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Effective Art Education Methods in Museums :
"Destination-Imagination: an Introduction
to the Memorial Art Gallery"

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For the great support and encouragement,
I would like to dedicate this thesis to:

My Parents

&

All my family...

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Introduction

The purpose of creating the CD-ROM title, "Destination-Imagination: an Introduction to the Memorial Art Gallery", is to present an effective art education tool for kindergarten through sixth-grade students by providing an interactive computer tour of Memorial Art Gallery in Rochester, New York. The concept of a pre-tour of the Memorial Art Gallery in an electronic format was developed by Susan Dodge Peters, Education Director of the Memorial Art Gallery, and Gordon Goodman, Professor of Information Technology at Rochester Institute of Technology in Rochester, New York. Then, it was pursued with the creation of this interactive CD-ROM title, "Destination-Imagination: an Introduction to the Memorial Art Gallery", by Hye Jung Hwang and Daniela Jorge. This thesis report includes a study of the related literature, a review of commercialized CD-ROM titles and other interactive projects such as websites and KIOSK, and a procedure of how this CD-ROM title was developed. Finally, the results of this project will be discussed.

Effective art education should educate and motivate the student by providing an opportunity for instant and interactive feedback as well as giving

an art experience in color, form, shape, perspective, composition, social aspects behind the art works and art history. Through this pre-tour of the Memorial Art Gallery in an interactive CD-ROM, not only does the user appreciate the works of art themselves but he or she can also learn about history, social aspects, and the artists' points of view and emotional feelings attached to each work. With explanations of each work of art and an effective feedback in this CD-ROM title, more information and appreciation of art can be conveyed.

In addition, interactive CD-ROM titles created with motion, animation, sound, images, metaphors, graphics and text information are certainly effective art educational tools motivating users because they actively participate in an interactive multimedia project through touching, watching and hearing. Since interactive CD-ROM titles can be developed with multimedia, they can provide imaginary visuals created on computer as well as text information and explanations to help students' better understanding of art. Sound aid also helps students to become involved in art work and art education along with visual effects. These aspects of multimedia can be extremely valuable in art education. Experiencing all multimedia elements with interactivity reinforces users' learning motivation and makes their interest levels remain higher: therefore users can better retain the message and information of the project.

Consequently, interactive CD-ROM titles in art education are very effective in the learning process as well as in simply sharing information. "Destination-Imagination: an Introduction to the Memorial Art Gallery" was developed with multimedia: pictures, graphics, narration, small animations, text information, and so on. These multimedia are efficiently used for powerful interactivity in this CD-ROM title. This aspect of interactive multimedia is enhancing the quality of art education of "Destination-Imagination: an Introduction to the Memorial Art Gallery".

The target audience covers a wide range: kindergarten through sixth-grade students. However, this CD-ROM is designed to appeal to all users at their own level. Even within the same level, each student has his or her own learning pace and interest in different subjects. Unlike traditional books, there are no page numbers in interactive CD-ROM titles because the users can explore them through their own individual learning paths. Therefore, this effective educational tool assists each different individual according to his or her own learning style.

The objective of creating "Destination-Imagination: an Introduction to the Memorial Art Gallery" was to develop a showcase for the works of art in the Memorial Art Gallery and an effective art education supporting tool which

would not only contain information but also entertain a wide age range of the target audience using computerized interactive multimedia. The significance of this project is that it created intuitive interfaces, developed the grid system for computer monitor display, and applied all interactive multimedia elements—pictures, text, graphics, sound and motion—into the grid system to deliver and provide powerful and effective art education.

Image quality of this project displayed on a monitor would be limited because monitors—the displaying equipment of this project—vary and limit showing image quality according to their own hardware capability and the computer system they are connected to. For viewing the best quality of this project, one must use at least a 13-inch and thousand-color-monitor with a graphics card on a Macintosh computer with a minimum of 8 megabytes of RAM installed.

Definition of terms used in this project:

compact disk read-only memory (CD-ROM) A plastic disk which is read-only optical storage containing 650 megabytes of digitally encoded computer data.

CD-ROM title Large and mass-produced projects delivered in compact disk read-only memory that are now being published in the areas of education,

training, and entertainment.

digitization A process whereby analog data is transformed into digital form representing data in the form of numerical digits.

flowchart A graphic diagram representing the hierarchical levels and links of project contents.

graphical user interface (GUI: pronounced "gooey") A design for a part of a program that uses graphics to display look and behavior; that helps a user interact and use the application program easily and productively.

interactive multimedia Project in which the user may control what elements are delivered and when they are delivered.

icon Pictorial and graphic image that represents data on computer such as a file, a folder or a hard drive or a function in a program.

kiosk A stand-alone computer with a specific built-in multimedia application in a digital context; used in museums, supermarkets, tradeshows and malls.

lingo Scripting language used by the multimedia authoring program Macromedia Director.

metaphor A symbol based on real-life objects for on-screen actions. For instance, the metaphor for a Macintosh computer screen is a desktop.

monitor The complete output device that produces an on-screen display.

pixel In a video display system, the smallest element of an image.

random-access memory (RAM) The temporary working memory available for program instructions and data via the processor's high-speed data bus when a computer is on.

resolution In a computer screen, a measurement of the image sharpness expressed as a number of pixels per inch.

Research

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This interactive multimedia presentation is a supporting educational tool using a new technology to give every student a chance to explore at his or her own pace, and it also entertains the student at the same time. As a result, the student can comprehend and retain the information more easily and for a longer time than with conventional print technology. This research section will discuss how effective an interactive multimedia project can be in art education and how a powerful and interesting interactive art educational multimedia presentation can be developed. These points will be examined through a study of literature and a review of interactive multimedia projects.

Museums have used interactive multimedia technology for enhancing their art education programs. Sources for this research were: the experience of the Micro Gallery in the National Gallery of Art, Washington, DC in spring 1996; a review of several kiosks in the Museum of Science, Boston, in fall, 1995; a viewing of CD-ROM titles such as *"A Passion for Art: Renoir, Cézanne, Matisse and Dr. Barnes"* by Corbis Publishing (1995) and *"With Open Eyes: Images from the Art Institute of Chicago"* by Voyager (1995); and a visit to *"The Kimbell Art*

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Museum of Fortworth, Texas" website. Along with these sources, a study of literature related to this thesis subject provided a comprehensive understanding of interactive art education in museums.

According to Koester, the important elements for the success of an interactive technology-based exhibit in art museums are topics related to the visitors, depth of information delivered, and visitors' degree of control and interaction (Koester, 1993). Computers allow us access to a large amount of information easily and quickly because digital format images and information can be displayed without worrying about the physical exhibit space limitation or conservation restrictions.

A computer system provides an opportunity to store a tremendous amount of information and to categorize all works of the museum. The Micro Gallery in Washington, for example, contains images and information about 1,700 paintings, sculptures, and works of decorative art. It cross-categorizes them in a timeline from 1100 A. D. to the present, according to more than 530 subjects (for example, animals, environment, mythology, literature, politics, emotion, seasons, and weather), according to 650 artists, and according to a twelve-map geography showing places artists worked. Therefore, the users are able to view art works and the information of a related topic very easily and quickly.

Erik Holsinger emphasizes integral interactive multimedia's role in education through his comment, "By taking one topic and adding as much related information as possible with graphics, text, video, and so on, a multimedia title allows teachers and students to explore topics from broader perspectives (Holsinger 1994, 9)." It is true in art education as well. Also, Hooper-Greenhill says that an opportunity for exciting advanced learning and profound experience is offered by the interactive museum experience (Hooper-Greenhill 1991).

Koester also stated the result of some studies on learning time and retaining information after an interactive technology-based exhibit: "...interactive multimedia decreases learning time by 50 % and increases retention by 50% (Koester 1993, 61)." Audio, video, animation, games, and simulation controlled by the users help them understand information faster and remember it longer. This proves that interactive multimedia is an effective art educational aide tool in museums.

The Micro Gallery of the National Gallery of Art in Washington D.C. is the most comprehensive interactive multimedia computer system in an American art museum. For instance, it presents interactive zooms and images with higher resolution through 8,000 available pathways that users can follow

according to their own interests and desires. While exploring the Micro Gallery on the computer, the viewer can create his or her own museum tour plan. This personal tour plan can be printed, too, because all 13 computers in the Micro Gallery are connected to a central printer at the art information desk. The multimedia data stored locally on each computer makes this possible.

Interactive multimedia are becoming a different kind of publication. The benefit of this medium is that a great amount of information can be preserved, replicated and distributed quickly and cheaply. Interactive multimedia also bring the visual materials provided by museums to school classrooms and homes. Even though digital images are not the original objects, they are excellent visual materials which teachers can use in the classroom and the learners may view even at their own individual places. Technologically, "Multimedia instructional systems are becoming powerful, user-friendly and cheap— while schools, governments, and corporations are looking for better ways to educate people," stated Willam E. Halal (*The Futurist* November 1994, 21).

An interactive multimedia project is an integration of text information, graphics, animation, motion, and sound. Mandatory skills for authoring an effective and creative interactive multimedia project are understanding, mastering, and designing all the above elements. Since the project is viewed on a

monitor equipped with a computer, an appropriate design approach for human

and computer to communicate is also needed to create effective interactive

multimedia. Steven Heller and Daniel Drennan defined interactivity "as a user's

engagement and involvement with a dynamic system which in turn changes

and adapts to the user" in *The Digital Designer: The Graphic Artist's Guide To The*

New Media (Heller 1997, 61). This means that a user controls the pace and navi-

gation of information, deciding what to look at and what to ignore.

For creating powerful interactive multimedia projects, the develop-

er should define the user interface design architecture for the interactive project

to maintain the quality and consistency of the project. An effective and appro-

priate graphical user interface design for the intended users necessitates good

interaction design and a pleasing and consistent design style from screen to

screen. Characteristics of graphical user interface are recognizable and attrac-

tive graphics and an interaction that is easy to anticipate intuitively and to use.

Graphics and interaction should be consistent and easy to read as well as to

learn (Minasi 1994).

The graphical user interface elements would be divided into three

big parts: the structural elements of screen (backgrounds, windows, etc.), the

control elements (buttons, icons, cursors, pointers, etc.), and the media elements

(graphics, images, text, sound, animation, movie clips, etc.). Graphic elements are used as a way to create a specific appearance (look and feel), to support an intuitive interaction, to design a specific mood or intended aesthetic, and to rely less on language. Erik Holsinger mentions that good graphics state concept and background information more clearly than text does. They also enhance the multimedia projects presentation and improve the users' enjoyment and interest when they view (Holsinger 1994).

First, backgrounds and windows are the structural elements. The background is a very powerful element used to create the appearance of the visual presentation. Ray Kristof and Amy Satran stress that "although every element on the screen contributes to the look and feel of the interface, the background carries the greatest load simply because it fills so much of the screen (Kristof 1995)." Since all other graphic elements are laid down on top of this background graphic, smooth integration with other elements is expected in order to create a dominant design or decorative statements. Windows, one of the structural elements, are the areas holding media and presenting the specific functional region on screen.

Secondly, input items such as buttons, icons, cursors, and pointers are the control elements. Controls allow the user to choose options and explore

the content. Mark Minasi said of controls, "The heart of your user's ability to interact with your program lies in objects on the screen (Minasi 1994, 146)." Buttons would be text buttons or graphic buttons: text buttons include text description of the buttons' action, and graphic buttons contain graphic images of the buttons' action. Text description and graphic representation should be clear and unambiguous so that the buttons' functions are intuitively understood.

Similarly, icons also have their specific functions. William Horton said that "you can use icons to activate menus, to perform actions, to select tools, to toggle between modes, to manipulate windows, to point to items on the screen, to reveal the state of the data and allow it to be changed , to represent files and directories and disks, and to provide a way to delete unneeded items (Horton 1994, 3)." The icon is the visual symbol which depicts and represents its function graphically (Horton 1994 & Kristof 1995). Well designed icons can help and improve users' efficiency and productivity.

When users click on buttons or icons with the input device, their functions are activated. Therefore, the graphical indication of clickable objects in a three-dimensional look or shadow can help users to understand the objects' functions. Highlighting buttons and icons and sound effects give feedback to the users' action while the pointer moves over them, or when they are clicked

on (Vaughan 1994). Pointers and cursors are control elements as well.

As the user moves the mouse—the input device—the pointer moves and changes shape according to its specific location on the screen. Its default shape is a pointer—an arrow—and the various other shapes are used to identify pending actions or system status. There are three types of cursors: text cursor, selection cursor, and animated cursor. A text cursor marks insertions—the point where the user last made a text entry and where the user will make the next entry. A selection cursor is an outline box around selected objects. An animated cursor delivers a message about some processing going on or some interesting visual effect caused by the same action. "An animated wait cursor lets the user know that processing is still in progress and the system has not crashed," says Isaac Victor Kerlow and Judson Rosebush (Kerlow 1994, 89). Stylish and intuitive controls give the viewers the chance to explore information easily and to be intrigued, amused and entertained (Kristof 1995 & Vaughan 1994).

The final media elements are the graphic components and the contents, which can be images, text information, sound, animation, and video. Graphics integrate with other screen elements, and well-integrated graphics consequently enhance the visual impact. Images can be rendered on the drawing software, and the original images may be scanned and edited to be used as

multimedia elements. Text is not only information, but can also be a graphical element. As Kristof and Satran mention, "Text on the screen serves many masters: it has to look right for the message; it has to be easy to read; and it also has to work in the interface (Kristof 1995, 106)."

Tay Vaughan suggests some design tips for working with text: select appropriate fonts for the message delivered; use few different typefaces; create a pleasing text block, and adjust the text line width, letter spacing and leading carefully; blend text with graphics; and make sure that text is legible, anti-aliased and large enough for a professional look (Vaughan 1994, 200-202). For maintaining the design of text, there are two approaches. One is choosing the system default fonts; when a computer does not have a typeface chosen, the screen would display an available alternate typeface in that computer. The other is converting the chosen text into graphic format; thus the layout can stay the way the developers designed it.

Along with text information, narration provides information to users as well. Sound—music, narration and sound effects—is an essential element in multimedia for enriching the multimedia presentation. For sound playback on computer, audio should be digitized. A 44.1KHz (kilohertz) sampling rate and 16-bit resolution recording set-up is required for a compact disc's audio

quality (Holsinger 1994). Vaughan mentioned that a 22.1KHz sampling rate and 8-bit resolution recording set-up is typical on the Macintosh computer (Vaughan 1994, 240-275).

Video also needs to be either recorded on computer or digitized for the best use of video clips in multimedia presentation: demonstrations, live action, interviews, performance, etc. (Kristof 1995). Digital video reinforces a story with motion pictures rather than with still images, and compels viewers to engage more in the message. Like motion video clips, animation gives power and vitality to the visual impact. Animation is sequential images, moving objects, and transitions such as wipes, zooms, dissolves, slides, pushes, and fade visual effects.

An integral element in graphics is color, which can improve visual presentation and user performance in interactive multimedia projects. Colors have to be well chosen for harmony and contrast, as well as for their associative value. Mark Minasi specified the guidelines for using colors: reduce the number of colors necessary for users to grasp; use high-contrast colors to distinguish between background and foreground; limit to five colors if each one has a different meaning to be recognized; and use colors to organize (Minasi 1994, 70-82). Vaughan emphasized: "Human response to color is complicated by cultur-

al and experiential filters that cause otherwise straightforward color frequencies to carry pleasant, unpleasant, soothing, depressing, and many other special meanings (Vaughan 1994, 293)."

How the developer composes all these elements and designs an eye-catching screen with them can result in a creative and innovative layout. The consistency of how graphic elements appear on a monitor displayed throughout the whole project is very important not only to convey and deliver information effectively but also to enable users to learn and operate the project easily. In a good presentation, a well-defined layout grids allow easy integration of all interactive multimedia elements.

"... the word 'grid' refers to the drawn pattern of lines and coordinates that the designer uses as a framework for a design..." as Allen Hurlburt defined it (Hurlburt 1987, 86). The grid is established for the contents of the specific project, and it creates various patterns and forms to help generate continuity in a design (Hurburt 1981, Hurburt 1987 & Swann 1987). When the multimedia elements for the project are positioned on the screen, the grid is a guide to ensure the alignment of all elements and to achieve unity of appearance in balance and structure.

For developing the powerful and effective pre-tour of Memorial Art

Gallery in interactive multimedia, design skills for developing an interactive multimedia project as well as an understanding of the museum's role are mandatory. If multimedia elements such as text, graphics, sound, video, and animation are integrated effectively in a creative design that provides well-defined interactivity and contents, then it will deliver effective art education.

Procedure

The interactive multimedia CD-ROM title "Destination-Imagination: an Introduction to the Memorial Art Gallery" was developed by Hye Jung Hwang and Daniela Jorge as the production team. Susan Dodge Peters, the Education Director of the Memorial Art Gallery, provided text information, and all pictures in slides and prints for "Destination-Imagination: an Introduction to the Memorial Art Gallery." This group work experience was a especially relevant since multimedia projects are often created by a group effort: graphic designers for graphics, sound designers for sound editing and production, animators for animation, editors for writing, programmers for authoring all multimedia elements, and other specialties in fields related to a project.

For developing this pre-tour of the Memorial Art Gallery in a digital format, the equipment used was a 8100 Power PC from Apple computer with a two-gigabyte APS external hard drive, flatbed and slide scanners, a Kodak Digital Science DC50 digital camera, and a Macintosh microphone. All slides' pictures were transferred in a digital format and stored in Kodak PhotoCDs to archive this data. Various software products were also used for creating graph-

ics and images, and for authoring this interactive multimedia project: Strata

StudioPro, QuarkXpress, Adobe Photoshop, Adobe Illustrator, Macromedia

FreeHand, Macromedia Director, and Macromedia SoundEdit 16.

How "Destination-Imagination: an Introduction to the Memorial

Art Gallery" was created can be examined by looking at the different design

stages of the multimedia production process. This section presents planning,

designing, producing, testing and delivering stages of this interactive multime-

dia CD-ROM title development.

First, a project's goal, audience, and content should be defined in

the planning stage. In October of 1995, the first meeting with Peters and Gordon

Goodman, a Professor of Information Technology at Rochester Institute of

Technology, defined the concept of this project, its audience, its information,

delivery format, and other miscellaneous elements: this interactive multimedia

would be an introduction to the Memorial Art Gallery which would give a pre-

tour of the gallery and teach basic art education. This project would entertain

children by providing an exciting and fun gallery experience as well as educat-

ing them in art appreciation.

The works of art used for the pre-tour of the Memorial Art Gallery

would be chosen from the permanent collection of the gallery. Four main works

of art would be selected for the art lesson section. For production and completion of this project, the text information, pictures, and permission for the use of works of art would be provided and prepared by Peters. To develop a high quality art education tool in a digital format and to ensure meeting the project objective, tests with children and art educators would be required. This interactive multimedia project would be distributed to schools for assisting students in becoming familiar with the Memorial Art Gallery before their actual gallery tour. For purposes of easy distribution and use, this interactive multimedia title would be transferred to CD-ROM, which is durable and cost effective. This CD-ROM title could be viewed either by a group of students in a school classroom or by an individual in a media center equipped with multimedia computers with a CD-ROM drive installed.

After several meetings, the information for the tour section and the lesson section were determined; the details for both sections needed to be researched. To ensure children's interest, the tour section would be divided into seven different categories: "Portraits of Famous People," "Animals in Art," "Art from Around the World," "Pictures of Children," "Artists' Materials," "Puzzling Pairs," and "Favorite Places of Famous Artists."

The lesson section would include two paintings: *"Boomtown"* by Thomas Hart Benton, and *"Ruby Gold"* by Hans Hofmann. Each of these paintings would be examined in four different areas: "The Artist's Story" would include the painter's biography; "What's the Big Idea?" would examine social aspects and historical facts related to the work. "What's Happening?" would explain the specific art elements in paintings; and lastly, "Get Smart About Art" would teach the basic art elements such as color, form, shape, line, perspective, and composition. Again, the details of each area would be studied for an effective and interesting art lesson for children.

Determining the outline for the tour and lesson sections led to creating the prototype of this project and presenting it to Peters. The visual presentation of a small computer animation (Appendix B: figure 11), and three different computer generated perspectives (Appendix B: figure 12) of the *"Boomtown"* painting by Benton, ensured that this interactive multimedia project would be developed for effective art education.

Defining the audience and understanding them were necessary to design a creative and effective project. The audience was determined to be students from kindergarten to sixth-grade, a wide age range for developing an art education tool. Kindergarten and lower-grade students might be unable

to read and their understanding of some words and art terms would be limited. However, the higher-grade students would have some knowledge of art terms and of art appreciation already, and would have different levels of interest. Therefore, the big task for meeting their needs in art education required scrutinization of their behavior in the gallery. Observations of students' Memorial Art Gallery tours with tour guides occurred in January of 1996.

Observations indicated that: in the beginning of a tour, students seemed to be intimidated by the quiet ambiance in the art gallery and by works of art that were unfamiliar to them. Students with knowledge of art appreciation looked at works of art more seriously and enjoyed their gallery experience. The tour guide certainly helped students appreciate works of art by explaining social facts, history, and basic elements of a specific art work. With a guide's assistance, students' gallery experience was enriched and became more valuable to them.

Secondly, after the goal of this project, the definition of its audience, the outline of its contents, and its decision of delivery format were determined in the planning stage, the designing stage was begun. The design of the project needed to be established before the production stage was started. The creative

design made the process of production fast and the cost of production less because it gave an opportunity to plan and organize tasks efficiently for completing the project.

Defining the content of the tour and the lesson sections of this CD-ROM title were very important before determining an effective interaction and designing a graphical user interface. The content of the tour section was organized for seven categories; seventy five works of art were chosen for this whole tour by Peters and the staff of the Memorial Art Gallery. Detailed information in the seven categories would be as follows: "Animals in Art" would include works of art whose subjects are animals. "Art from Around the World" would present works of art according to places where they came from such as Africa, Ancient Rome, Belgium, China, Egypt, England, France, Greece, Holland, India, Italy, Japan, North America (Mexico, North Americans, and USA), and Peru. "Artists' Materials" would be divided according to the materials which works were made from—stone, glass, paint, clay, metal, and wood. "Pictures of Children" would show art works which presented the way the children lived at various times. "Favorite Places of Famous Artists" would be a collection of art works which showed places portrayed by famous artists. "Portraits of Famous People" would state that famous people were the favorite subject of certain

artists. "Puzzling Pairs" would provide a chance to think, learn, and comprehend works of art more by looking at two works side by side. From this exercise, imagination would be stimulated.

Several meetings and research concluded that each work of art in this tour section would be identified with the work's title, its artist's name, its date and facts associated with the work. This information about each work of art along with instructions for this tour would be provided in narration as well as in written text. Narration surely would help students unable to read yet, since the target users of this project were kindergarten through sixth-grade students. This also gave users options either to read or to listen to the information, according to their need or circumstances. Only an interactive multimedia project could make this array of options possible.

The lesson section would teach these students how to look at works of art, by providing visual experience and interactive experiments. The content of the lesson section was appropriately organized for effective art education from several brainstorming meetings with Peters. There would be different art lessons for *"Boomtown,"* and *"Ruby Gold."* However, these lessons would each be taught in four categories: "What's Happening?," "What's the Big Idea?," "Art Smarts," and "The Artist's Story."

In the "*Boomtown*" lesson, perspectives, color, shapes, lines, composition, social aspects of that time, and brief information on Thomas Hart Benton would be taught: "What's Happening?" would include an explanation of the painting's scene. "What's the Big Idea?" would interpret the implications of a painting in terms of social factors during that time period. Computer-generated animation of this painting would be created to support the story of "*Boomtown*." "Get Smart About Art" would instruct in the basic elements such as color, shape, composition, and point of view. "The Artist's story" would contain general information about the life of Benton.

In the "*Ruby Gold*" lesson, color theory, shapes, composition, abstract painting, and information on Hans Hofmann would be taught: "What's Happening?" would explain the color theory with color experiment games. "What's the Big Idea?" would teach about abstract painting with a game allowing the user to create his or her own abstract painting with colors and shapes from "*Ruby Gold*." "Get Smart About Art" would include a comparison of Hofmann's paintings and a game letting the user design his or her own abstract painting with objects from "*Ruby Gold*." "The Artist's Story" would introduce Hofmann's life and his activities in the art field.

procedure 30

The graphical user interface for screens would be pictures, titles, text information, background graphics and icons. The icons, or control elements, needed for these two sections were different. The tour section was determined to have seven icons integral for navigating this section: an icon for narration, icons to navigate backwards and forwards, an icon for volume control, an icon for help, an icon to go back to a main menu, an icon to go to the lesson section, and finally, an icon to quit the program. These icons would be accessible from any screen in the tour section. The lesson section needed icons to access to these four different categories: "What's Happening?," "What's the Big Idea?," "Get Smart About Art," and "The Artist's Story." When these graphical user interfaces were laid down in creative way, the information would be delivered effectively.

For a functional and dynamic layout, it was necessary to create a grid which would serve as a guideline for positioning elements on screens. One grid system (Appendix A: figure 2) for both sections—the tour section and the lesson—was created for consistency and clear communication although elements for each were different. Based on this grid, the arrangement of pictures, titles, text information, and icons was determined. Based on this grid system, the layout of the tour section (Appendix A: figure 3) would display the group

of icons on the bottom of the screen. The image display area would be in the middle part and the titles would appear on the left-upper corner on the screen. The layout of the lesson section (Appendix A: figure 4) would also be based on this grid system: the top area of the screen would contain the title of the work and a short paragraph with information on the work. The image display area would be on the left-middle, and text information would be positioned on the right-middle in the screen. This grid system provided and supported a creative, simple and functional layout for the tour and lesson sections.

After the content and control elements for both sections were defined, the creative interaction was developed for interesting navigation. The major concern of navigation design was to engage the user in an informative, interesting, and stimulating interaction that would encourage exploration of this project. The navigation chart (Appendix A: figure 1) would establish the structure of this project and illustrate the possible access routes.

Thirdly, the production of screens and authoring was started in March of 1996 after designing the navigation chart with content elements and control elements. Before beginning actual production, collecting all elements, sorting them, and listing elements needed was very important. For this project,

seventy five selected slides and prints were supplied by Peters. These were transferred into Kodak PhotoCD in three different resolutions. However, the finalized text information was not ready at that point. So, while the production was going on, the copy was delivered in Microsoft Word files from Peters. There were lists of elements needed: narration, sound effect, background graphics as a visual element, and icons for navigation.

Narration and sound effects were recorded with a Macintosh microphone and then edited on Macromedia SoundEdit 16. Three different voices were used for different areas' narration to distinguish them and enrich the presentation. For the introduction statement and some instructions of the top level in the tour section, the voice of a child was used because it would be engaged with the target users, kindergarten through sixth-grade students. For content information of each painting in the tour section, a professional recorded the narration because the information about each work needed to be pronounced correctly. For the lesson section, a soft female drama performer's voice was used because she could dramatize meaning with her voice and it would deliver information effectively and consequently would encourage the users to learn more.

The animated logo (Appendix B: figure 6) of the Memorial Art Gallery for the opening (Appendix B: figure 5) was created with the three-

dimensional animation application Strata StudioPro. This animations were saved as pics files, which became cast members in Macromedia Director, the authoring program of this project. The following screen from the animation opening became the introduction screen (Appendix B: figure 7): a small animation of a girl's facial expressions that blended into the collage of pictures used in this project, accompanied by an introductory phrase in text, a child's narration, and background music already used for radio commercials of the Memorial Art Gallery. The girl's sequential facial expressions were captured with a Kodak Digital Science DC50 and transferred into a computer directly. These images were enhanced with color corrections in Adobe Photoshop software. The collage was also created in Photoshop. These two main graphics were imported into Director, and then the small animation was created with these sequential images using dissolve transitions.

It was determined that the main menu screen followed by the introduction would take users either to the tour section—named "Tour"—or to the lesson section—named "Looking Laboratory". The first screen of the tour section (Appendix B: figure 8) would introduce the contents of this section and include icons for volume controller, narration, help, backward, forward, tour section, lesson section, and quit. Creating the look and feel of this project and

intuitive icons was a major task at that point. In order to maintain the quiet and elegant ambiance of a museum , works of art, text and icons would be arranged in a simple layout: a minimum of colored supporting background graphics would reinforce the works of art so that the gray computer-illustrated graphics were laid down for background. Teckton was chosen for text information because this san-serif typeface would have a fun look, and add a childlike flavor to the layout in a subtle way.

Through work sessions for creating icons, it was concluded that photo-realistic icons would be most suitable to create the desired look and feel for screens. As a result of searching for the right images in stock photography CDs, images from PhotoDisc CD were selected to create icons that would animate and play a sound when they were rolled over by a cursor. These special effects would work not only as an effective interactive feedback for users' actions, but also as a supplementary feature for users' engagement. Each animation of each icon was created manually with a selected image using manipulation tools in Photoshop: an ear for volume control, animated chattering teeth to play narration, an animated hand with a question mark to open the help screen, animated cowboy boots to view previous or next pictures, an animated picture frame to go to the lesson section, an animated suitcase to look at pictures in the

tour section, and finally an exit sign to quit the project.

Once one template for this tour section was set, all screens followed in order to keep consistency. Furthermore, to provide incentives to the users, some interactivities were given in the "Animals in Art" category: several paintings that containing animals would have hidden spots that could be seen in close-up when the users rolled over them (Appendix B: figure 9). The viewers would have to look more closely to find these, so they would learn to look at detailed elements of the art work without even realizing that this was part of the learning process.

The lesson section was expected to be even more interactive, so that the users would learn about art effectively. For instance, an interactive comparison (Appendix B: figure 13) was produced on the screen presenting the *"Boomtown"* painting and Benton's *"Oil Town"* sketch — Benton had done a sketch of Borger, Texas, before he painted it. On this screen, a user would detect differences between these two works by rolling a cursor over either one of them: if the right spot was found by a cursor, this area would be distinguished from the other ares, which would darken (Appendix B: figure 14). In order to produce this screen, two scanned digital images were made from the original works. Then darker versions of these two were manipulated using the level edit tool

and layers on Photoshop. These prepared images were imported and cropped properly in Director for producing this interactivity.

When a user put a cursor over the blue text in the content information, he or she may either view hidden pictures or get relevant information in the same screen (Appendix B: figure 15). Clicking on red text would take him or her to a different screen. For example, when the cursor clicked on a red text of horizontal line, vertical line, or diagonal line in the *"Boomtown"* painting (Appendix B: figure 17), the relevant other screen would be introduced with more explanations; then when a user came to view this screen, he or she would view a little animation, which was created using Director transitions. This visual supporting animation would emphasize the specific line to teach it very efficiently. Animation would become supporting visual effects for art education in interesting and exciting ways.

In *"Boomtown"* by Benton, elements of the painting—such as a car, a woman with parasol, smoke and fighting people—were animated (Appendix B: figure 11). Because this animation with sound effects would be interesting, users would like to look at them closely. Consequently, they would pay more attention to the elements in *"Boomtown"* and would remember more of them for

a longer time. Each animation was created with sequential objects. To make sequential objets, each element was cut out from the scanned "Boomtown" image on a computer. It then was manipulated for creating sequential images in Photoshop. These altered images from the original image were laid down for an animation in Director.

Besides this animation, several games were also developed for reinforcing specific art lessons. For instance, "Get Smart about Art" of *"Ruby Gold"* (Appendix B: figure 18) included a game called "Design Your Own Abstract Painting" (Appendix B: figure 19) to give a lesson in abstract painting. A user would create his or her own abstract painting by rearranging abstract objects of *"Ruby Gold"* on a different background color of his or her own choice. This newly created abstract painting and *"Ruby Gold"* would then be compared side by side. For creating this game, each major object was separated from the scanned digital *"Ruby Gold"* image on Photoshop. All objects were imported in Director, and were used for developing the game with Lingo, Director's scripting language. These objects would be dragged onto the new virtual canvas which was placed right next to *"Ruby Gold."* A cursor could change the background color of this canvas at will from blue, to yellow, red, green, or black.

Finally, this project was tested when its production was almost finished. Information, interaction, user interfaces and presentation errors were tested for successful completion. The test was performed in May, 1996, by several volunteer prospective users whose age range was kindergarten through sixth-grade. While this project was tested, the behavior of these volunteers was closely observed, especially their reaction to the interaction, their comprehension of user interfaces, their expectations of this project, and their navigating paths. This test was even recorded on videotape for reviewing more details which have been missed during the test itself. As a result of this test, it was apparent that the icons were recognizable and were interesting enough to users.

However, although the "help" screens had important instructions on how to view this project, they were almost ignored. This problem was solved by placing each "help" (Appendix B: figure 20; figure 21) screen before the main menu of each section, so that it had to be viewed.

Several programming bugs were found: for instance, the user's click on the thumbnail on several screens did not take one to the right screen, and some sound effects did not stop when they were expected to. One of bugs even resulted in such a crash that the computer needed to be restarted.

Also the users were discovered to be impatient: they were constantly clicking while program processes were still going on. To solve this problem, the watch cursor rather than the pointer cursor was made to appear during the processes. This visual feedback gave some sense of what the users should do.

After correcting all problems, a beta version of this project was transferred and then was tested by experts and educators. Performance of the presentation on the CD-ROM format was also tested by the production team because CD-ROM was decided to be the delivery format for users. The performance from the CD-ROM format was found to be acceptable. From the tests by experts and educators, some text refinements were incorporated for descriptions of paintings and content information. Two "Help" sections were also simplified with words and instructions more suitable for children.

This interactive multimedia project was refined as a complete package (including the pre-tour of the Memorial Art Gallery,) from numerous revisions and changes during concept, design, production and tests. The interactive multimedia CD-ROM title "Destination-Imagination: an Introduction to the Memorial Art Gallery" was finally produced.

The size of this finished project became 214 Megabytes, and was stored on a CD-ROM. This project was composed with 64 small Director movie files and fourteen sound files. The reason the whole project was divided into small files was that the small size of Director movies was better to load into a computer's RAM. When one single movie file was small enough to be loaded on the installed RAM, the movie would play faster and smoother. For this project, 8 MB RAM on a computer is recommended. Among these movies, the opening movie containing the animation of the Memorial Art Gallery's logo was exported to two projector files: "Start Macintosh" for a Macintosh computer and "Start PowerPC" for a Power PC. These projector files would not require the Director software because both are self-running applications.

Results

"Destination-Imagination: an Introduction to the Memorial Art Gallery" was completed as a powerful interactive multimedia CD-ROM title that introduced the pre-tour of the Memorial Art Gallery and provided the art education. The goal of this project, development of an effective interactive multimedia art education tool, was achieved.

This project had been produced the way interactive multimedia should be produced: the concept of this project by Susan Peters, the director of the Memorial Art Gallery, and Gordon Goodman, a professor of Information Technology at Rochester Institute of Technology, Rochester, New York, was brought to interactive multimedia developers, Hye Jung Hwang and Daniela Jorge. The project's creative and unique design was defined from serious brainstorming sessions and research with Hwang, Jorge and Peters. After the design had been planned, all details for this project were produced including reproductions of the works of art, content information, graphics, music, animation, and interactively.

Well organized and assigned collaboration of experts' effort in each field contributed to this production: the content information was prepared and written by Peters; the works of the Memorial Art Gallery used were chosen and provided by Peters and staff of the Memorial Art Gallery; an original composition by Andy Rykaert was used for the introduction music; graphics, animation, interactivity, and other design elements were created by Hye Jung Hwang, and Daniela Jorge. Finally, this finalized project was tested several times by prospective users, experts, and educators. According to the results of these tests, this interactive project was refined for completion.

This interactive CD-ROM title "Destination-Imagination: an Introduction to the Memorial Art Gallery " was divided into two major sections: The "Tour" introduces the pre-tour of the Memorial Art Gallery, and the "Looking Laboratory" gives art lessons through *"Boomtown,"* and *"Ruby Gold."* The "Tour" presents the seventy five selected art works of the Memorial Art Gallery's permanent collection organized in seven categories—"Portraits of Famous People," "Animals in Art," "Art from Around the World," "Pictures of Children," "Artists' Materials," "Puzzling Pairs," and "Favorite Places of Famous Artists." These categories interest children and excite them because they are able to engage with them very easily.

The "Looking Laboratory" provides very powerful art education: in the *"Boomtown"* section with interactive feedback, computer simulations of different perspectives, animation, and one game.These were designed as vehicles to teach color, line, shape, composition, social aspects of the painting's time, biographical information about Thomas Hart Benton, and various other concepts. In the *"Ruby Gold"* section, instant interactive feedback and five games were developed as supporting art-education tools to explain the color theory, an abstract painting, color, and shape, as well as information about Hans Hofmann.

The major concern was designing simple interactions and creating an intuitive graphical user interface to support interactivity which would make this project an exciting educational package. The simple interaction design created helps the user to navigate this project easily. The interesting feedback designed with interactive multimedia—like the small animations, instant feedback, and games—enhances the quality of art education because the users enjoy learning about art. The graphics of the screen layout support the works of art and interactivity. The subdued background graphic created makes the works of art dominant on screen. The photographic icons on the bottom provide users with ways to make their own paths to view works of art, and to obtain infor-

mation about the art. With this well developed interactive multimedia, powerful art education occurs while users are entertained.

Summary

In conclusion, interactive multimedia can provide productive and effective learning about the museum experience.

Museums are striving to inform and educate society even though their learning environment is informal. With interactive multimedia, art education in museums can be more engaging and enjoyable so motivating and reinforcing further interest and desire for continued learning. Interactive multimedia using computer technology contribute to satisfy learners' requests and demands because this technology's information capacity is tremendous, its possible interactivity is attractive, and its multimedia capabilities are high. Furthermore, with computer technology, interactive multimedia make the museum experience possible not only in museums but also outside of them: the interactive multimedia CD-ROM title "Destination-Imagination: an Introduc-tion to the Memorial Art Gallery," designed to be viewed on a computer, enriches art education and is a valuable museum experience within or outside of museums.

For a successful supporting art-education tool with interactive multimedia, there are so many important factors to be considered: an understanding of a target audiences interests, motivation, behavior, and background is significant; designing an intuitive and proper user interface which is easily understood and used is necessary; developing instant and interesting interactivity is essential; and presenting relevant topics to the target users is very important. All of these can be created through an efficient and productive process: from the creative concept to the well-scrutinized research, the original and well-planned design, the polished production, effective testing, and finally, the well-thought-out-refinements.

"Destination-Imagination: an Introduction to the Memorial Art Gallery" not only shows but verifies that productive learning through a museum experience can be accomplished with no limitations on time or space. The students can view and experience by touching and hearing whenever they want and wherever the computer is set up.

Museums are the places in which works of art are primarily exhibited. Therefore, the quality of art work viewed in these projects is critical: it must convey the right information about works of art and offer art appreciation in the best environment. Unfortunately, displaying works of art on a computer

monitor limits the viewing quality of images. For the best quality of viewing images of art works, further studies for enhancing the image quality on a computer monitor and for developing a creative design for the best view are recommended.

Appendix A

Flowchart of the Project
&
Grid System of the Project
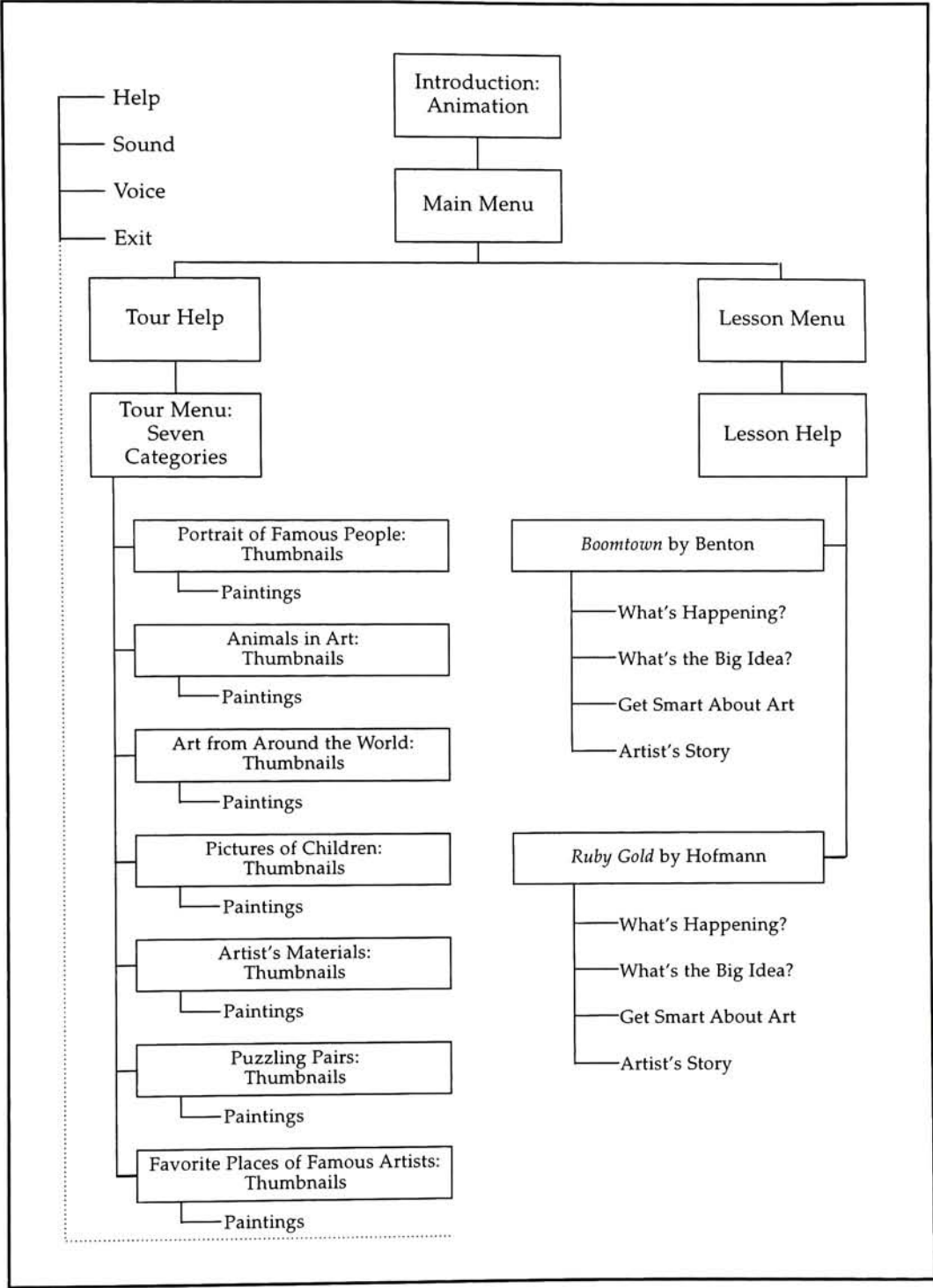
Figure 1. Navigation flowchart of the Project
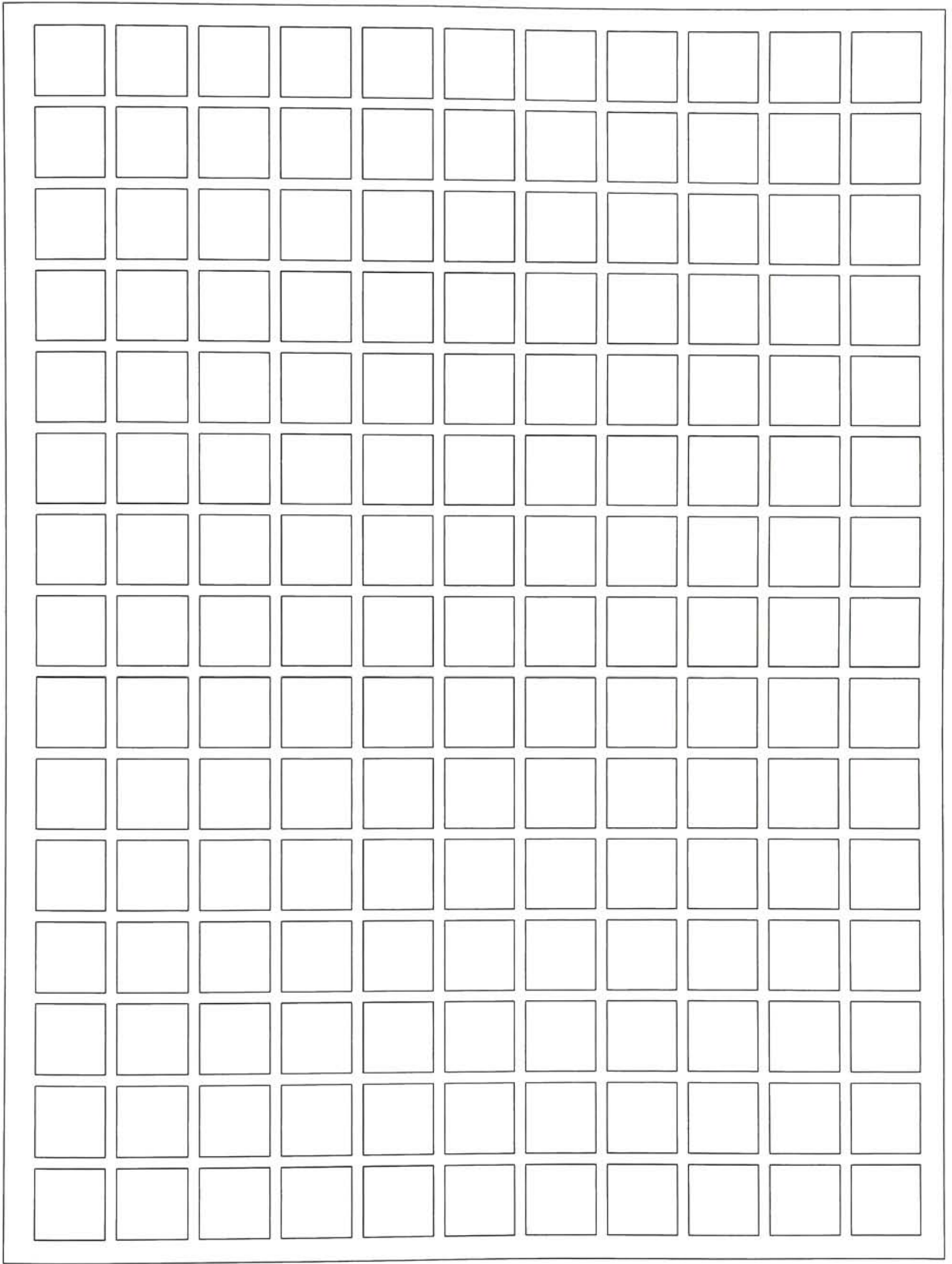
Figure 2.   Grid System of the Project

TITLE

PICTURE & TEXT INFORMATION

ICONS

Figure 3. Grid system on the tour section

TITLE

TEXT
INFORMATION

CAPTION

PICTURE

Figure 4. Grid system on the lesson section

Appendix B

Color Prints of Screens
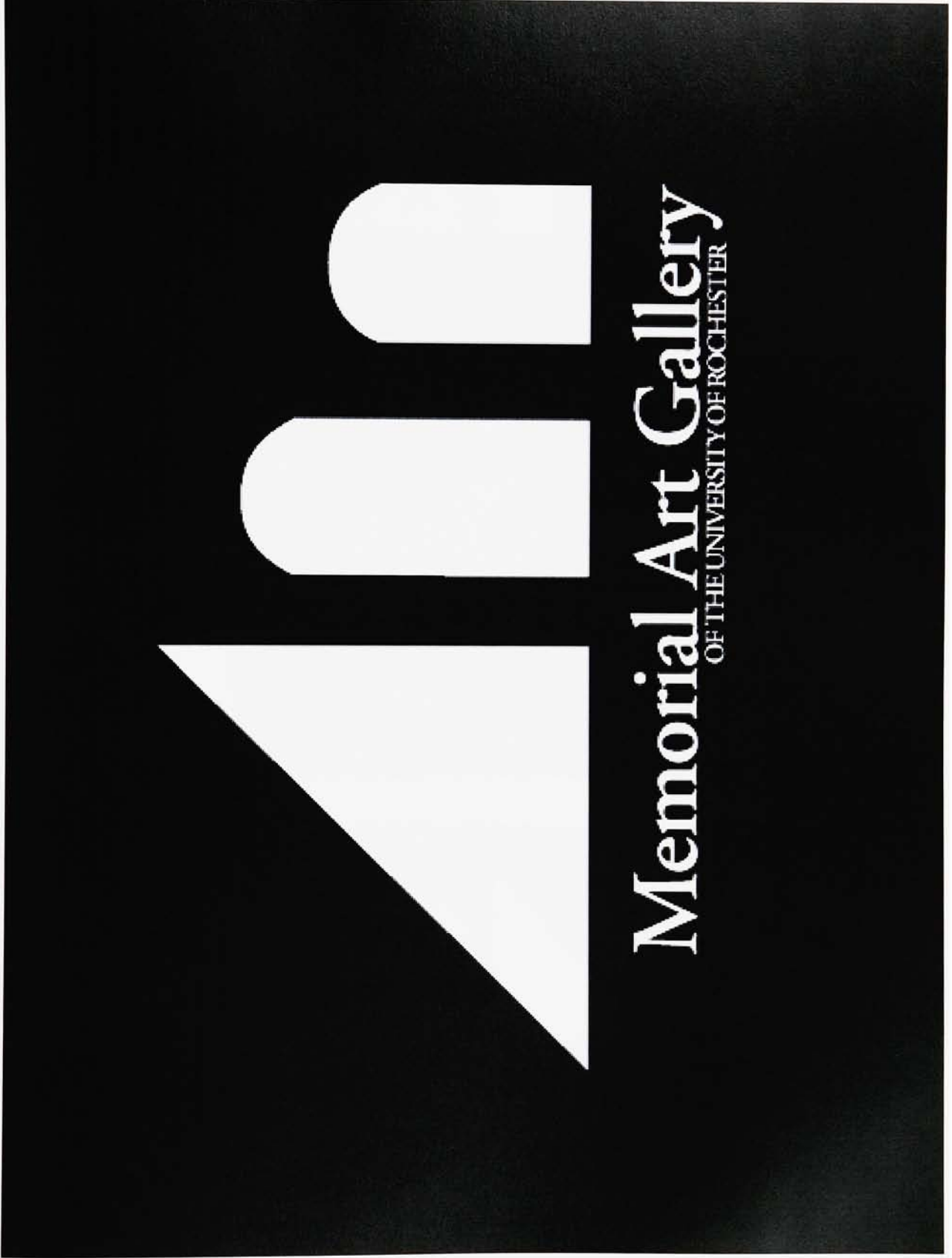
Figure 5. The "Opening" screen
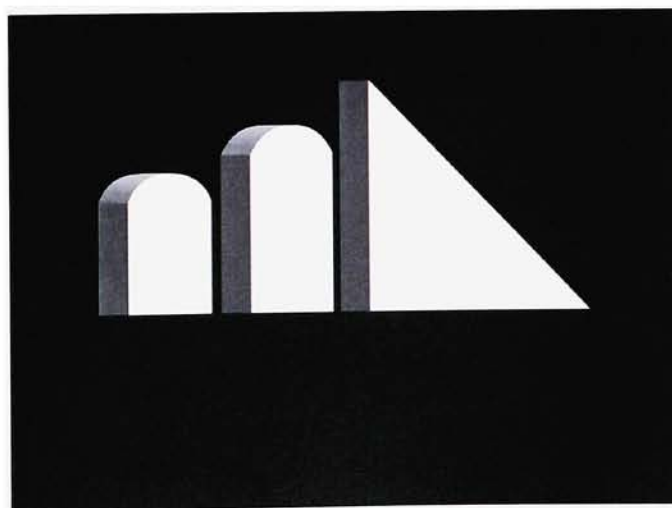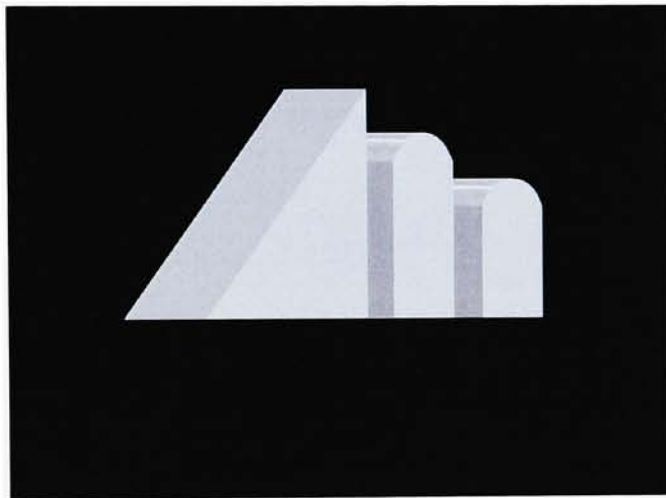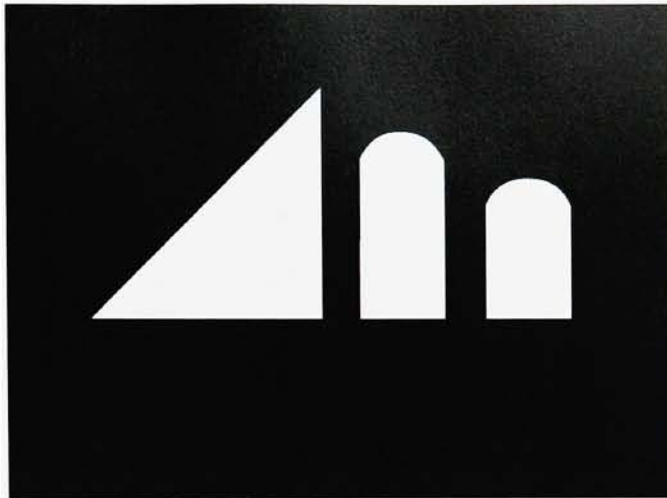
Figure 6. The animated logo of the Memorial Art Gallery in the opening screen

Figure 7. Animation of the introduction screen

We have seven
tours planned for you.
You can go on one or all.
To choose click on the
highlighted words.

Animals in Art?

Art from Around the World?

Artists' Materials?

Pictures of Children?

Favorite Places of Famous Artists?

Portraits of Famous People?

Puzzling Pairs?

EXIT

Figure 8.   The "Tour Menu" screen

Rachel Ruysch. *Floral Still Life*. Oil on canvas. 1686

This picture shows snails in close-up while the spot was rolled over by a cursor.

Rachel Ruysch. *Floral Still Life*. Oil on canvas. 1686. Memorial Art Gallery. The right picture shows snails in close-up while the spot was rolled over by a cursor.

Figure 9.

Figure 10. Thomas Hart Benton, *Boomtown*, Oil on canvas, 1927 or 1928. Memorial Art Gallery
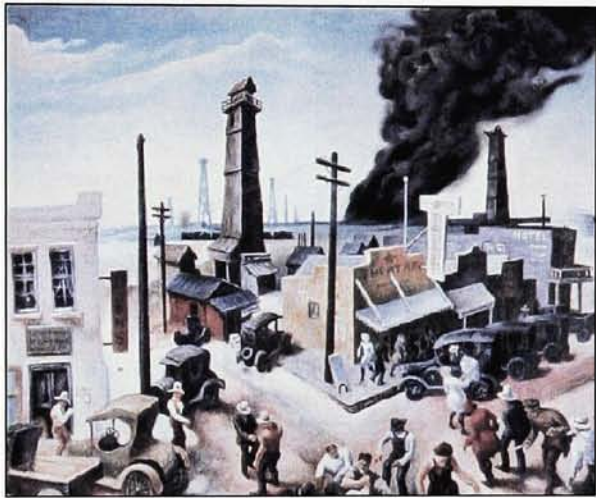
Figure 11. Animation of the *"Boomtown"* lesson section

The original *Boomtown*

The computer generated
2nd floor view of *Boomtown*

The computer generated
bird's eyeview of *Boomtown*

The computer generated
worm's eye view of *Boomtown*

Figure 12. Computer generated different perspectives of the *"Boomtown"* painting

Figure 13. The "Sketch" screen of "Get Smart about Art" in the *"Boomtown"* lesson section

Figure 14. The "Sketch" screen of "Get Smart about Art" in the *"Boomtown"* lesson section while a hot spot of either picture was rolled over by a cursor

The first screen of "What's the Big Idea?" in the *"Boomtown"* lesson section

The detailed screen of "What's the Big Idea?" in the *"Boomtown"* lesson section while the blue text "Oil" word was rolled over by a cursor.

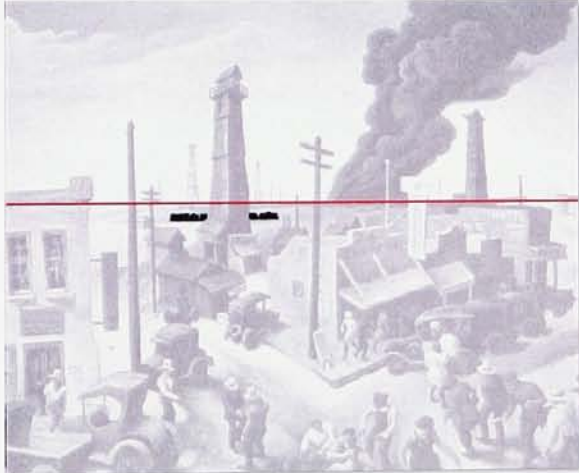Figure 15. The screen of "What's the Big Idea?" in the *"Boomtown"* lesson section

Figure 16. The "Lines" screen of "Get Smart about Art' in the *"Boomtown"* lesson section

Figure 17. The "Horizontal line" screen of "Get Smart about Art' in the *"Boomtown"* lesson section
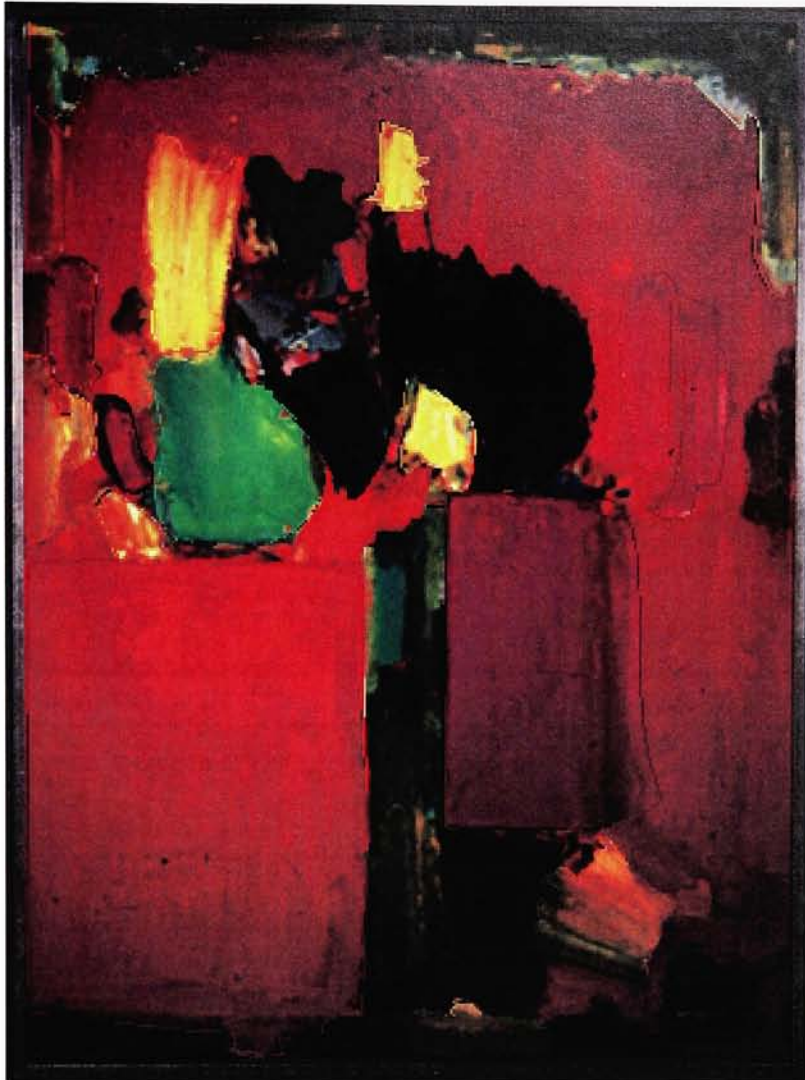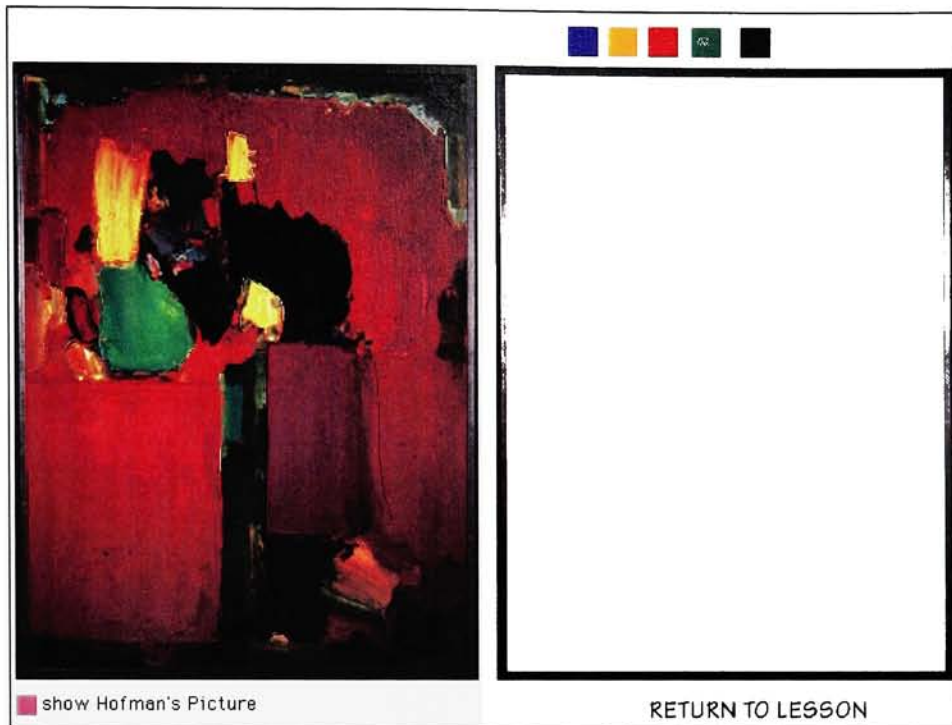
Figure 18.   Hans Hoffmann. *Ruby Gold*. Oil on canvas. 1959.
            Memorial Art Gallery

The first screen of the game "Design your own abstract paintings"

The screen showing the process of playing the game

Figure 19. Game: design your own abstract paintings in the *"Ruby Gold"* lesson section

TOUR HELP

Need help? Anytime during the tour, just click on the "helping hand"!
Place the arrow over the icon for instructions. Click anywhere to continue.

Tom Cafferty was
painted by American
artist Robert Henri
in 1924. Tom was a
boy the artist knew
in Ireland.

EXIT

Click on the "helping hand"
for instructions.

Figure 20. The "Help" screen of the tour section

LOOKING LABORATORY HELP

Click anywhere to continue.

Title of the painting

RUBY GOLD

Name of the Lesson

THE ARTIST'S STORY

Move your cursor to this area to see the Menu.

Click on the circle to choose the lesson.

WHAT'S THE BIG IDEA?

WHAT'S HAPPENING

GET SMART ABOUT ART

LOOKING LABORATORY

RUBY GOLD
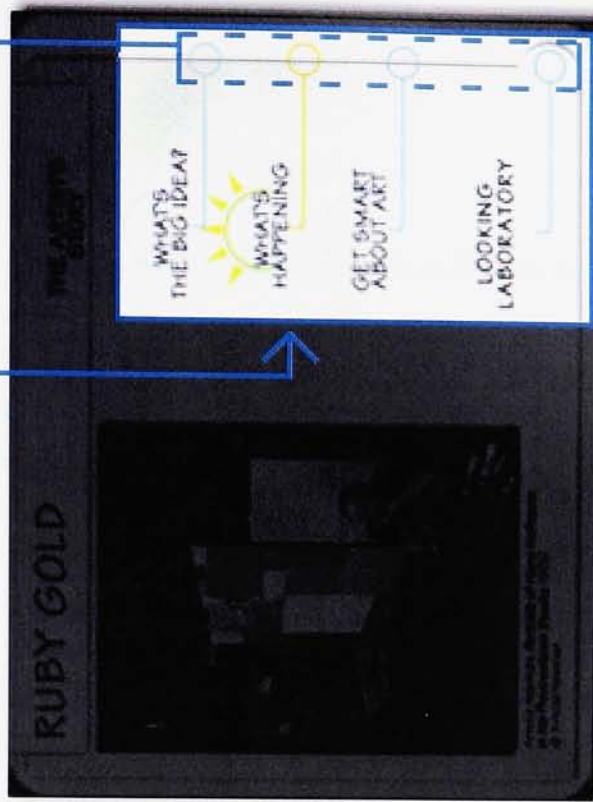
SOUND
Click on the text to hear or stop the sound.

PINK WORDS
Click on the pink words to learn more.

Wolf Kahn

Helen Frankenthaler

◀ Go back to the previous page.
▶ Go to the next page.

BLUE WORDS
Rollover the blue words to learn more about them. Click on them to hear the sound.

Figure 21. The "Help" screen of the lesson section

Works Cited

A Passion for Art: Renoir, Cézanne, Matisse and Dr. Barnes. Bellevue, WA: Corbis Publishing, 1995.

Halal, William E., and Jay Liebowitz. "Telelearning: The Multimedia Revolution in Education." *The Futurist* November 1994, 21.

Heller, Steven, and Daniel Drennan. *The Digital Designer: The Graphic Artist's Guide to the New Media.* New York, NY: Watson-Guptill Publications, 1997.

Holsinger, Erik. *How Multimedia Works.* With a Foreword by Richard Hart, host of the television show "The Next Step". Emeryville, CA: Ziff-Davis Press, 1994.

Horton, William. *The Icon Book: Visual Symbols for Computer Systems and Documentation.* Toronto, Canada: John Wiley & Sons, Inc., 1994.

Hurlburt, Allen. *The Design Concept: A Guide to Effective Graphic Communication.* New York, NY: Watson-Guptill Publications, 1981.

_____. *The Grid: A Modular System for the Design and Production of Newspapers, Magazines, and Books.* New York, NY: Van Nostrand Reinhold, 1987.

Kerlow, Isaac Victor, and Judson Rosebush. *Computer Graphics For Designers & Artists,* 2nd ed. New York, NY: Van Nostrand Reinhold, 1994.

Koester, Stephanie Eva. *Interactive Multimedia in American Museums.* Pittsburgh, PA: Archive & Museum Informatics, 1993.

Kristof, Ray, and Amy Satran. *Interactivity by design: Creating & Communicating with New Media.* Mountain View, CA: Adobe Press, 1995.

Minasi, Mark. *Secrets of Effective GUI Design.* Alameda, CA: SYBEX Inc., 1994.

Swann, Alan. *How to Understand and Use Design and Layout.* Cincinnati, OH: North Light Books, 1987.

The Kimbell Art Museum of Fortworth, Texas (http://www.corbis.com/features /secure/kimbell). Bellevue, WA: Corbis Publishing, 1995.

Vaughan, Tay. *Multimedia: Making It Work.* 2d ed. Berkeley, CA: Osborne McGraw-Hill, 1994.

With Open Eyes: Images from the Art Institute of Chicago. New York, NY: Voyager, 1995.

Works Consulted

Books, Reports & Proceedings:

Apple Computer, Inc. *Macintosh Human Interface Guidelines*. Reading, MA: Addison-Wesley, 1992.

Bearman, David. *Archives & Museum Informatics Technical Report*, No.1, *Optical Media: Their Implications for Archives & Museums*. Pittsburgh, PA: Spring 1987; reprint, Pittsburgh, PA: Archives & Museum Informatics, 1989.

Bearman, David, ed. *Archives and Museum Informatics Technical Report*, No. 14, Fall 1991. And *Hypermedia & Interactivity in Museums: Proceedings of an International Conference Held in Pittsburgh, PA. 14-16 October 1991*. Pittsburgh, PA: Archive & Museum Informatics, 1991.

Blattner, Meera, and Roger Dannenbeg, eds. *Multimedia Interface Design*. New York, NY: ACM, 1992.

Chenhall, Robert G., and David Vance. *Museum Collections and Today's Computers*. New York, NY: Greenwood Press, Inc., 1988.

Craig, James, and Bruce Barton. *Thirty Centuries of Graphic Design*. New York, NY: Watson-Guptill Publications, 1987.

Davis, Graham. *Quick Solutions to Great Layouts:Everything You Need to Know to Create Dynamic Layouts*. Cincinnati, OH: North Light Books, 1993.

Dewey, John. *Art and Education*. 3d ed. Merion, PA: Barnes Foundation Press, 1954.

Durbin, Gail, ed. *Developing Museum Exhibitions For Lifelong Learning*. London, England: The Stationery Office for the Group for Education in Museums, 1996.

Falk, John H., and Lynn D. Dierking. *The Museum Experience*. With a Foreword by Willard L. Boyd. Washington, D.C.: Whalesback Books, 1994.

Heller, Steven, and Daniel Drennan. *The Digital Designer: The Graphic Artist's Guide To The New Media*. New York, NY: Watson-Guptill Publications, 1997.

Holsinger, Erik. *How Multimedia Works*. With a Foreword by Richard Hart, host of the television show "The Next Step". Emeryville, CA: Ziff-Davis Press, 1994.

Hooper-Greenhill, Eilean. *Museum and Gallery Education*. Leicester: Leicester University Press, 1991.

_____, ed. *Museums and Their Visitors*. London, England; New York, NY: Routledge, 1994.

_____, ed. *Museum, Media, Message*. London, England; New York, NY: Routledge, 1995.

_____. *The Educational Role of the Museum*. London, England: Routledge, 1994.

Horton, William. *The Icon Book: Visual Symbols for Computer Systems and Documentation*. Toronto, Canada: John Wiley & Sons, Inc., 1994.

Hurlburt, Allen. *The Design Concept: a Guide to Effective Graphic Communication*. New York, NY: Watson-Guptill Publications, 1981.

_____ . *The Grid: A modular system for the design and production of newspapers, magazines, and books*. New York, NY: Van Nostrand Reinhold, 1987.

Kerlow, Isaac Victor, and Judson Rosebush. *Computer Graphics For Designers & Artists*. 2nd ed. New York, NY: Van Nostrand Reinhold, 1994.

Koester, Stephanie Eva. *Archives and Museum Informatics Technical Report*, No. 16, *Interactive Multimedia in American Museums*. Pittsburgh, PA: Archive & Museum Informatics, 1993.

Kristof, Ray, and Amy Satran. *Interactivity by design: Creating & Communicating with New Media*. Mountain View, CA: Adobe Press, 1995.

Microsoft Corporation. *The Windows Interface Guidelines for Software Design*. Redmond, WA: Microsoft Press, 1995.

Minasi, Mark. *Secrets of Effective GUI Design*. Alameda, CA: SYBEX Inc., 1994.

Perkins, Michael, and Celia Núñez. *KidWare: the Parent's Guide to Software for Children*. Rocklin, CA: Prima Publishing, 1995.

Roberts, Lisa C. *From Knowledge to Narrative: Educators and the Changing Museum*. Washington, D.C.: Smithsonian Institution Press, 1997.

Screven, C. G. *The Measurement and Facilitation of Learning in the Museum Environment: an Experimental Analysis*. Washington, D.C.: Smithsonian Institution Press, 1974.

Swann, Alan. *How to Understand and Use Design and Layout*. Cincinnati, OH: North Light Books, 1987.

The Museum Documentation Association. *Museums and Interactive Multimedia: Proceedings of the Sixth International Conference of the MDA Held in Cambridge, England, 20-24 September 1993, And The Second International Conference on Hypermedia and Interactivity in Museums (ICHIM '93)*, edited by Diane Lees. Cambridge, England: Museum Documentation Association; Pittsburgh, PA, USA: Archives & Museum Informatics, 1993.

Vaughan, Tay. *Multimedia: Making It Work*. 2d ed. Berkeley, CA: Osborne McGraw-Hill, 1994.

Williams, Robin. *How to Boss Your Fonts Around: a Primer on Font Technology and Font Management on the Macintosh*. Berkeley, CA: Peachpit Press, Inc., 1994.

Periodicals:

Alben, Lauralee, Jim Fairs, and Harry Saddler. "Making It Macintosh." *Interactions* January 1994, 10-19.

Backlund, Nicholas. "Focus on User Interface." *I.D. Magazine* (New York, NY) March/ April 1991, 84.

"Interactive Communications." *Editor & Publisher* 11 March 1995, 30.

"Interactive Multimedia." *AV video* August 1994, 46.

Halal, William E., and Jay Liebowitz. "Telelearning: The Multimedia Revolution in Education." *The Futurist* November 1994, 21.

Harney, John. "Interactive Multimedia: All Worlds at Once." *Inform* April 1995, 36.

Rudd, James, and Scott Isensee. "Twenty-Two Tips for a Happier, Healthier Prototype." *Interactions* January 1994, 35-40.

Saga, Hiroo. "Are We Ready Enough to Learn From Interactive Multimedia?" *Educational Media International* September 1992, 181.

Schorr, Joseph. "Learning Power: Software for Kids." *MacUser* December 1994, 90-104.

Zelevansky, Paul. "Crisscrossing the Interface: The Design, Display and Evaluation of an Interactive Computer Exhibit." *Leonardo* Vol. 28, No2 (1995): 137-142.

Works of Art, Software, CD-ROM Titles & Websites:

Benton, Thomas Hart. *Boomtown*. Oil on canvas. 1927 or 1928. Memorial Art Gallery, Rochester, NY.

Hofmann, Hans. *Ruby Gold*. Oil on canvas. 1959. Memorial Art Gallery, Rochester, NY.

Ruysch, Rachel. *Floral Still Life*. Oil on canvas. 1686. Memorial Art Gallery, Rochester, NY.

Adobe Illustrator® Version 6.0. Adobe Systems Incorporated, Seattle, WA.

Adobe Photoshop® Version 3.05. Adobe Systems Incorporated, Seattle, WA.

FinderHider Installer Version 1.0. Andrew Green, San Francisco, CA.

FreeHand Verson 5.5. Macromedia®, Inc., San Francisco, CA.

Director Version 4.04. Macromedia®, Inc., San Francisco, CA.

Microsoft Word Version 5.1. Microsoft Corporation,

QuarkXpress™ Version 3.02. Quark, Inc., Denver, CO.

SimpleText Version 1.3.3. Apple Computer, Inc., Cupertino, CA.

SoundEdit 16™ Version 1.0.1. Macromedia®, Inc., San Francisco, CA.

StudioPro™ Version 1.5.2. Strata Inc., St. George, UT.

Toast Pro Version 2.5.1. Adaptec, Milpitas, CA.

A Passion for Art: Renoir, Cézanne, Matisse and Dr. Barnes Rel. 1. Corbis Publishing, Bellevue, WA.

Bar-Min-Ski [Interactive Multimedia]: Consumer Product Rel. 1. Consumer Productions, Los Angeles, CA.

Peters, Susan Dodge. "Interview with Susan Dodge Peters, Director of Education at the Memorial Art Gallery." Interview by Alicia Tedeschi (Program, 24 October 1996). *The World*. http://206.106.95.11/atw/int10.24.96.htm.

Photography in the 1990s [Interactive Multimedia]: Fifty Portfolios Rel. 1. Wright State University Art Galleries, Dayton, OH.

The Kimbell Art Museum of Fortworth, Texas (http://www.corbis.com/features /secure/kimbell) Rel. 1 (Bellevue, WA: Corbis Publishing).

With Open Eyes: Images from the Art Institute of Chicago Rel. 1. Voyager, New York, NY.