4. PRINCIPLES OF MEDIA ELEMENTS

4.0 INTRODUCTION

When it comes to learning, the goal is to create environments in which learners actively process new information in the working memory in ways that lead to storage in long-term memory. And when needed, can be retrieved back into working memory. Positive learning outcomes require instructional methods that accommodate the limits of working memory and encourage processing of new information for storage in long-term memory.

The main psychological processes you need to support include: attention, management of load in working memory, rehearsal of new information in working memory that results in encoding in long-term memory, and retrieval of new skills back into working memory when needed. Let's take a look at some of the basic instructional methods you can use to support these learning processes in digital learning environments.

Learning Objectives:

The objective of this unit is to

Apply the Principles of Media Elements in developing E-Content

The specific objectives are listed below

- State the important elements of e-Lesson
- List the six media element principles
- Explain Multimedia Principle
- Explore the ways to use graphics to promote Learning
- Explain Contiguity Principles and the common violations
- Explain Modality Principles, and its Psychological Reasons and Evidence
- Explain Redundancy Principles
- Explain Coherence Principles, its Psychological Reasons and Evidence
- Explain Personalization Principles, its Psychological Reasons and Evidence

4.1 Elements of E-Lesson

Decisions about e-Learning courseware must begin with an understanding of how the mind works during learning and of what research data tell us about what factors lead to learning. This is where decisions must begin. Naturally factors other than psychological effectiveness come into play in your multimedia learning decisions. For example, instructional strategies will

be shaped by parameters of the technology like bandwidth and hardware, and by environmental factors such as budget, time, and organizational culture.

There is a distinction among three important elements of an e-Lesson: the ***instructional methods, the instructional media, and media elements***. In spite of optimistic projections of the positive impact of technology on learning, the reality has not lived up to expectations. From film to the Internet, each new wave of technology has stimulated prospects of revolutions in learning. But research-comparing learning from one medium such as the classroom with another medium such as the Internet generally fails to demonstrate significant advantages for any particular technology. These repeated failures lead us to abandon a technology-centered approach to learning in favor of a learner-centered approach. Having participated in many poor training sessions in the classroom and on the computer, we recognize that it's not the medium that causes learning. Rather it is the design of the lesson itself and the best use of instructional methods that make the difference. A learner-centered approach suggests that we design lessons that accommodate human learning processes regardless of the media involved.

Instructional methods are the techniques used to help learners process new information in ways that lead to learning. Instructional methods include the use of techniques such as examples, practice exercises, simulations, and analogies. **Instructional *media*** are the delivery agents that contain the content and the instructional methods including computers, workbooks, and even instructors. Not all media can carry all instructional methods with equal effectiveness. For each new technology that appears on the scene, we typically start by treating it like older media with which we are familiar. For example, much early Web-based training looked a lot like books — mostly using text on a screen to communicate content. As the technology behind a given medium matures, we get better at exploiting the features unique to that medium for learning. A third component of multimedia learning is the media elements. The ***media elements*** refer to the text, graphics, and audio used to present content and instructional methods.

4.2 Principles of Media Elements

Richard Mayer and his colleagues at the University of California at Santa Barbara have conducted a series of controlled experiments on how best to use audio, text and graphics to optimize learning in multimedia. Six media element principles can be defined based on Mayer's work. They are

- The Multimedia principle
- The contiguity principle
- The modality principle
- The redundancy principle
- The coherence principle

- The personalization principle

What follows is a summary of these principles along with supporting examples, psychological rationale, and research. Use this information as guidelines regarding the benefits of graphics, the placement of text and graphics on the screen, and the best way to present words that describe graphics among others.

4. 3 The Multimedia principle: Adding graphics to words can improve learning.

Graphics is referred to a variety of illustrations including still graphics such as line drawings, charts and photographs and motion graphics such as animation and video. Research was shown that graphics could improve learning. The trick is to use illustration message. Images added for entertainment or dramatic value not only doesn't improve learning but they can actually depress learning.

4.3.1 Select Graphics that Support Learning

Let us consider several possible functions of graphics

1. **Decorative graphics**. Decorative graphics are one of the most common types of visuals used in training materials. Their intended purpose is to build motivation by adding either aesthetics or humor to the instructional display. For example such as photo or a video of a person riding in a bi-cycle in a lesson on how bi-cycle tire pumps work; Figure 4.1 shows another example. In general, decorative graphics serve no real instructional purpose. And when taken to extremes such as the fantasy theme visual, they have been shown to depress learning. It is recommended that decorative visuals be used sparingly in instructional materials.

Figure 4.1: Example of decorative graphics

2. **Representational graphics.** Representational visuals are appropriately used to present concrete concepts and factual information related to job tasks such as scenes, forms, equipment, and common work settings. Representational graphics portrait a single element such as photo of a bicycle tire pump along with the caption, "bicycle tire pump".

3. **Organizational graphics.** Organizational graphics are extremely important to help orient learners to the structure and sequence of lesson content as shown in figure 4.2. An organizational graphic shows qualitative relationships among the main ideas in a lesson. Often geometric visuals are used as the basis for organizational graphics. Organizational graphics depict the relations among the elements such as the diagram of a bicycle tire pump with each part labeled or a matrix giving a definition and example of each of three different kinds of pumps

4. **Relational graphics.** Whereas organizational graphics display qualitative relationships, relational visuals communicate quantitative relationships among lesson content. Some common examples include bar graphs and pie charts. The use of relational visuals has exploded over the past 20 years. Luckily recent controlled research gives some good guidelines for best design and use of different types of relational graphics. For example, Relational graphics portrait a quantitative relation among two or more variables such as line graph showing the relation between years of age on X axis and probability of being in a bicycle accident on the Y axis.

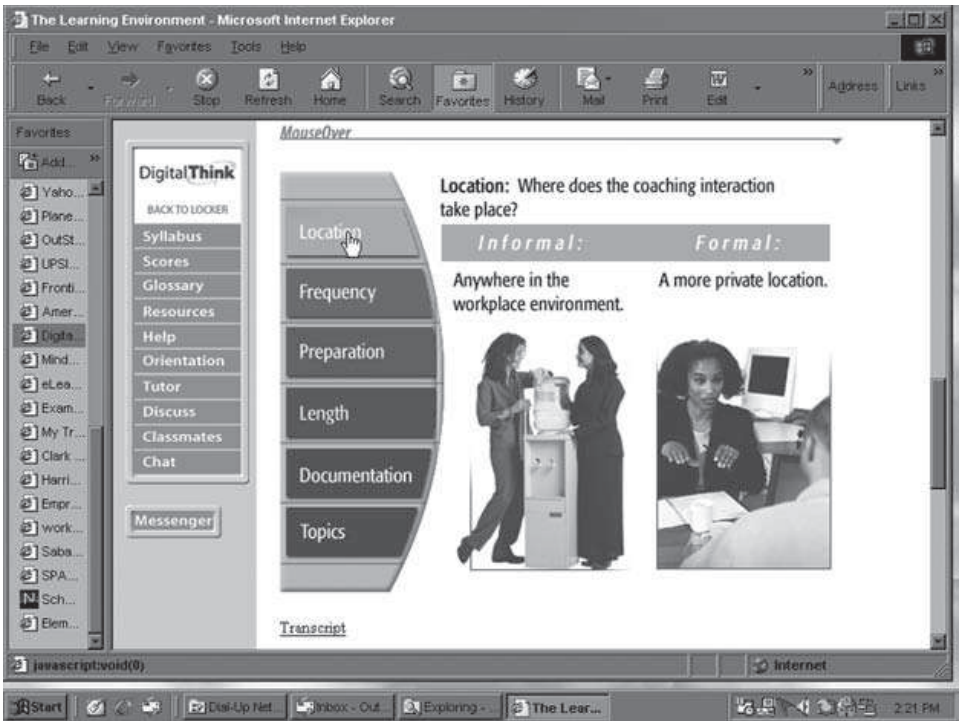

Figure 4.2: An Organisational Graphic on Coaching topics

5. **Transformational graphics**. Transformational graphics depict changes in a object over time, such as a video showing how to fix a flat tire, or a series of annotated frames showing steps in how a bicycle tire pump works.

6. **Interpretive graphics.** Interpretive visuals build understanding of concepts or principles that are abstract, invisible, or both. Interpretive graphicsillustrate invisible relationship such as an animation of the bicycle pump that includes small dots to show the flow of air into and out of the pump. Figure 4.3 shows an example developed by the Biologica project designed to teach secondary students the laws of genetics, the visual simulation allows students to change gene combinations on the chromosomes and immediately see the results in the dragon's features.

Based on this analysis it is recommended to minimize graphics that decorate the page (called decorative graphics) or simply represent a single object called representational graphics, and incorporate graphics that help the learners understand the material (called transformational and interpretive graphics) or organize the material (called the organizational graphics).

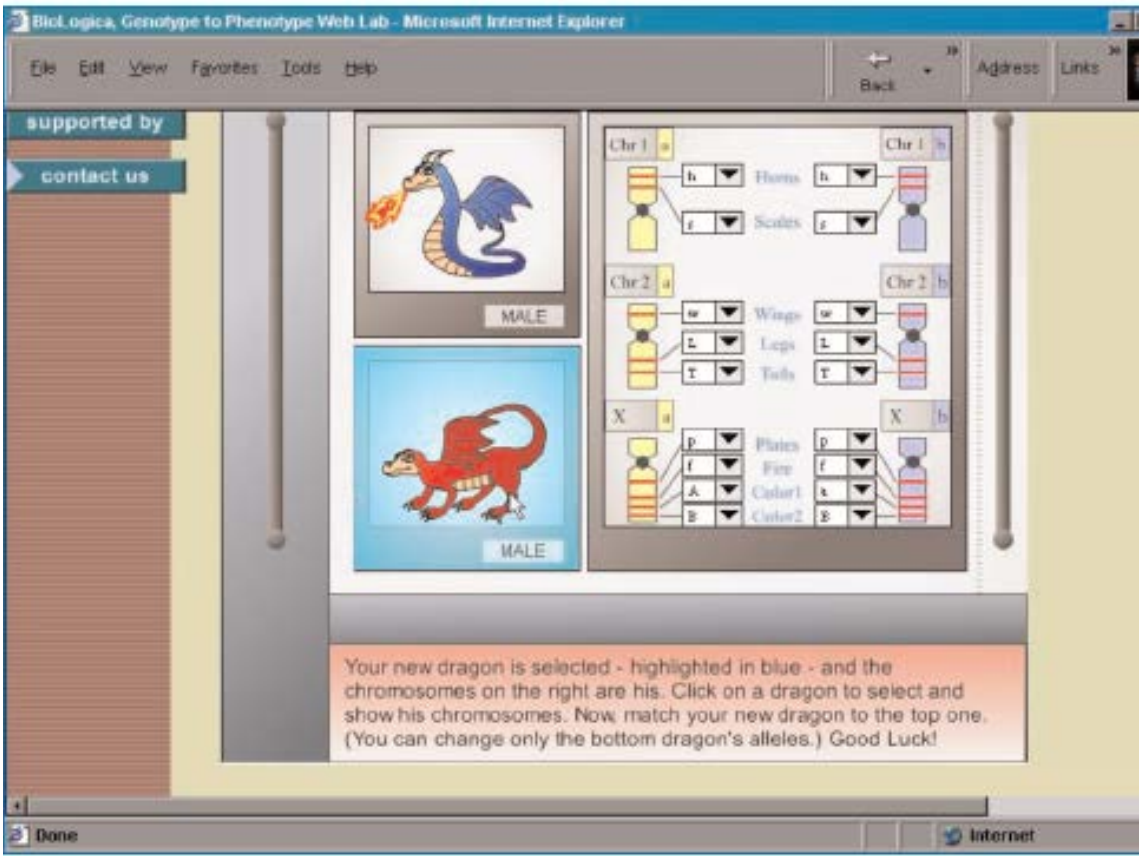

Figure 4.3: An interpretive visual to teach genetics. From Biologica project

4.3.2 Some ways to use graphics to Promote Learning

While graphics can boost learning, it will be important to select the kind of graphic that is congruent with the text and with the learning goal. Graphics can be used as instructional rather than decorative roles to teach Content types, as topic organizers as in lesson interfaces

Graphics to teach content types

Clark (2007) has identified 5 different kinds of content: fact, concept, process, procedure and principle. Table 4.1 briefly describes each content type and list graphics types commonly used to teach specific lesson content such as facts, concepts, process, procedures and principles. Figure 4.4 is a screen from animated graphics showing the steps or process involved in business.

TABLE 4.1: GRAPHICS TO TEACH CONTENT TYPES

Content type	**Description**	**Useful graphics types**	**Example**
Fact	Unique and isolated information such as specific application screen, forms or product data	Representational Organizational	Illustration of software screen
Concept	Groups of objects, events or symbols designated by a single name	Representational Organizational Interpreter	Diagram of a data base table, a tree diagram of the biological species
Process	A descriptive of how something works	Transformational Interpretive Relational	Activities in a computer network, animation of how the heart pumps blood
Procedure	A series of steps resulting in completion of a task	Transformation	Animation of how to use a software application
Principle	Guidelines that result in completion of a tasks; cause- and – effect relationship	Transformational imperative	Video showing to effective sales approaches.

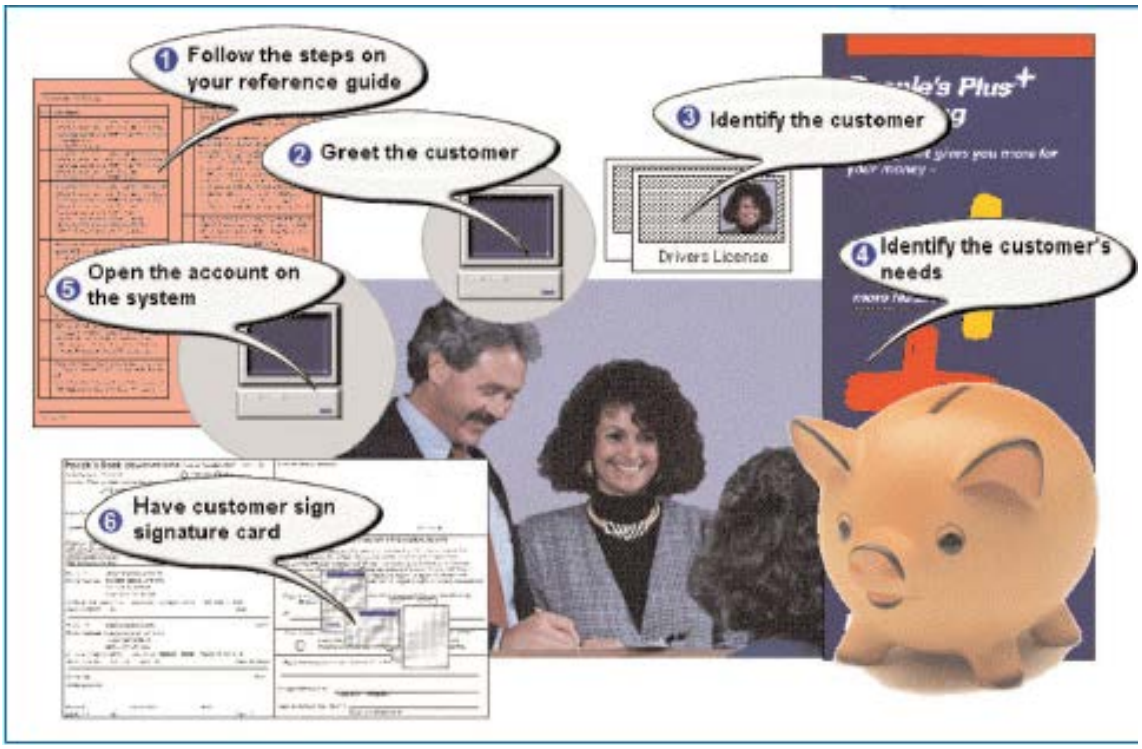

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Figure 4.4: An individual graphic to illustrate a process

Graphics as topic organizer

In addition to illustrating specific content types, graphics such as topic maps can serve an organizational function by showing relationships among topics in a lesson. For example a screen with series of coaching topics mapped in the left hand bar, including where to coach, when to coach, how long to coach and so on. When the mouse is placed over each of the topics in the graphics organizer, a different illustration appears on the right side of the screen. (see Figure 4.5)

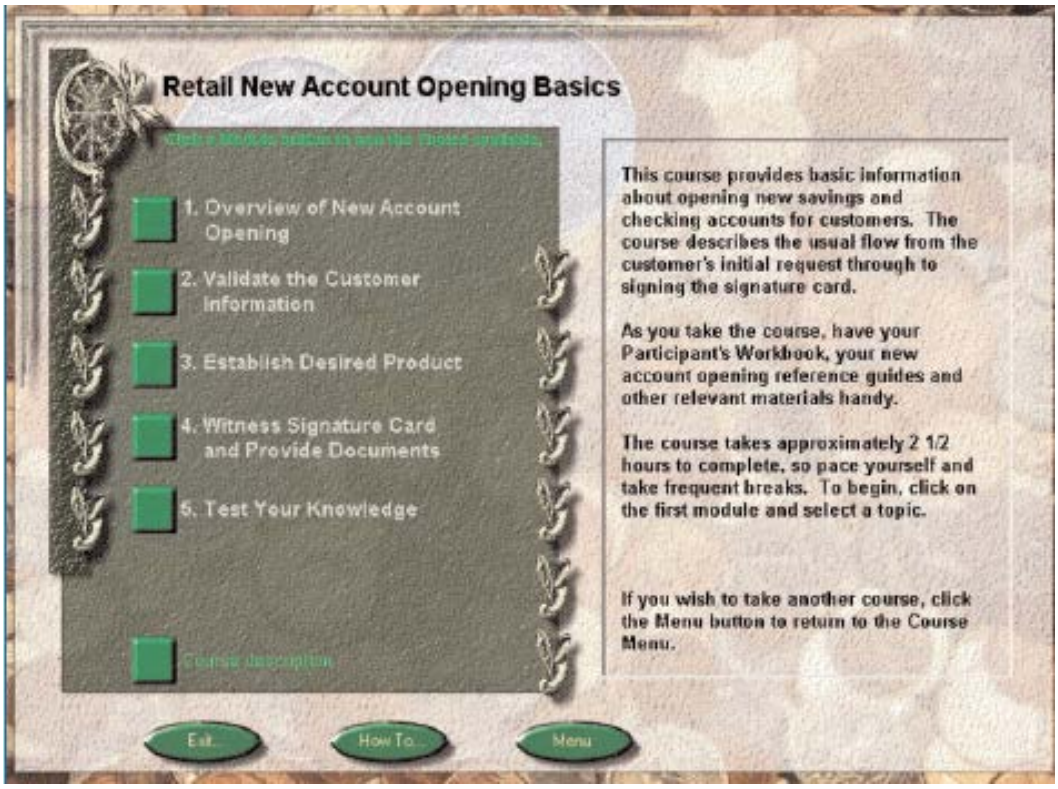


Figure 4.5: Graphical user interface related to content

Graphics to show relationship

Graphics in the form of dynamic and static graphs can make invisible phenomena visible and show relationships. Imagine an e learning lesson to teach fast food workers safe cooking and food handling practices. An animated line graph with numbers of vertical axis and time on the horizontal axis illustrates change in bacterial growth in food could that different temperatures are handled in safe and unsafe ways. The lesson includes an interactive simulation in which the learner adjusts the cooking temperature and sees the impact on the dynamic line graph called a "germ meter". A geographical map can illustrate population density by adding a small red dot to represent 5000 individuals if made interactive, the map could include a slider bar that accessed different time periods, allowing the viewer to see population shifts over time.

Graphics as lesson interfaces

Finally courses designed using guided discovery approach often use a graphical interface as a backdrop to represent case studies. For jobs that are conducted in office settings, a generic office is shown in the Figure.4.6. It illustrates a number of resources for the learner to use while working on a simulated job assignment. In this lesson bank loan agent can use the computer, telephone, Fax machine and bookshelf to research a commercial loan application.

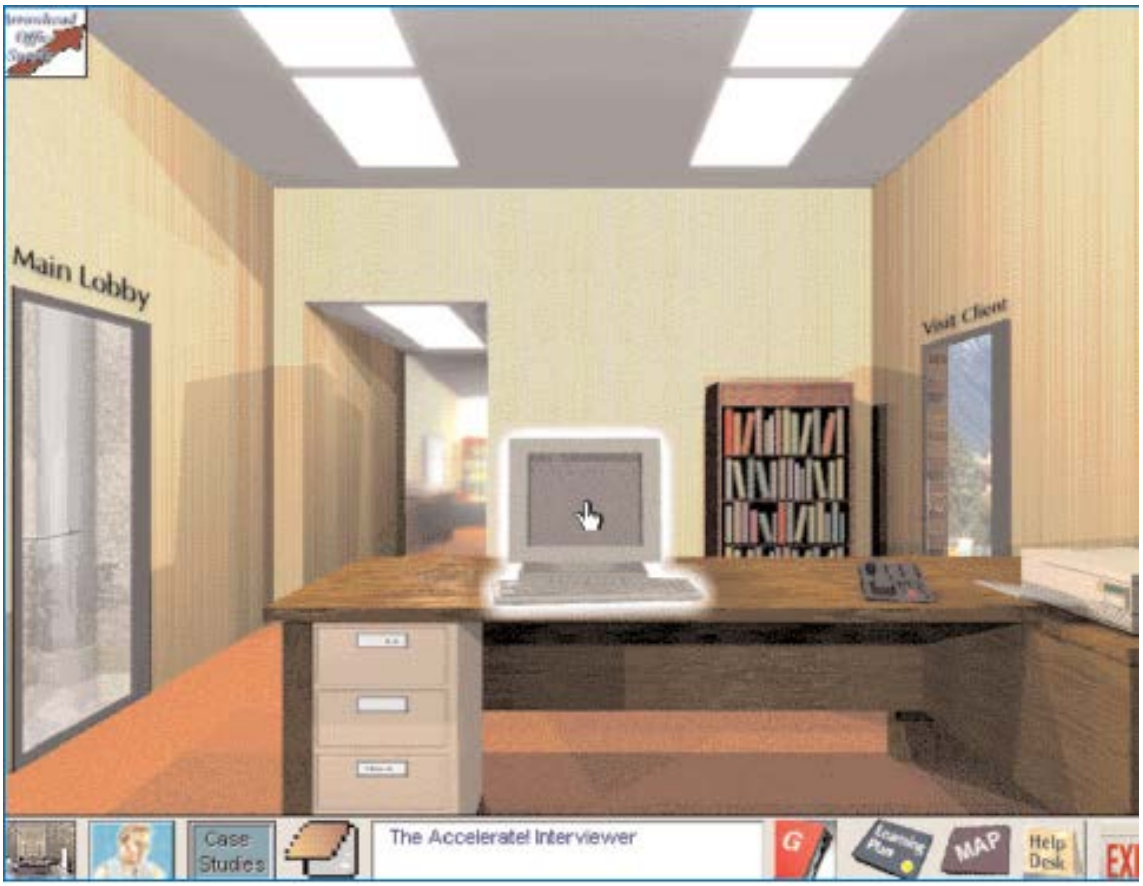


Figure 4.6: A virtual workplace serves as a visual backdrop for problem-centered learning.

4.3.3 The research

Mayer compared learning about various mechanical and scientific processes including how a bicycle pump works and how lightning forms, from lessons that used words alone or used words and pictures (including still graphics and animations). In most cases he found much improved understanding when pictures were included. In fact, he found an average gain of 89% on transfer tests from learners who studied lessons with text and graphics compared to learners whose lessons were limited to text alone.

The research findings clearly support empirically that the use of screens and screens of text discourages an effective learning environment. However not all pictures are equally effective. The other principles will explain how to best make use of visual to promote learning.

The Psychology

Learning occurs by the encoding of new information in permanent memory called long-term memory. According to a theory called dual encoding, content communicated with text and graphics sends two codes - a verbal code and a visual codes. Having two opportunities for encoding into long-term memory increases learning.

Applying the Multimedia Principle: What to look for in e-Learning

1. Graphics & text used to present instructional content
2. Graphics are relevant, not decorative
3. Representative graphics used to illustrate concrete facts, concepts, and their parts
4. Animation used to illustrate processes, procedures, and principles
5. Organizational graphics used to show relationships among ideas or topics
6. Interpretative illustrations like graphs used to show relationships among variables or to make invisible phenomena visible
7. Graphics are used as a lesson interface for case studies

4.4 The Contiguity principle: Placing text near graphics improves learning.

Contiguity refers to the alignment of graphics and text on the screen. Often, in e-learning when a scrolling screen is used, the words are placed at the top and the illustration is placed under the words, where text is visible with out graphics and vice versa. This is a common violation of the contiguity principle, which states that graphics and text related to the graphics should be placed closed to each other on the screen.

Contiguity principle 1

Place printed words near corresponding graphics

In designing or selecting e-learning courseware, consider how on screen text is integrated with on screen graphics in particular, when printed words referred to parts of on screen graphics make sure that the printed words are placed next to the part of graphics to which they refer. Similarly when a lesson represents words that describe actions depicted in series of still frames, make sure that the text describing an action is placed near the corresponding part of graphic, using an pointing line to connect the text with the graphic. When there is too much text to fit on a screen the text describing each action or state can appear as a small pop up message that appears when the mouse touches the corresponding portion of the graphics. This technique is called mouse over or roll over. For example, Figure 4.7 shows an application screen that uses the rollover technique. When learners place their cursors over different section of the application screen, a text caption appears that explains that section. In Figure 4.7 the mouse has rolled over section 1 and the text window below it appear as long as the mouse remains in that area of the screen. Rollovers are transient. The text box disappears when the cursor moves to a different location on the screen.

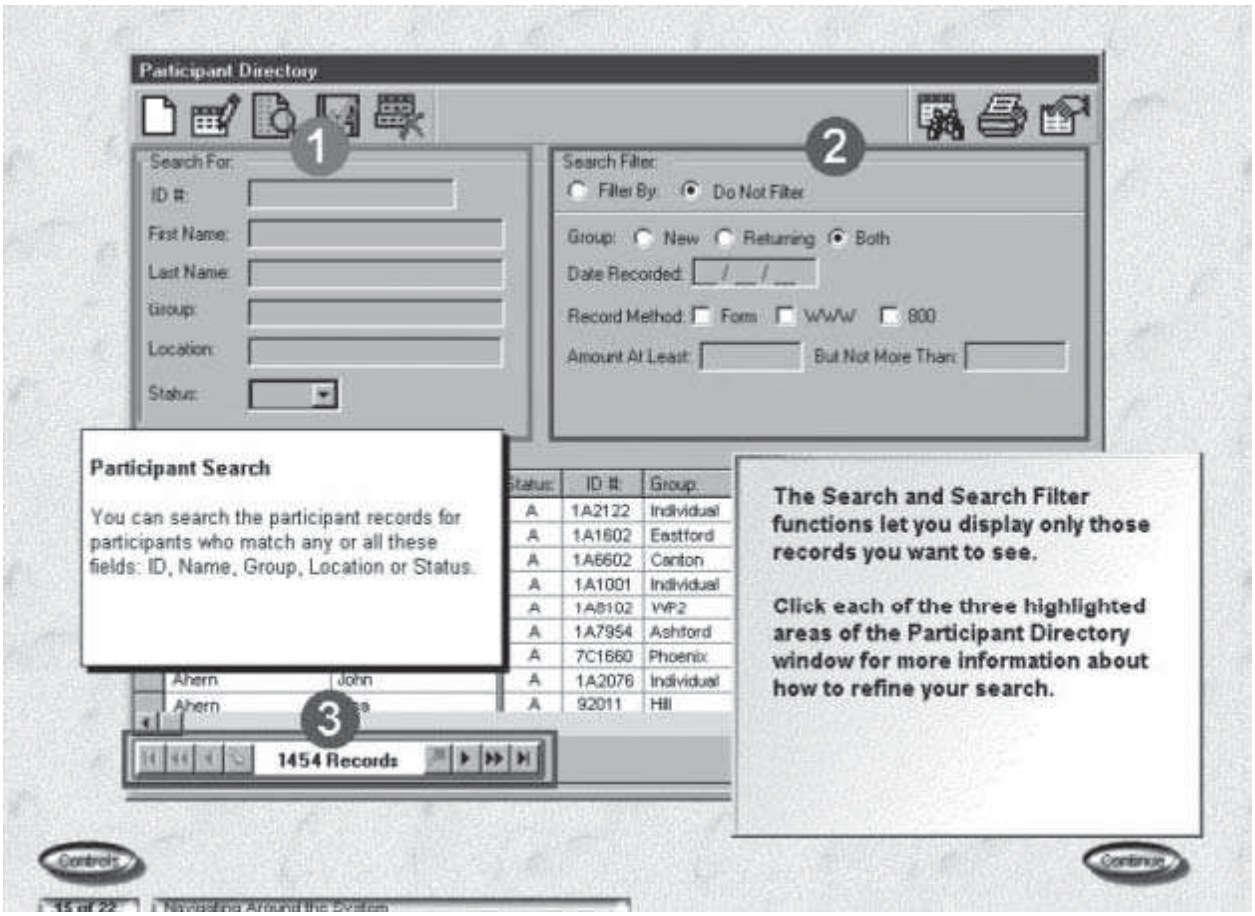


Figure 4.7: A Screen Rollover Integrates Text Below Section 1 of Graphic.

Violations of contiguity principle 1

Violation of the contiguity principle is all too common. The following list gives some of the most common violation of this principle that is frequently seen in e-learning course ware:

- In a scrolling window graphics and corresponding printed text are separated one before the other, and partially obscured because of scrolling screens.
- Feedback is displayed on a separate screen from the practice or question.
- Links leading to an on-screen reference appear in a second browser window that covers the related information on the initial screen (i.e. printed text in one window and graphics are in another window)

- Direction to complete practice exercises are placed on a separate screen from the application screen in which directions are to be followed.
- All text is placed at the bottom of the screen away from graphics.
- Key elements in a graphic are numbered, and legend at the bottom of the screen includes the name for each numbered element.

Separation of text and graphics on scrolling screen

Sometimes scrolling screen is poorly designed so that the text is presented first and visual illustration appears further down the screen. This problem can be remedied by integrating text and visual on a scrolling screen. Alternatively fixed screen display is used when it is important to see the text and graphic together. On a fixed screen the graphic can fill the screen, and text box can be placed over the graphic near the element of the screen being described. Another remedy to the scrolling problem is to use text boxes that popup over graphics when the graphic is touched by the cursor.

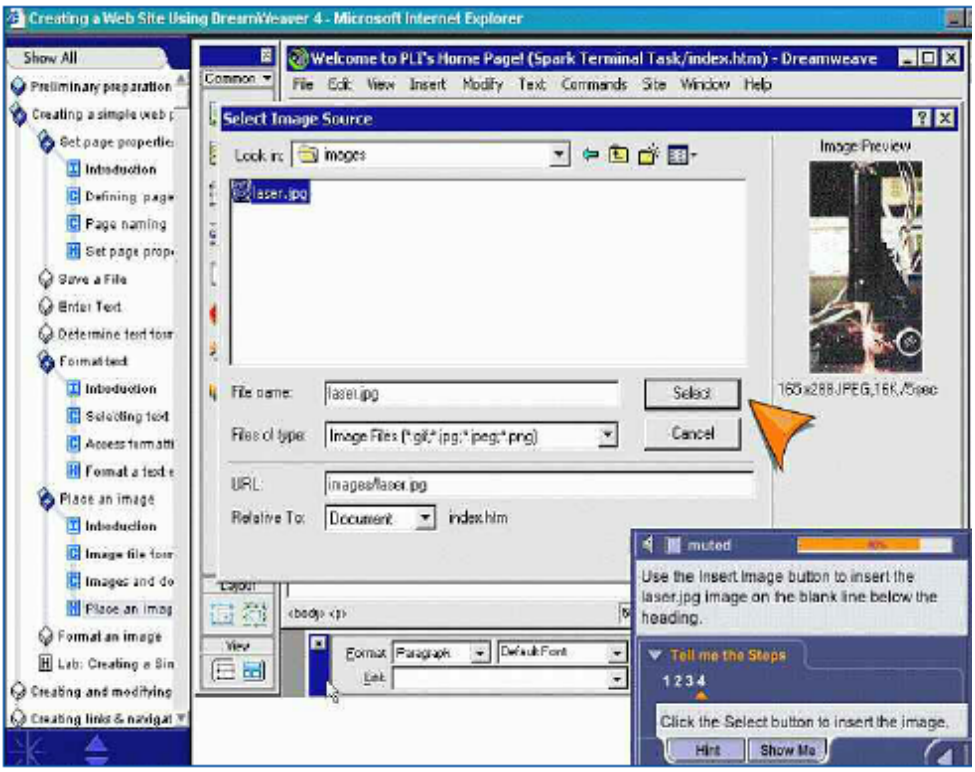


Figure 4.8. : A Screen Rollover Integrates Text Below the Arrow of Graphic

Separation of feedback from questions or responses

Another common violation of contiguity principle feedback is placed on a screen separate from the question or from the learner's answers. This requires a learner to pageback and forth between the question and the feedback, adding cognitive load to the learning. A better solution is to carry over from the question screen and place next to the correct answer, llowing a quick and easy comparison without paging back.

Covering Lesson Screens with Linked Windows

The use of links to lead to adjunct information is common in e-learning. However, when the linked information covers related information on the primary screen, this practice can create a problem. For example, an application screen leads to a window containing a job aid. Having access to reference material is a good idea for memory support. However, if the resulting windows cover the graphic example that it describes, the contiguity principle is violated. A better solution is to link to a window that is small, can be moved around on the main screen, and/or can be printed.

Presenting Exercise Directions Separate from the Exercise

Another common violation of the contiguity principle is presenting exercise directions in text separated from the screens on which the actions are to be taken. A better alternative is to put the step-by step directions in a box that can be minimized on the application screen.

Displaying Captions at the Bottom of Screens

For consistency, many e-learning designs place all text in a box at the bottom of the screen. Such as the frame shown in figure 4.9 a.The problem with this layout is that the learner needs to scan back and forth between the words at the bottom of the screen and the part of the graphic they describe. A better arrangement is to relocate the text closer to the visual as well as to insert lines to connect the text and visual, as shown in figure 4.9 b

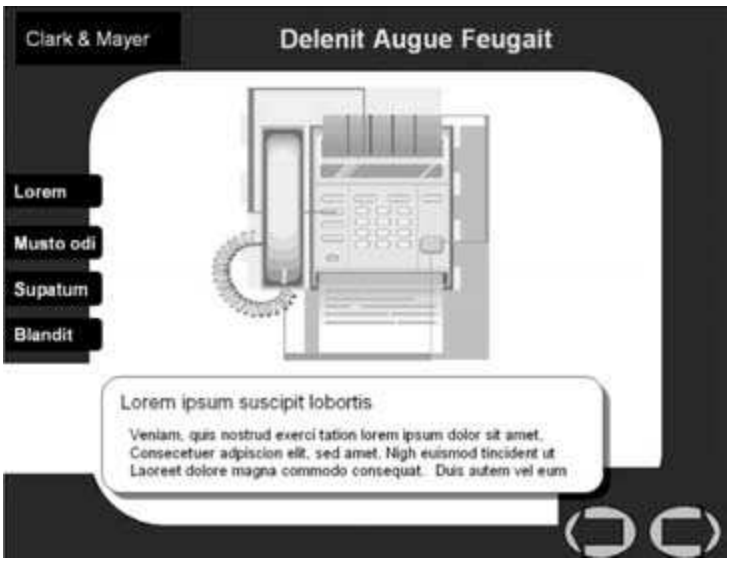


Fig 4.9 a: Text Placed at Bottom of Screen

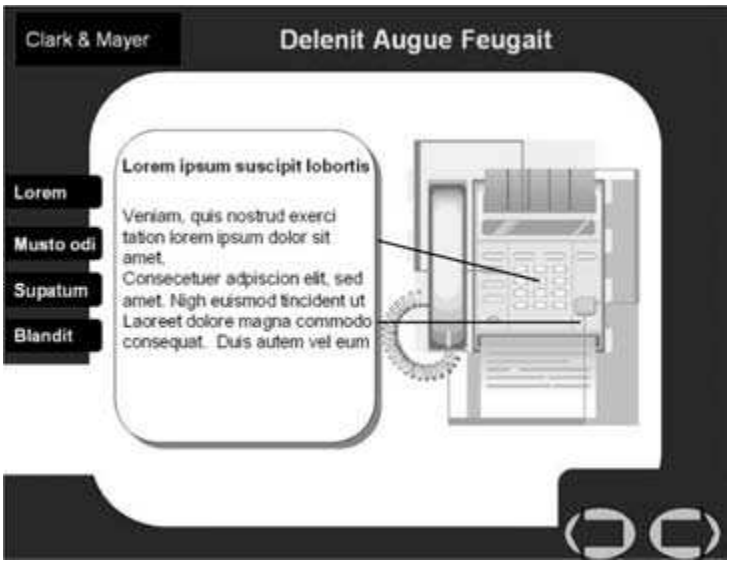


Fig 4.9 b: Text Placed Next to Visual

Using a legend to indicate the Parts of a Graphic

Suppose you want students to learn about the parts in a piece of equipment. You could show them an illustration in which each equipment parties numbered and a legend below the illustration describes each one. The problem with this layout is that the learner must scan between the number and the legend – which creates wasted cognitive processing. A more efficient design would place the name and part description in a separate box near the

corresponding part on the visual. The text could be placed in a rollover box or in a fixed display on the screen.

Contiguity Principle 2: Synchronize Spoken words with Corresponding Graphics

Another version of the contiguity principle deals with the need to coordinate spoken words and graphics. The spoken words (narration) that describe an event should play at the same time as the graphic(animation or video) is depicting the event. In short, it is recommended that corresponding graphics and spoken words be presented at the same time. When e-learning courseware contains narration and corresponding graphics (animation or video), the spoken words describing a step or an action should correspond to the steps shown in graphics or video.

Violations of Contiguity Principle 2

Violations of the contiguity principle include the following:

- A Link to audio is indicated by one icon and a link to video is indicated by another icon
- A segment provides a narrated introduction followed by animation or video.

Separation of graphics and Narration through Icons

Suppose you click on “How the Hearts Works” in an online encyclopedia and two buttons appear – a speaker button indicating that you can listen to a short narration about the four steps in the heart cycle – and a movie button indicating that you can watch a short animation, as illustrated in figure 4.10. You click on the speaker button and listen to a description of the 4 steps in the heart cycle. Then you click on the movie button and watch a narration showing the 4 steps in the heart cycle. You might think this is an excellent presentation because you can select which mode of presentation you prefer. You might like the idea that you listen to the explanation first and then watch or vice versa, thereby giving you 2 complementary exposures to the same material.

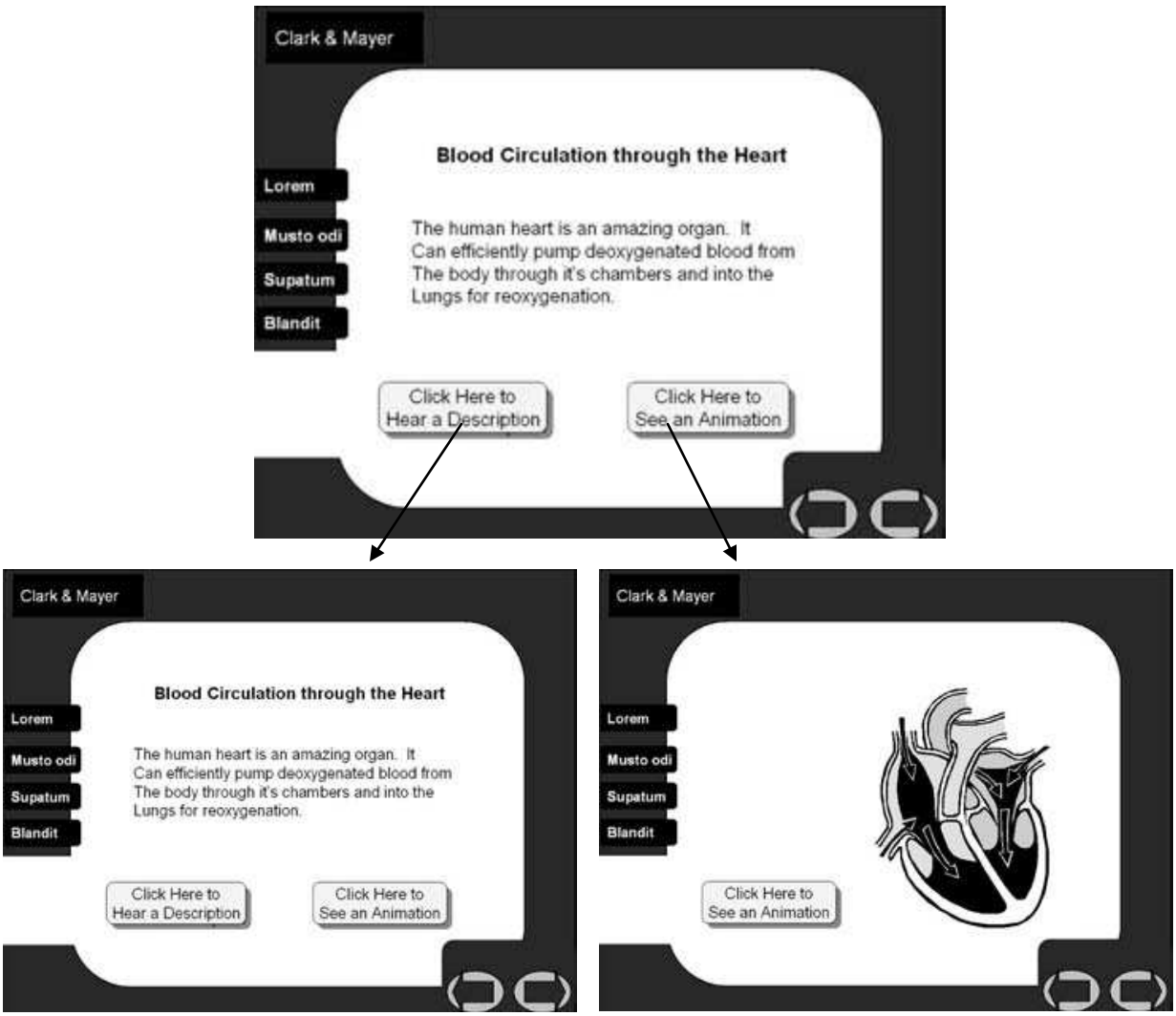


Figure 4.10: Narration is presented separately from Animation

What's' wrong with this situation? The problem is that when a lesson separates corresponding words and graphics, learners experience a heavier load on working memory-leaving less capacity for deep learning. Consider the learners cognitive processing during learning when a narration is flowed by an animation. After listening to the narration, the learner needs to hold all the relevant words working memory and then match up each segment to the corresponding segment of animation. However, having to hold so much information in working memory can be overwhelming so the learners may not be able to engage in other cognitive process needed for deep learning. This is the type of load called extraneous processing. Extraneous processing refers to the mental loads that do not contribute to learning. Therefore, it is recommended that you avoid e-learning lessons at present narration and graphics separately.

Separation of graphics and Narration in a continuous presentation

Even when a lesson presents graphics and narration as a continuous unit a lesson may be designed so that an introduction is presented as brief mention that is followed by graphics such as an animation, video or series of still frames depicting the same material. For example consider a multimedia presentation on “How the heart works” that begins with the narrator describing the 4 steps in the heart cycle, followed by 4 still frames depicting the 4 steps in the heart cycle.

At first glance you might like this arrangement because you get a general orientation in words before you inspect a graphic. Like the previous scenario this situation can create cognitive overload because the learner has to mentally hold the words in working memory until the graphics appears – thereby creating a form of extraneous cognitive processing. To overcome this problem it is recommended to present the narration at the same time the static frames are presented. In this situation, the learner can more easily make mental connections between corresponding words and graphics.

4.4.2 The research

Mayer compared learning about the science topics described above in versions where text was placed separate from the visuals with versions where text was integrated on the screen near the visuals. The visuals and text were identical in both versions. He found that the integrated versions were more effective. In five out of five studies, learning from screens that integrated words near the visuals yielded an average improvement of 68%.

The Psychology

Learning occurs in humans by way of working memory, which is the active part of our memory system. Working memory is not very efficient and has a severe limitation of holding seven (plus or minus two) facts or items at a time.

Since working memory capacity is needed for learning to occur, when working memory becomes overloaded, learning is depressed. If words and the visuals they describe are separate

from each other, the learner needs to expand extra cognitive recourses to integrate them. In contrast, in materials in which the words and graphics are placed contiguously, the integration is done for the learner. Therefore the learner is free to spend those scarce cognitive resources in learning.

4.5 The modality principle: *Explaining graphics with audio improves learning*

The use of other modalities like audio can substantially improve learning outcomes. This is especially true of audio narration of an animation or a complex visual in topic that is relatively complex and unfamiliar to the learner.

The research

Mayer compared learning from two e-Learning versions that explained graphics with exactly the same words — only the modality was changed. Thus he compared learning from versions that explained animations with words in text with versions that explained animations with words in audio. In all comparisons, the narrated versions yielded better learning with an average improvement of 80%.

The psychology

As described under the contiguity principle, working memory is a limited resource that must be preserved for learning purposes. Cognitive psychologists have learned that working memory has two sub-storage areas — one for visual information and one for phonetic information. One way to stretch the capacity of working memory is to utilize both of these storage areas. Figure4.4 illustrates how the use of graphics, which enter visual memory, and audio, which enters phonetic memory, maximize working memory capacity.

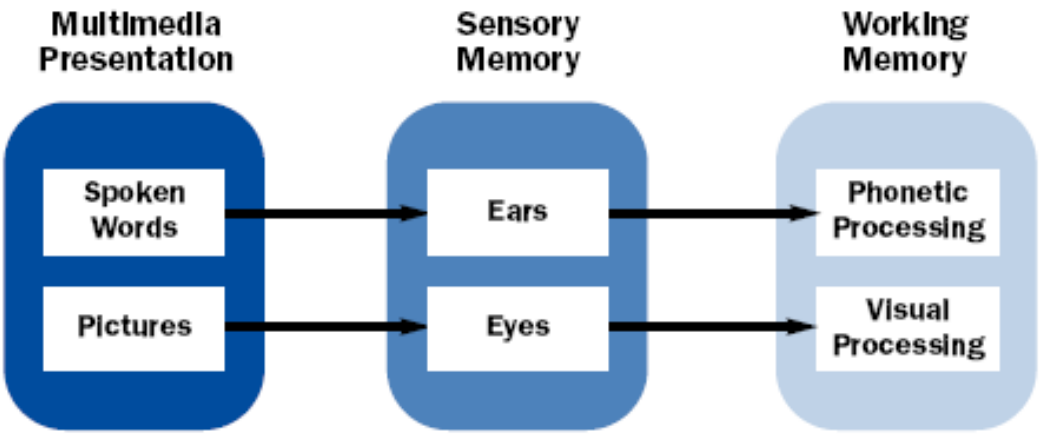


Figure 4.4: Visual and supporting auditory information maximize working memory resources

The Application

Audio should be used in situation where overloaded is likely. For example, if you are watching an animated demonstration of maybe five or six steps to use a software application, you need to focus your visual resources on the animation. If you have to read text and at the same time watch the animation, overload is more likely than when you can hear the animation being narrated. This does not mean that text should never be used.

4.6 The redundancy principle: *Explaining graphics with audio and redundant text can hurt learning.*

Some e-learning provides words in text and in audio that reads the text. This might seem like a good way to present information in several formats and thus improve learning. Controlled research however, indicates that learning is actually depressed when a graphic is explained by a combination of text and narration that reads the text.

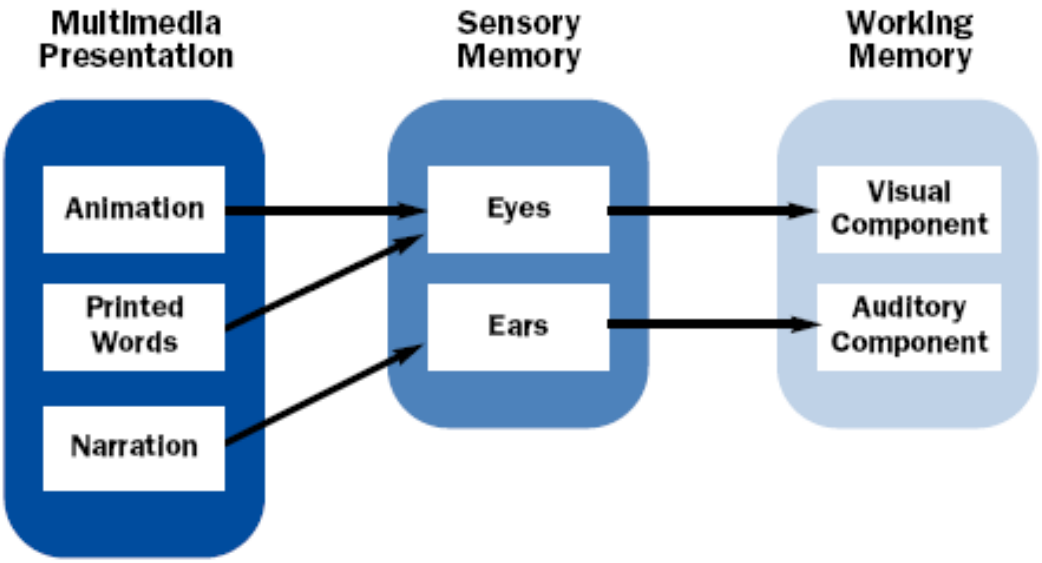


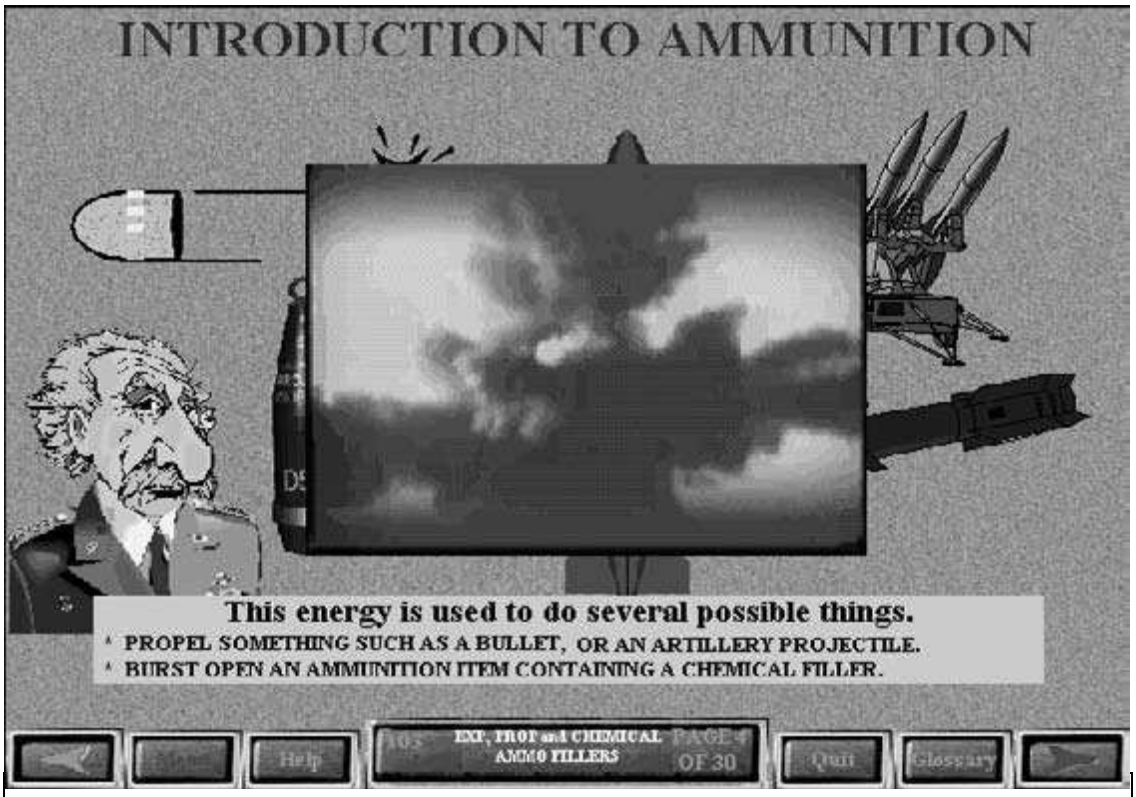
Figure 4.12: Presenting words in text and audio can overload working memory in presence of graphics.

Redundancy Principle 1:*Do Not Add On- Screen Text to Narrated Graphics*

Redundancy Principle 2:*Consider Adding On- Screen Text to Narration in Special situations*

It is recommended to omit redundant on-screen text in most e-learning programs yet it can be considered to use it in special situations that will not over load the learners visual information processing systems, such as when:

- There is no pictorial representation (for example when screen contains no animation, video, photos, graphics, illustrations and so on);
- There is ample opportunity to process the pictorial representation (for example, when the on-screen text and corresponding graphics are presented sequentially or when the pace of representation is sufficiently slow) are
- Learner must exert much greater cognitive effort to comprehend spoken text than printed text (for example, for learners who are not native speakers are who have specific learning disabilities are when the verbal material is long and complex are contains and familiar keywords.



Audio: "This energy is used to do several possible things such as propel something such as a bullet or an artillery projectile or burst open an ammunition item containing a chemical filler."

Figure 4.13. Graphics Explained Using Identical Text and Audio Narration.

4.6.1 The research

In studies conducted by Mayer and by others, researchers have found that better transfer learning is realized when graphics are explained by audio alone rather than by audio and text. Mayer found similar results in two studies for an average gain of 79%. There are exceptions to the redundancy principle as recently reported by Roxana Moreno and Mayer. In a comparison of a scientific explanation presented with narration alone and with narration and text, learning was significantly better in conditions that included both narration and text.

The researchers conclude that, "An effective technique to promote broader learning with multimedia explanations is to use the auditory and visual modalities simultaneously for verbal information if no other visual material is presented concurrently." Therefore there will be limited

situations in which narration of onscreen text could be helpful to learning such as when there is no graphic on the screen or when readers lack good reading skills.

The psychology

As illustrated in Figure 4.12, overload of the visual and auditory components of working memory occurs if an on-screen graphic is explained by both text (which enters the visual center) and narration. However if there were no on-screen visual, then overload would not result and because dual codes would be provided, learning would be increased.

The application

In general, it's advisable to avoid narration of text when there is a demanding visual illustration on the screen. This is especially important when working memory is subject to overload such as during an animation in which learners have limited control over the pacing, or during the presentation of complex new information. In contrast, when there is no graphic information on the screen, then research to date would suggest that presenting words in text and auditory format would benefit learning.

4.7 The Coherence principle: ***Using gratuitous visuals, text and sounds can hurt learning***

E learning attrition can be a problem. Some designers use a Las Vegas approach with well-intended efforts to spice up e-learning. Las Vegas approach means they adding glitzy and games to make the experience more engaging. The glitzy can take a variety of forms such as dramatic vignettes (in video or text) inserted to add interest, background music to add appeal or popular movie characters or themes to add entertainment value.

As an example, consider a storyboard for a course on using statistical quality control techniques to improve quality, shown in Figure 4.14. To add interest, several stories about the costs of product recalls were added. But how do these additions affect learning?

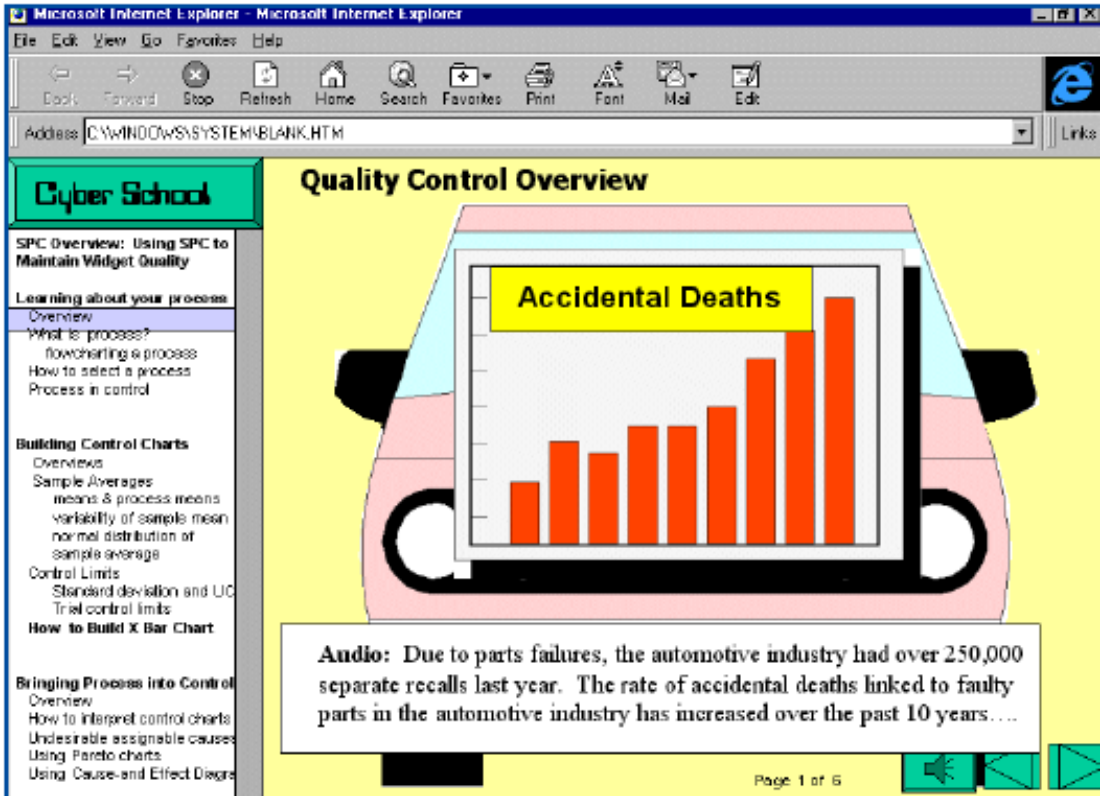


Figure 4.14: A seductive detail from a quality lesson. From Clark and Mayer, 2002.

Coherence Principle 1: Avoid e- lession with Extraneous Audio

Back ground music and sounds may overload working memory so they are most dangerous in situation in which the learner may experience heavy cognitive load for example when the material is unfamiliar, when the material is presented at the rapid rate or when the rate of presentation is not under learner control. For example, Figure 4.14 shows a screen from a military multimedia lesson on ammunition. As the lesson illustrates the different types of ammunition that workers may encounter, background sounds such as bullets flying, bombs exploding, and tanks firing are included. These sounds are extraneous to the points being presented and are likely to prove distracting. Figure 4.15 shows a screen from the same program that invites the learners to select the type of background music they want to hear during the course introduction. Again, the addition of extra sounds in the form of music is likely to depress learning.

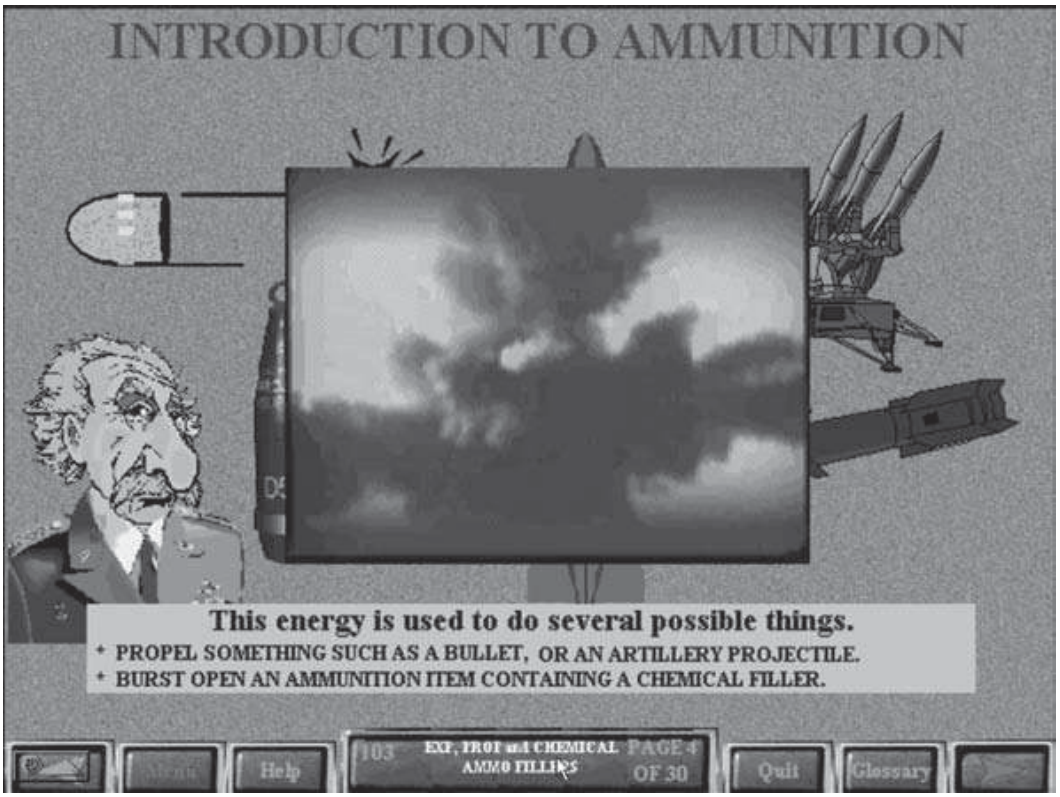


Figure 4.15: Sounds of Explosion and Bullets Added to Narration of On-Screen Text.

Coherence principle 2: Avoid e-lessons with extraneous graphics

Extraneous graphics can be distracting and disruptive of the learning process. In short, when pictures are used only to decorate the page or screen, they are not likely to improve learning. As an example of irrelevant graphics, Figure 4.16 shows a screen from a lesson on ammunition safety that includes extensive video about the history of ammunition. Some of the information is quite interesting but not related to the tasks involved in handling ammunition. It is recommended to exclude this type of information.

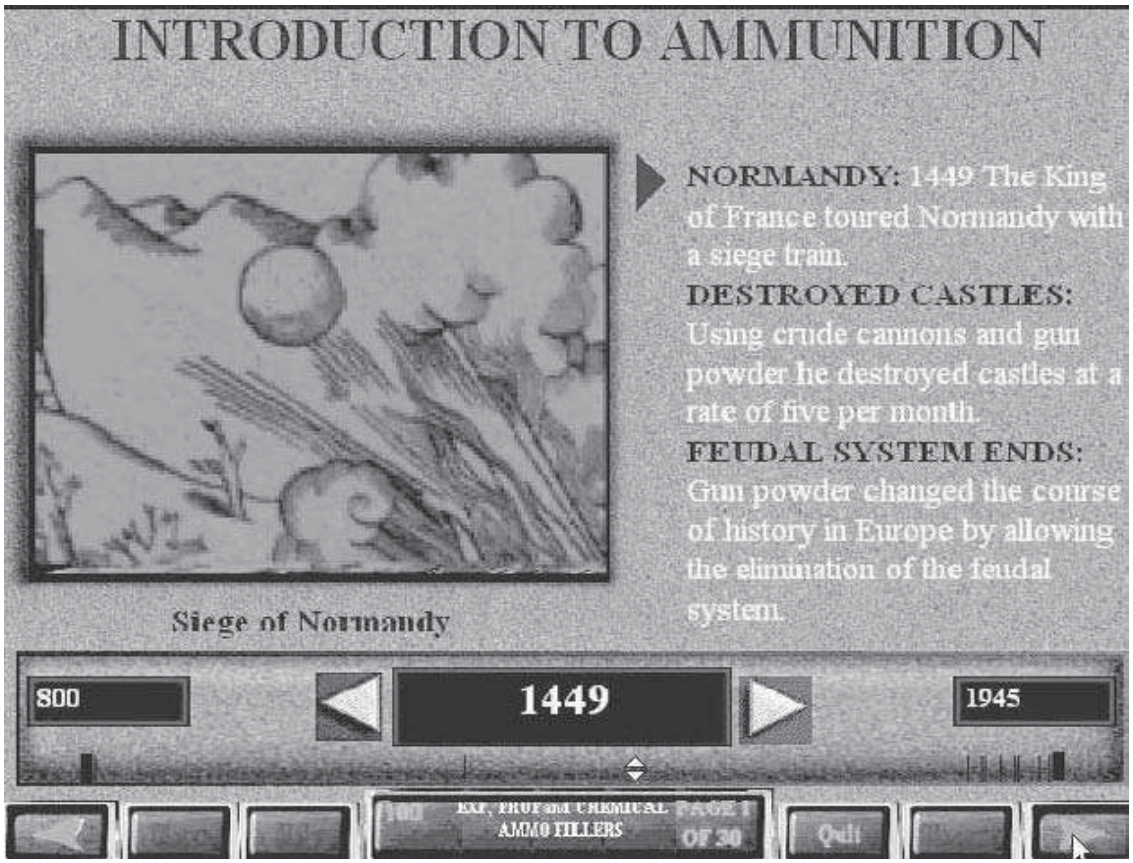


Figure 4.16: Interesting But Unrelated Historical Information Should Be Excluded.

Coherence principle 3: Avoid e-lessons with extraneous words

The third version of Coherence principle recommends that you avoid adding extraneous words to lessons. When the goal is to promote learning of the target material – such as the workings of a cause–and-effect system –adding interesting but extraneous words may result in poorer learning. Cute little stories and interesting pieces of trivial may seem like harmless embellishments, but the research reviewed in this chapter shows that such device may not produce the intended effects.

This guideline is helpful when limited screen real estate and bandwidth suggest shorter rather than longer narrations. Rather than fully embellished textual or narrative descriptions, stick to basic and concise descriptions of the content. It also helps implement the modality principle effectively. By keeping the narration on each screen concise, learners won't become as frustrated waiting for lengthily audio segments to play.

In the 1980's research on details presented in text that were related to a lesson explanation but were extraneous in nature found them to depress learning. Such additions were called "seductive details." In more recent research, Mayer has found similar negative effects from seductive details presented either via text or video. For example, in the lesson on lightning formation, short descriptions of the vulnerability of golfers to lightning strikes and the effect

oflightning strikes on airplanes were added to the lesson. In six of six experiments, learners who studied from the base lesson showed much greater learning than those who studied from the enhanced versions. The average gain was 105%. Similar effects were seen in a comparison of lessons that included background music and environmental sounds with base lessons that did not add extra auditory material. Finally, a third series of experiments compared an expanded explanation that used 500 words and several captioned illustrations with a lesson that used only the illustrations and their captions. Students who received the summary version — just the visuals and their captions — actually achieved 69% more learning.

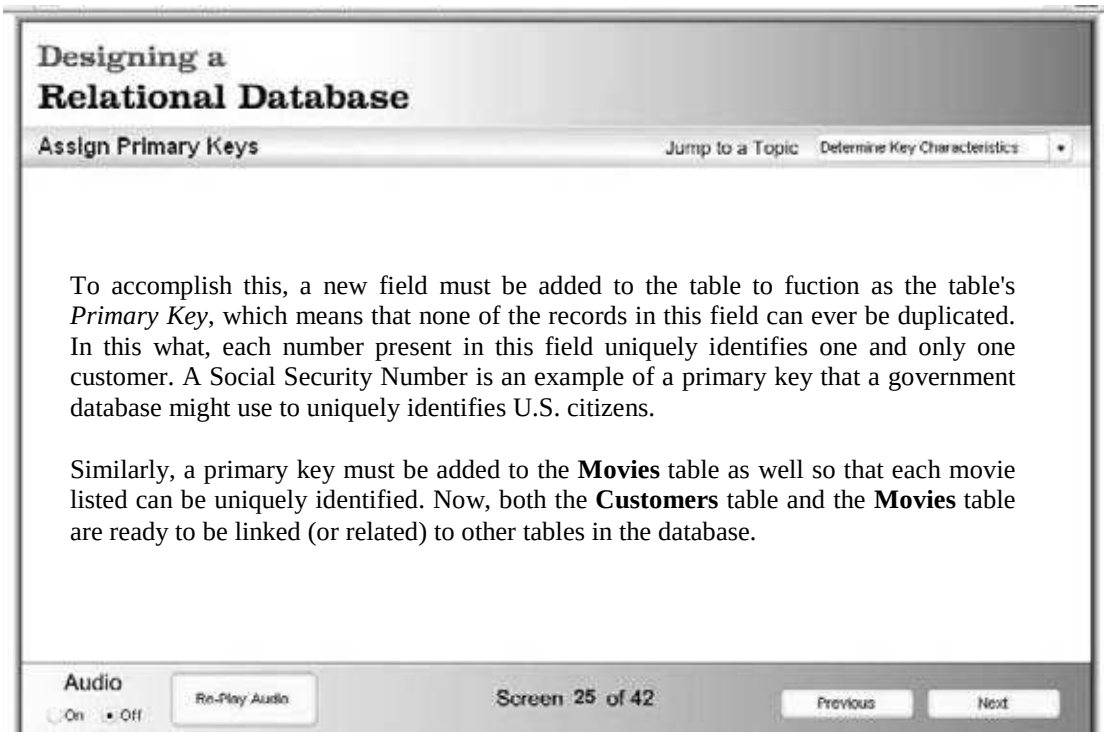


Figure 4.17. Extensive Text Elaborates on Database Concepts.
From *e-Learning and the Science of Instruction* CD.

Figure 4.17 shows that include a great deal of text added to provide detailed explanation of the concept of a primary key in the database lesson. Compare this treatment with the screen shown in Figure 4.18 that limits words to the essential points and uses a relevant visual to illustrate the concept.

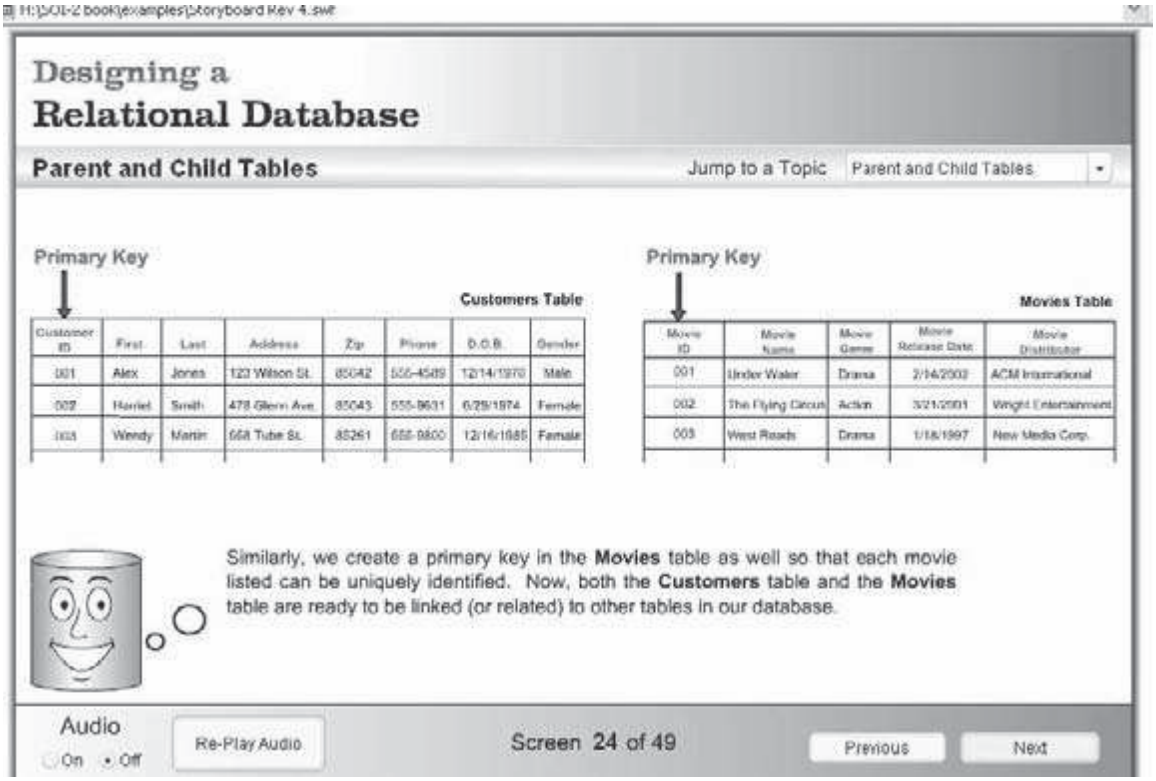


Figure 4.18 . Lean Text and Relevant Visual Explains Database Concepts.
From *e-Learning and the Science of Instruction* CD.

The psychology

Mayer did several studies together with S. F. Harp to determine why seductive details depress learning. In these experiments they evaluated the hypotheses that these added materials did their damage by:

1. Distracting learners from key instructional points,
2. Disrupting the learner's organization of information into a coherent mental model, or
3. Activating irrelevant prior knowledge.

They created three versions of lessons that included seductive details but that also added instructional methods that should compensate for their damaging effects. Only one of their compensatory treatments reduced the negative effects of the seductive details. Seductive details placed at the beginning of a lesson were more damaging than the same information placed at the end of the lesson. Therefore, they concluded that these details activate inappropriate prior knowledge. Since learning takes place by the integration of new information into existing knowledge in long-term memory, stimulating inappropriate prior knowledge would have a damaging effect.

The coherence principle essentially tells us that “less is more” when learning is the primary goal. It suggests that visuals or text that is not essential to the instructional explanation be avoided.

It suggests that not to add music to instructional segments. It also suggests that learn text that gets to the point is better than lengthily elaborate text. Designers should make a distinction between entertainment and learning. This is not to say that an effective e learning course is not interesting

Mayer reminds us of prior distinctions between cognitive interest and emotional interest. Cognitive interest stems from materials that promote understanding of the content presented — in other words from materials that optimize learning. Emotional interest comes from the addition of extraneous materials, which have been shown to depress learning. Our goal should be to promote cognitive interest and avoid emotional interest in situations that require cognitive learning processes.

4.8 The personalization principle: *Use conversational tone and pedagogical agents to increase learning*

A series of interesting experiments summarized by Byron Reeves and Clifford Nass in their book, *The Media Equation*, showed that people responded to computers following social conventions that apply when responding to other people. For example, Reeves and Nass found that when evaluating a computer program on the same computer that presented the program, the ratings were higher than if the evaluation was made on a different computer. People were unconsciously avoiding giving negative evaluations directly to the source.

Of course individuals know that the computer is not a person. However, deeply ingrained conventions of social interaction tend to exert themselves unconsciously in human-computer interactions. These findings prompted a series of experiments that show that learning is better when the learner is socially engaged in a lesson either via conversational language or by an informal learning agent.

Based on the work of Reeves and Nass, Mayer and others have established that learning programs that engage the learner directly by using first and second person language yield better learning than the same programs that use more formal language. Likewise a number of studies have shown that adding a learning agent — a character who offers instructional advice — can also improve learning. While some computer scientists are working to make agents very realistic, a series of studies using Herman the Bug (see Figure 4.19) as an agent found that:

Figure 4.19: Herman the Bug is a pedagogical agent. From Clark and Mayer, 2002.

1. The appearance of the agent made little difference a cartoon or human worked just as well.
2. Learning was better when the agent's words were presented in audio rather than in text and in a conversational style rather than in a formal style — congruent with the modality and personalization principles.
3. The agent did not even need to be visible on the screen — the voice alone was sufficient to promote better learning.

The psychology

Learning is based on an engagement of the learner with the content of the instruction. Even though learners know that computers are inanimate, the use of conversational language either directly in the program or via an agent seems to stimulate very ingrained unconscious social conventions that lead to deeper learning. When you are in a conversation with someone you are expected to listen and respond in a meaningful way. This requires you to invest attention in what the person is saying, to process it and to generate a meaningful response. A similar model seems to apply when learners see the e Learning as an engagement with a social partner — even an inanimate one.

The application

When you write the script for your e-Lessons, use first and second person constructions, but don't over do it. For example, dialog such as, "Hey Dude — Are you ready for some exciting information on quality control tools?" is incongruent and more distracting than helpful. The research on pedagogical agents is quite new so applications are still a bit tentative at a fourth to sixth grade level, the agent Jim is introduced and appears throughout the program to show readers comprehension strategies that have worked for him.

First it is not necessary to invest a lot of effort in the physical representation of the agent. Second it is necessary to consider the sole of the agent. To be useful the agent needs to serve an instructionally valid sole – not just appear as an on-screen character. An example is shown in Figure 4.20

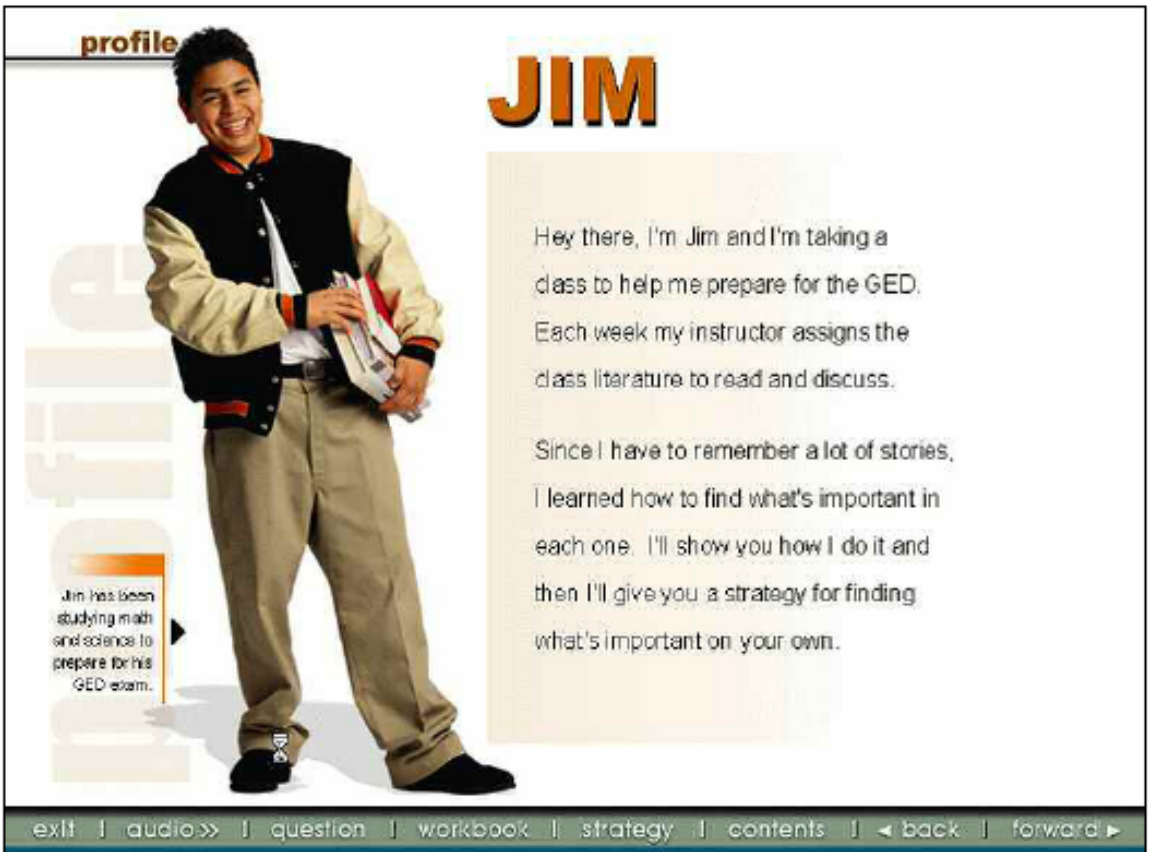


Figure 4.20: Jim serves as a pedagogical agent. With permission from Plato Learning Systems.

Summary:

E learning programs rely on some combination of graphics, text and audio to deliver the content. Hence these six media element principles would help to fell more confident in using them.

There are six different media element guidelines to follow when doing e-Learning instruction.

These guidelines are outlined in this chapter. They include:

1. **The Multimedia Principle**: Use words and graphics rather than words alone.

2. **The Contiguity Principle**: Place corresponding words and graphics near each other

3. **The Modality Principle**: Present words as audio narration rather than onscreen text.

4. **The Redundancy Principle:** Presenting words in both text and audio narration can hurt learning.

5. **The Coherence Principle:** Adding interesting material can hurt learning

6. **The Personalization Principle:** Use conversational style and virtual coaches.

References:

Ruth Colvin Clark and Richard E. Mayer: " E-learning and the Science of Instruction", Second Edition, Pfeffier Wiley, 2008

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