.

Step 5: Completed recall and problem-solving tests (order determined randomly).
Pictures-before-Words/Words-before-Pictures Format

Step 1: Answered questionnaires which determined the level of knowledge in the subject matter.

Step 2: Viewed a presentation in a pictures-before-words format.

Step 3: Completed recall and problem-solving tests (order determined randomly).

Step 4: Viewed a presentation in a words-before-pictures format.

Step 5: Completed recall and problem-solving tests (order determined randomly).

Appendix F shows an abbreviated sequence of still-frames from the brass instrument presentation, followed by the bicycle pump presentation. Upon completion of the first presentation, the participant was then informed to "Please raise your hand to show that you are finished."

Testing

After finishing the first presentation, participants were tested on problem-solving and recall. Participants completed the tests in a problem-solving/recall format (the four test questions for problem-solving, followed by the recall test) or in a recall/problem-solving format (the recall test, followed by the four test questions for problem-solving). Participants were allowed 2.5 minutes to answer each of the four problem-solving questions, for a total of ten minutes on the problem-solving test. Participants were allowed five minutes to answer the recall test (see Appendix D and Appendix E).
Upon completion of the first presentation and tests, participants moved on to the next section of the experiment and watched the second remaining presentation (either brass instrument content or bicycle pump content). The participant was then informed to "Please raise your hand to show that you are finished." Participants then completed the recall and problem-solving tests in the same manner as the first presentation. A schematic summary is shown in Figure 12 illustrating the design of this investigation.
Figure 12  Schematic Design of the Research Procedure
Scoring

For the recall portion of the test, participants were given one point for each correctly identified action recalled from the presentations, for a total of ten points. When scoring the recall responses, judges referred to the following checklists containing each of the ten actions involved in the brass instrument and bicycle pump presentations:

**Brass Instrument**

1. player buzzes into mouthpiece
2. air burst from vibrating lips
3. causes molecules in tube
4. crowd together and push against each other
5. pushing and shoving
6. creates wave-like ripple
7. moves rapidly out toward bell
8. leaves tube
9. continues through open air
10. ear hears it as sound

**Bicycle Pump**

1. handle is pulled up
2. piston moves up
3. inlet valve opens
4. outlet valve closes
5. air enters cylinder
6. handle is pushed down
7. piston moves down
8. inlet valve closes
9. outlet valve opens
10. air moves out through hose

When scoring the problem-solving responses, the judges referred to a list of possible appropriate responses. An acceptable answer for the first problem-solving
question involving the brass instrument was to blow harder into the brass instrument. An acceptable answer for the second problem-solving question was to keep the instrument clean and in good working order. An acceptable answer for the third problem-solving question was that something may be stuck in the tubing of the instrument. An acceptable answer for the fourth problem-solving question was that sound waves created from the mouthpiece produce the sound. With the bicycle pump example, an acceptable answer for the first problem-solving question was to pump harder and faster. An acceptable answer for the second problem-solving question was to use heavy-duty materials in the construction. An acceptable answer for the third problem-solving question was to check for a hole in the pump. An acceptable answer for the fourth problem-solving question was that air pressure forces the air out through the tube. Participants were given one point for each correct answer on the problem-solving tests, a maximum of four points for questions one, two, and three; a maximum of two points for question four.

The identity of the treatment group to which the participants were assigned was unknown to the two judges. Inter-judge agreement measured for the problem-solving analyses was .95 (forced agreement on 5%). Inter-judge agreement measured for the recall analyses was .96 (forced agreement on 4%).

**Pilot Study**

A pilot study of this investigation was carried-out in the fall of 1993. The pilot study used a single presentation design illustrated in Figure 13. 60 students enrolled in a southwest Virginia university participated in the pilot study. The researcher informed the participants of the objectives of the experiment, procedures, any other information necessary for implementation of the materials. All participants were assigned to one of
the three treatments. 15 participants were randomly assigned to the words-and-pictures presentation. 15 participants were randomly assigned to the words-before-pictures presentation. 15 participants were randomly assigned to the pictures-before-words presentation. 15 participants were randomly assigned to a control group receiving no presentation. The 60 participants viewed the assigned presentations (no presentation in the control group) and completed a recall test and problem-solving test.

After the pilot test, the researcher made adjustments to the presentation programs, animation sequences, and narrations. The control group was eliminated and a second presentation topic was added for the main data collection phase. Also added, were questionnaires determining the knowledge level of the participants.

![One Presentation Design](image)

**Figure 13** One Presentation Design
Method of Analysis

An Analysis of Variance (ANOVA) 3 X 2 factorial design was used to analyze the test data. Main effects and interactions were considered for presentation type (words-with-pictures, words-before-pictures, pictures-before-words) and question type (problem-solving, recall). The level of significance of all of the analyses was set at .05. In the secondary analysis, a one-way Analysis of Variance was used to test whether there was a significant interaction between presentation type and test order.
CHAPTER IV
RESULTS OF THE STUDY

Description of the Participants

The research experiment which provided the data for this study was conducted on the campuses of two southwest Virginia universities on December 1-5, 1994. A total of 106 participants took part in the experiment. Of those participants, 85 novice-level participants were included in the analyses. After completing the questionnaire rating their knowledge of pump mechanisms and brass instruments, students showing more than novice-level knowledge of the subject matter were eliminated from the primary analysis. A four-item problem-solving test and a recall test were administered after the participants' viewing of each presentation. The following sections show the results of various statistical analyses and answers to the research hypotheses.

Results

Total scores from the recall tests and the problem-solving tests were subjected to an ANOVA providing results concerning the three treatment groups (words-with-pictures, words-before-pictures, pictures-before-words). Four assessment instruments were used as dependent measures for recall and problem-solving performance. The recall tests (PR and BR) were used to assess recall performance, while the problem-solving tests (PPS and BPS) were used to assess problem-solving performance.
Primary Analysis

**Hypothesis one.** Novice-level participants in the words-with-pictures group will perform significantly better than novice-level participants in the words-before-pictures and pictures-before-words groups in problem-solving performance.

Mean scores from the problem-solving tests for each group were subjected to an analysis of variance. The analysis was adjusted for unequal cell size. The resulting $F$ statistic was not significant for the three experimental groups. None of the experimental groups scored significantly higher on problem-solving than any of the other groups.

The first hypothesis was rejected at the .05 level. Participants in the words-with-pictures group did not perform significantly better than participants in the words-before-pictures and pictures-before-words groups in problem-solving transfer. Participants in the words-with-pictures group averaged a score of 5.137 on problem-solving; the words-before-pictures group averaged a score of 5.127; and the pictures-before-words group averaged a score of 5.016. Table 5 shows the mean and standard deviation of responses on the problem-solving test as a function of type of presentation which was used with each treatment group.

**Table 5**  
**Mean Problem-Solving Scores as a Function of Presentation Type**

<table>
<thead>
<tr>
<th>Presentation Type</th>
<th>$M$</th>
<th>$SD$</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Words-with-Pictures</td>
<td>5.137</td>
<td>1.929</td>
<td>51</td>
</tr>
<tr>
<td>Words-before-Pictures</td>
<td>5.127</td>
<td>1.954</td>
<td>55</td>
</tr>
<tr>
<td>Pictures-before-Words</td>
<td>5.016</td>
<td>1.879</td>
<td>63</td>
</tr>
</tbody>
</table>

58
Hypothesis two. Novice-level participants in the words-with-pictures and pictures-before-words groups will perform significantly better than novice-level participants in the words-before-pictures groups in recall performance.

Means scores from the recall tests for each group were subjected to an analysis of variance. The analysis was adjusted for unequal cell size. The resulting $F$ statistic was not significant for the three experimental groups. None of the experimental groups scored significantly higher on recall than any of the other groups.

The second hypothesis was rejected at the .05 level. Participants in the words-with-pictures and pictures-before-words groups did not perform significantly better than participants in the words-before-pictures groups in recall. Participants in the words-with-pictures group averaged a score of 4.333 on recall; the words-before-pictures group averaged a score of 4.036; and the pictures-before-words group averaged a score of 3.889. Table 6 shows the mean and standard deviation of responses on the recall test as a function of type of presentation which was used with each treatment group.

<table>
<thead>
<tr>
<th>Presentation Type</th>
<th>$M$</th>
<th>$SD$</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Words-with-Pictures</td>
<td>4.333</td>
<td>2.330</td>
<td>51</td>
</tr>
<tr>
<td>Words-before-Pictures</td>
<td>4.036</td>
<td>1.688</td>
<td>55</td>
</tr>
<tr>
<td>Pictures-before-Words</td>
<td>3.889</td>
<td>1.867</td>
<td>63</td>
</tr>
</tbody>
</table>
Secondary Analysis

With the use of two testing formats: 1) problem-solving followed by recall (PS/R) and 2) recall followed by problem-solving (R/PS), it seemed logical to investigate the relationship, if any, between test scores and test order. When analyzing differences in problem-solving scores of novices who had taken the recall tests first and the problem-solving tests second versus the problem-solving scores of novices who had taken the problem-solving tests first and the recall tests second, no significant differences were found. Novices who took the tests in a problem-solving/recall format did not score significantly higher than novices who took the tests in a recall/problem-solving format.

There was no significant difference in novice problem-solving/recall test takers and recall/problem-solving test takers in problem-solving performance. Novices in the problem-solving/recall group averaged a score of 5.023 on problem-solving, and novices in the recall/problem-solving group averaged 5.160. Table 7 shows the mean and standard deviation of responses on the problem-solving test as a function of test order.

Table 7  Mean Problem-Solving Scores as a Function of Test Order  

<table>
<thead>
<tr>
<th>Test Order</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem-Solving / Recall</td>
<td>5.023</td>
<td>2.133</td>
<td>88</td>
</tr>
<tr>
<td>Recall / Problem-Solving</td>
<td>5.160</td>
<td>1.639</td>
<td>81</td>
</tr>
</tbody>
</table>

When analyzing differences between recall scores of novices who had taken the recall tests first and the problem-solving tests second, versus the recall scores of novices
who had taken the problem-solving tests first and the recall tests second, significant differences were found. Novices who took the tests in a recall/problem-solving format scored significantly higher than novices who took the tests in a problem-solving/recall format.

There was a significant difference in novice recall/problem-solving and problem-solving/recall performance in recall. Novices in the recall/problem-solving group averaged a score of 4.654 on recall, while novices in the problem-solving/recall group averaged 3.534. Table 8 shows the mean and standard deviation of responses on the recall test as a function of test order.

<table>
<thead>
<tr>
<th>Test Order</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem-Solving / Recall</td>
<td>3.534</td>
<td>1.838</td>
<td>88</td>
</tr>
<tr>
<td>Recall / Problem-Solving</td>
<td>4.654</td>
<td>1.938</td>
<td>81</td>
</tr>
</tbody>
</table>

Summary

This chapter presented the results from the data analysis of the relationship between presentation type (words-with-pictures, words-before-pictures, pictures-before-words) and test performance (problem-solving, recall).

Primary analysis of the data indicated:

1. There was no significant difference in problem-solving scores by novice-level participants receiving presentations in a words-with-pictures, words-before-pictures, or pictures-before-words format.
2. There was no significant difference in recall scores by novice-level participants receiving presentations in a words-with-pictures, words-before-pictures, or pictures-before-words format.

Secondary analysis of the data indicated:

1. There was no significant difference in problem-solving scores between novice recall/problem-solving format test-takers and novice problem-solving/recall format test-takers.

2. There was a significant difference in recall scores between novice recall/problem-solving format test-takers and novice problem-solving/recall format test-takers.

Chapter 5 will present the summary, discussion, and conclusion.
CHAPTER V

SUMMARY, DISCUSSION, AND CONCLUSION

Summary

New advances in computer hardware and software have enabled educators to incorporate multimedia instruction into their teaching routines. More and more software using combinations of text, sound, graphics, animation, and digital video is being developed for use in the classroom. Improvements in multimedia authoring systems have now made it possible for many educators to develop their own multimedia instruction according to their own specific needs. Research on various learning theories, such as Paivio's (1986) dual-coding theory, Ausubel's (1980) advance organizers, and Mayer's (1989) conceptual models and contiguity principle has provided a theoretical foundation for the use of multimedia in instruction.

Researchers such as Mayer (1989, 1993), Mayer and Anderson (1991, 1992), Baggett and Ehrenfeucht (1983), and Rieber (1989, 1990, 1991) have conducted several studies on the use of attributes such as still pictures, motion pictures, animation, and narration in instruction. More research is needed, however, to demonstrate the effectiveness of multimedia and to investigate different attributes of multimedia such as animation and narration. Through research into these areas, we can identify the situations which best utilize multimedia and help educators in the design and development of multimedia presentations. The purpose of this study was to investigate the effects of presentation type on the problem-solving and recall performance of novice learners at two southwest Virginia universities.

In this study, presentations were developed in contiguous words-with-pictures, isolated words-before-pictures, and isolated pictures-before-words formats. There were
two research hypotheses applied to this study. Hypothesis One stated that participants in the words-with-pictures group will perform significantly better than participants in the words-before-pictures, and pictures-before-words groups in problem-solving performance. Hypothesis Two stated that participants in the words-with-pictures and pictures-before-words groups will perform significantly better than the participants in the words-before-pictures groups in recall performance.

Six computer-based multimedia programs developed by the researcher were used as instructional material. Using animation and narration, each computer-based instructional presentation illustrated how a bicycle pump works and how a brass instrument makes a sound. For example, the first presentation might depict the playing of a brass instrument in a words-before-pictures format, while the second presentation might depict the workings of a bicycle pump in a pictures-before-words format. All three treatment groups (words-with-pictures, pictures-before-words, words-before-pictures) completed corresponding problem-solving and recall tests upon the completion of each presentation. Differences in problem-solving and recall performance by any or all of the three experimental groups were tested at the .05 level.

The first hypothesis was rejected. Participants in the words-with-pictures group did not perform significantly better than participants in the words-before-pictures, and pictures-before-words groups in problem-solving. Primary results from the study showed that there were no significant differences in problem-solving or recall performance among any of the treatment groups (words-with-pictures, pictures-before-words, words-before-pictures). These results disagreed with the findings of Mayer (1991) in which contiguous words-with-pictures presentations produced higher problem-solving performance. However, these results seem to confirm Rieber's claim that "The few
serious attempts to study the instructional attributes of animation have reported inconsistent results" (1990).

The second hypothesis was also rejected. Participants in the words-with-pictures and pictures-before-words groups did not perform significantly better than the participants in the words-before-pictures groups in recall. Although earlier studies had suggested that receiving an instructional presentation in a pictures-before-words format might result in recall performance significantly better than a words-before-pictures format (Baggett, 1984), the results of this study agreed with the findings of Mayer (1991), in which there were not significant differences between words & pictures, words-before-pictures, and pictures-before-words groups in recall performance. When recall is the desired outcome, the presentation order may not be as important as the content of the presentation in which verbal information is presented. The placement of verbal information with, before, or after animation does not seem to matter, as long as the verbal information is indeed presented.

When examining the effect of test order on recall and problem-solving, participants who took the recall test first and the problem-solving test second scored significantly higher in recall than participants who took the problem-solving test first and the recall test second. These results agree with previous studies which show that recall may be hindered by the length of delay between presented material and recall of the material. With this in mind, participants who are asked to recall material first should and do score higher on recall than participants who are asked to complete a problem-solving test prior to a recall test. Differences of recall scores between problem-solving/recall and recall/problem-solving test takers may also be explained by interference. The problem-solving test may act as interference for those taking the recall test second, resulting in lower recall scores for the problem-solving/recall test takers.
Discussion

As with any experimental study, there are factors which may have influenced the results of this study. Because of computer speed, at times the narration portion of the presentations skipped or "clipped-out" for a fraction of a second. Although this clipping of the narration seemed to not interfere with the understanding of the narration, it could be seen as a distraction to the participants encountering this. Also, this study used only written answers for recall and problem-solving questions. Other methods of data collection could have been used, such as drawings, sketches, and verbal interviews.

Although care was taken to pattern the brass questionnaires and tests as closely after Mayer's (1991) as possible, it appears that the questionnaires and tests may not have been equivalent to each other. For example, the bicycle pump questionnaire asks general household repair questions, while the brass instrument questionnaire asks questions specific only to brass instrument playing experience. Therefore, the novice-level bicycle pump participants may have been of a different level than the novice-level brass instrument participants.

Another question which must be addressed is whether the recall tests actually measured recall. The recall tests asked the participant to "Please write down an explanation of how a bicycle tire pump (or brass instrument) works. Pretend that you are writing to someone who does not know much about pumps (or brass instrument)." While recall deals with remembering the verbal narration of the presentation, it appears that the recall test may encourage the participant to reconstruct the presentation for the purpose explaining, rather than recall.

Further research should investigate the types of tests used to evaluate recall and problem-solving performance. On several of the tests, participants sketched
diagrams and illustrations of their answers. How can these drawings be included in the scoring? How do these drawings help the participants in recall or problem-solving?

**Conclusion**

The design of this study improved upon previous methodologies by eliminating the possibility of unwanted pictures-before-words and words-before-pictures occurrences. This study also allowed the additional investigation of the relationship of test order on recall and problem-solving performance. The results of this study have implications for developers of instructional materials which use animation and narration. Educators must be more aware of the different attributes which go into the development of a multimedia instructional presentation. They must take into consideration not only the presentation format (words-and-pictures, pictures-before-words, and words-before-pictures), but also the order of the testing, and the procedure used for testing. Designing instructional multimedia presentations involves much more than incorporating production features such as presentation format. This research helps us to understand the relationship between animation & narration and the many factors influencing recall and problem-solving performance.
REFERENCES


APPENDIX A

EXAMPLE OF THE COMPUTER PROGRAM
You are about to see and/or hear a presentation.

When finished, please notify the assistant.

Click here to begin
Please raise your hand to show that you are finished.
Thank you.

Please raise your hand to show that you are finished.
APPENDIX B

PUMP QUESTIONNAIRE
PQ

Put a check next to the things which apply to you:

_____ I own a set of tools including screwdrivers, pliers, and wrenches.

_____ I own at least one power tool (such as a power saw or power drill).

_____ I have replaced the heads on a lawn sprinkler system.

_____ I have replaced the washer in a sink faucet.

_____ I have replaced the flush mechanism in a toilet.

_____ I have installed plumbing pipes or plumbing fixtures.

Put a check mark indicating your knowledge of how to fix household appliances and machines:

_____ Very Much    _____ Much    _____ Average    _____ Little    _____ Very Little
APPENDIX C

BRASS QUESTIONNAIRE
Put a check next to the things which apply to you:

_____ I own a brass wind instrument (such as a Trumpet or Trombone)
_____ I have played a Trumpet or French Horn.
_____ I have played a Trombone or Tuba.
_____ I have played another type of brass wind instrument.
_____ I have blown into the mouthpiece of a brass wind instrument.
_____ I have seen the inside of a brass wind instrument.

Put a check mark indicating your knowledge of how to play a brass wind instrument:

_____ Very Much    _____ Much  _____ Average  _____ Little  _____ Very Little
APPENDIX D

PUMP PROBLEM-SOLVING AND RECALL TESTS
1. What could be done to make a pump more effective, that is, to move more air rapidly?

2. What could be done to make a pump more reliable, that is, to make sure it would not fail?
3. Suppose you push down and pull up the handle of a pump several times but no air comes out. What could have gone wrong?

4. Why does air enter a pump?

Why does air exit from a pump?
Please write down an explanation of how a bicycle tire pump works. Pretend that you are writing to someone who does not know much about pumps.
APPENDIX E

BRASS PROBLEM-SOLVING AND RECALL TESTS
1. What could be done to make a brass instrument more effective, that is, to produce more sound?

2. What could be done to make a brass instrument more reliable, that is, to make sure it would not fail?
3. Suppose you buzz into the mouthpiece of the instrument and no sound comes out. What could have gone wrong?

4. Why does sound enter a brass instrument?

Why does sound exit a brass instrument?
Please write down an explanation of how a brass instrument makes a sound. Pretend that you are writing to someone who does not know much about musical instruments.
APPENDIX F

CONSENT FORMS
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Consent Form

Title of Project: An Investigation of the Instructional Attributes of Animation and Narration

Principal Investigator: Marcus D. Childress

HOW INVOLVED
The purpose of this study is to investigate the instructional attributes of animation and narration. The results of this study will provide the researcher with valuable information on ways to present instructional material to promote learning.

This project involves:

1. Answering 12 questions about your knowledge of systems.
2. Watching instructional sequences on a computer monitor.
3. Answering 8 questions about the instructional sequences.
4. Writing down your explanation of how the mechanisms work.

Completing the questions and viewing the instructional sequence should take about one hour or less.

PRIVACY
Please record the last four digits of your student ID number on all answer sheets. This will be used only for analyses of the research. All reports will be based on aggregated (grouped) data. No individual scores will be reported.

BENEFITS
From this project, we hope to learn more about how animation and narration affect the learning process and how we might best design multimedia instruction.

WITHDRAW PROCESS
You are free to withdraw from this study at any time without penalty or prejudice.

CONTACT
This project has been approved by the Human Subjects Committee and the Institutional Review Board. If you have further questions, feel free to contact Marcus D. Childress (231-5587, 220 WMH), or Dr. Norman R. Dodl (231-5587, 220 WMH).

I hereby agree to voluntarily participate in the research project described above and under the conditions described above.

Signature________________________ Date________________

ID Number________________
RADFORD UNIVERSITY
Consent Form

Title of Project: An Investigation of the Instructional Attributes of Animation and Narration

Investigator: Marcus D. Childress

HOW INVOLVED
The purpose of this study is to investigate the instructional attributes of animation and narration. The results of this study will provide the researcher with valuable information on ways to present instructional material to promote learning.

This project involves:

1. Answering 12 questions about your knowledge of systems.
2. Watching instructional sequences on a computer monitor.
3. Answering 8 questions about the instructional sequences.
4. Writing down your explanation of how the mechanisms work.

Completing the questions and viewing the instructional sequence should take about 30 minutes or less.

PRIVACY
Please record the last four digits of your student ID number on all answer sheets. This will be used only for analyses of the research. All reports will be based on upon aggregated (grouped) data. No individual scores will be reported.

BENEFITS
From this project, we hope to learn more about how animation and narration affect the learning process and how we might best design multimedia instruction.

WITHDRAW PROCESS
You are free to withdraw from this study at any time without penalty or prejudice.

CONTACT
This project has been approved by the Radford University Institutional Review Board. If you have further questions, feel free to contact Marcus D. Childress, Department of Educational Studies (206A Russell Hall, 831-5302).

I hereby agree to voluntarily participate in the research project described above and under the conditions described above.

Signature_________________________________________ Date____________________

ID Number________________________
MARCUS DALE CHILDRESS

EDUCATION

• C.A.G.S., Curriculum and Instruction
  Virginia Polytechnic Institute & State University. Blacksburg, VA
  May, 1994

• M.M., Education
  Appalachian State University. Boone, NC

• B.M., Education
  Appalachian State University. Boone, NC
  August, 1983.

EXPERIENCE

• Instructor, Radford University.
  Radford, VA (1994-1995)
  Teaching Introduction to Media course to undergraduate education students.
  Supervising student teachers in local schools.

• Graduate Teaching Assistant, Virginia Polytechnic Institute
  Taught Psychological Foundations of Education to undergraduate education
  and psychology students.

• Graduate Assistant, Education Technology Lab, Virginia Polytechnic Institute
  Assisted college of education faculty and students in hardware and software
  use in Educational Technology Lab.

• Computer Programmer, Educational Technologies, Virginia Polytechnic Institute
  & State University. Blacksburg, VA. (Summer 1993)
  Developed engineering visual database program and videodisc for the
  SUCCEED Project of the National Science Foundation.

• Researcher, Department of Education, Commonwealth of Virginia.
  Richmond, VA (Summer 1992)
  Conducted interviews, surveys, and focus group meetings for the Virginia
  Department of Education Special Education Program Standards Study.

• Graduate Research Assistant, Learning Resources Center, Virginia Polytechnic
  Developed multimedia instruction of music appreciation.
MARCUS DALE CHILDRESS

- **Teacher**, Rowan-Salisbury Schools, Spencer, NC (1989-1991)
  Taught band and chorus at North Rowan High School. NC Career Ladder
  Level II teacher.

- **Adjunct Instructor**, Catawba College, Salisbury, NC (1989-1991)
  Taught applied music courses.

  Taught band at Hugh M. Cummings High School and Broadview Middle
  School. Fine arts department chair.

PROFESSIONAL ACTIVITIES

Presentations -

Childress, M. D. (June, 1994). *Interactive Multimedia Tools for Music in General
Studies*. National Educational Computing Conference, Boston, MA

Childress, M. D. & Childress, T.W. (June, 1994). *Multimedia and Adult Basic Skills
Training: A Winning Combination*. National Educational Computing
Conference, Boston, MA

Childress, M. D. (March, 1994). *An Investigation of Digitized Audio and Video
Instruction*. Annual Conference of the Society for Technology and Teacher
Education, Washington, DC

the Language Arts*. Annual Conference of the Society for Technology and
Teacher Education, Washington, DC

Childress, M. D. & Braswell, B. R. (February, 1994). *Guided Development of
HyperCard-Based Multimedia Materials: Playing With a Full Deck.*
Annual Convention of the Association for Educational Communications and
Technology, Nashville, TN

Childress, M. D. & Braswell, B. R. (February, 1994). *Now You CD Them...Incorporating
CD-ROM into the Curriculum*. Annual Convention of the Association for
Educational Communications and Technology, Nashville, TN

Childress, M. D. (February, 1994). *Gagné's Conditions of Learning as Exhibited
in Various Teaching Models*. Annual meeting of the Eastern Educational
Research Association Conference, Sarasota, FL

Childress, M. D. (October, 1993). *A Study of Multimedia Instruction Using Digitized
Video and Narration*. Annual Conference of the International Visual Literacy
Association, Rochester, NY
MARCUS DALE CHILDRESS


Childress, M. D. (April, 1993). *Multimedia in the Language Arts*. Price Reading and Language Arts Symposium, Appalachian State University, Boone, NC


Publications -

Chapters in books of refereed proceedings or readings:


Workshops -

Conducted workshops with Chapter I teachers on integrating computers into the curriculum.

Appalachian State University Basic Skills Training Institute, Boone, NC (May, 1993)
Conducted workshops on computer and multimedia applications in basic skills training.

Academic Honors -

Phi Kappa Phi National Honor Society
Graduate Student Representative (elected), Graduate Curriculum Committee - College of Education, Curriculum & Instruction Division (1992-1993)
Excellence in teaching award- Burlington City Schools Board of Education (1987)
MARCUS DALE CHILDRESS

Organizations -

Association for Educational Communications and Technology
International Society for Technology in Education
International Visual Literacy Association
Eastern Educational Research Association
Virginia Educational Media Association
MARCUS DALE CHILDRESS

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