Designing Interactive Videodisc-based Museum Exhibits: A Case Study

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Technologists working in informal educational settings must adapt instructional design models to special needs. This article describes the analysis, design, development, implementation and evaluation of an interactive videodisc exhibit at a natural history museum. Advantages of using an existing videodisc are discussed and design requirements for museum environments and interactive videodisc-based exhibits are examined. Data are presented suggesting that systematically designed videodisc exhibits can attract and hold visitors' attention for longer periods of time than conventional exhibits.

☐ Museums differ from other educational and training settings in two important respects:

- People who go to museums do so by choice and freely choose their own activities (Linn, 1981). These non-captive learners will remain at an exhibit only as long as it holds their attention.
- Museum exhibits must be adaptable to a wide range of visitors in terms of age, interest, ability, and personal preference (American Association of Museums, 1992).

The educational value of museum exhibits depends, in part, on their ability to attract and hold people's attention (e.g., Koran, Foster, & Koran, 1989; Peart, 1984). Though attention is not believed to be the only determinant of learning, it is still viewed as one of the more powerful predictors of what individuals learn (Kulhavy, Schwartz, & Peterson, 1986), particularly from museum exhibits (Wittlin, 1968; Shettel, 1973; Koran, Koran, & Longino, 1986; Koran, Koran, Dierking & Foster, 1988). Similarly, viewing time, one measure of holding power and attention, is consistently correlated with cognitive and affective outcomes in museum settings (e.g., Falk, 1983; Peart, 1984; Koran, Foster, & Koran, 1989). Unfortunately, the average viewing time of museum exhibits ranges from about 20 seconds (Clowes & Wolff, 1980) to approximately 45 seconds (Van Rennes, 1981). It appears that, on average, visitors may spend less than a minute examining a single museum exhibit.

One reason conventional exhibits fail to gain and sustain viewers' attention may be that they are often passive in nature. Although museums strive to make visits active experiences, common media presentations, such as slide

shows, films and text labels, require little interaction (Allen, 1986). Visitors are unable to actively investigate or control information flow. It is also difficult to adapt linear presentations to the general public's varied abilities and interests, thus content is often calibrated to the needs of an average visitor. To allow visitors to adapt their experience, a number of museums and parks across the United States have adopted videodisc technology (Nash, 1992; Morrissey, 1991; Screven, 1990; Binder, 1987).

PROJECT OVERVIEW

The San Diego Natural History Museum has undertaken major revisions of its public exhibits to increase attendance and improve its educational value. The Chapman Grant Hall of Desert Ecology, one of the new exhibit areas, depicts relationships among southwestern desert organisms and their environment. Its primary goal is to show visitors that deserts are places of immense beauty, diversity, and value, instead of barren and infertile wastelands.

The hall features a walk-through desert environment which recreates the Anza-Borrego Desert State Park. It contains a 120-foot diorama, a discovery lab, and eight live arthropod displays. At the center of the hall are two interactive videodisc exhibits, both featuring the Desert Explorations program (Diamond, Bond, & Hirumi, 1989). Desert Explorations gives visitors the opportunity to explore and gain more information about the specimens on display in the Hall.

PROGRAM DESIGN

While a number of strategies and procedures concerning the process of exhibit development have been published (e.g., Bruman, 1975; Neal, 1976; Hipschman, 1980, 1987; Konikow, 1984, 1986; Oppenheimer, 1986), use of standardized models for the systematic design of exhibits appears to be rare. Screven (1990) recommended that referring to published materials on instructional design, "would be helpful for those interested in designing educational materials for computers in exhibit settings" (p. 132). A systematic procedure for designing instruction (Dick & Carey, 1990) therefore was adapted for creation of this exhibit. The entire process consisted of several steps and phases. In the analysis phase, data were collected regarding current media use and the concerns of museum personnel. Constraints imposed by the museum environment were examined, as was the feasibility of adapting an existing videodisc for an exhibit. In the design phase, the videodisc and hardware were selected and purchased, and general program content was determined. During the development phase a user interface was created and several working prototypes were tried out with museum personnel and selected visitors. In the evaluation phase, the final program was field tested after installation in the Desert Hall.

Analysis Phase

Front-end analysis efforts (Rossett, 1987) focused on interviews with museum administrators, policy makers, and technical personnel including curators, exhibit designers and artists. Twenty museum visitors were also interviewed and an additional twenty were observed touring exhibits. Existing data, including attendance records and the museum's master plan, were reviewed and an inventory of all current museum exhibits was conducted.

The public exhibits are divided into eight major sections made up of both thematic areas (e.g., endangered species) and regional halls (e.g., Chapman Grant Hall of Desert Ecology). The public exhibits cover approximately 26,000 square feet and display over 10,000 different specimens and models. Most exhibits are accompanied by one to three paragraphs of text. Some 100 pictures and diagrams are supported by larger blocks of text of up to ten paragraphs. Two slide-tape presentations, a film with audio, two separate audio tapes, and one continuous videotape are used.

Although some of the museum personnel felt that static text and images played an important role in museum exhibits, allowing visitors control over information access, they

also thought that these exhibits limited visitors' experiences. They felt that exhibits could be improved by providing information related to individual needs and interests. Many thought that the readability level of the text labels was too high, relying heavily on scientific terms and jargon. With regard to the linear, fixed-paced audiovisual presentations, most felt that those in the museum were aesthetically unappealing. They required costly and unreliable hardware and software, discouraged active participation, and allowed little control.

These limitations were particularly critical when the characteristics of museum visitors, as indicated by the results of the front-end analysis, were considered. Visitors were of any age and any educational level with diverse backgrounds and interests. They casually viewed exhibits and only looked at whatever interested them. Observations of museum visitors indicated that they tended to stop and look at exhibits which moved or could be made to do something (e.g., a slide show could be started). Visitors also spent much of their time touching exhibits they were allowed to handle, and often interacted with companions and other visitors.

Analysis results suggested that visitors were more attracted to and engaged by exhibits that required some sort of participation. Thus, museum personnel decided to explore the potential of utilizing computer technology. Interactive video exhibits, for example, can provide users with short, exciting presentations that attract and sustain interest through sound, motion, photographs, computer graphics, and text. Unlike static exhibits and linear media, interactive video exhibits allow users to search through images at their own pace, creating their own pathways through networked information. They can then learn what they want, when they want it.

Interactive video programs can be expensive to develop and the availability of suitable stock photographs and footage of the desert to produce an original videodisc was in question. Producing a videodisc designed to meet the specific requirements of the Desert Hall was estimated to cost about $50,000. Thus, commercially available videodiscs were reviewed and a product that contained sufficient desert images was identified. Adapting commercially available videodiscs offers an important alternative to producing new videodiscs. One can take an existing disc, select relevant images, overlay pictures with new graphics, sound and text, add menus and help screens, and provide different pathways for exploration. Although the chosen videodisc contained no relevant motion sequences, it was felt that there were enough still images (over 300) to develop an information-rich interactive program.

Design Phase

Content for the desert ecology videodisc program was specified, its goals and objectives defined, hardware and software for development were purchased, and an implementation and evaluation plan was developed. Each relevant image from the videodisc was cataloged in terms of species, frame number, and cinematic structure (e.g., camera angle, close up). A total of 325 still images representing 97 desert species was identified, including mammals, birds, reptiles, arthropods, and plants. Information about each species included its adaptation to the desert; ecological relationships (such as competition and predator/prey relationships); common and scientific names; species status (e.g., threatened, endangered); typical behaviors such as feeding, mating, and defense; habitat; prints and tracks; and vocalizations.

Initial information for text portions of the videodisc program was identified by curators and through library research. Information deemed ambiguous or of little interest to visitors by subject matter experts was eliminated and, in some cases, more compelling information about a species was added. Several species were presented in as many as ten images, usually with computer text superimposed over video so as not to obscure the image's important elements.

The goal of the program was to help museum visitors appreciate and understand the diversity of desert life and the complexity of its ecology. Program objectives derived from these goals included:

- Over 50% of the people who enter the *Chap-*

man Grant Hall of Desert Ecology will choose to watch or interact with the interactive program for at least one minute and access more information about a specific species at least once.

- Those interacting with the videodisc exhibit will describe the desert as a diverse ecosystem which contains an abundance of interrelated organisms and choose to preserve the desert's natural beauty.

Visitor characteristics guided the selection and the planned installation of the videodisc exhibit. The computer software and input devices had to be easy to use and durable since many visitors have little to no computer experience and the program was to be used frequently. Therefore, an infrared touch-screen system was selected. Since visitors tend to be intolerant of delays in exhibit response, authoring software was selected that used a fast, but relatively simple, interpreted language and a videodisc player was selected that could access disc images quickly. In addition, installation of two videodisc programs was planned. In one, the touch-screen monitor was placed about three and a half feet from the ground, to allow both adults and older children to interact with the program. In the other, the touch screen was placed about three feet from the ground to provide easier access to young children and individuals in wheelchairs. Both videodisc exhibits were identical in content and included a second, larger monitor placed high on the wall so some visitors could view the program while others interacted with it.

Development Phase

Differences between museum and traditional instructional settings were most apparent during this phase. In a traditional instructional design model, content structure and instructional strategies are prescribed before development of the instructional materials (Dick & Carey, 1990). In the development of computer-based instruction this usually involves the creation of storyboards and flowcharts. Although in this project storyboards and flowcharts were first used by designers and programmers to conceptualize program structure, these planning documents were not as useful for other project personnel. Using only the planning documents, curators and other reviewers could not assess the *feel* of the attraction sequence or evaluate how users would proceed through the program. Museum personnel cautioned that although exhibit design is like having an architect draw a house and a contractor construct it, in practice it can be more like building a house without drawings, trying things out one way and then another (A. Bond, personal communication, March 25, 1988). Therefore, instead of storyboards, working prototypes were created so that the program could be more easily evaluated. Changes were made, tested, revised and tested again.

The prototypes were reviewed by museum staff, educational technologists, and representative museum visitors (including children). They assessed the size and location of the *touch* options, monitor height, text size, color schemes, accuracy of text, readability, and the clarity of the menu options. Modifications were made until the reviewers and visitors were able to navigate through the program without any help or difficulties.

In contrast to traditional instruction that directs learning and incorporates teaching and assessment strategies to ensure mastery, museum exhibits must provide casual visitors with opportunities to explore information in any sequence, at any pace, and to any depth. Front-end analysis results suggested that the program structure should be open, flexible, fast, highly engaging and allow for user control. Initially, a *top-down* structure was developed with an introductory menu leading to a series of sub-menus. However museum personnel felt that a menu-driven program would not be sufficiently engaging. It was reasoned that a main menu would not capture visitors' interest and that limiting users to menu options would not enhance discovery and exploration. To address these concerns, three primary ways for exploring the program were created, that is, the *Picture Show, Menus,* and *Species Network,* described below.

In the final program a continuous Picture Show of images from the disc is used to attract

visitors to the exhibit and provides users with an alternative pathway for exploration. Control buttons on the screen allow visitors to request information about the displayed species or back up and review a previous image. If no request is made, the program displays a new image after three seconds. These options allow visitors to randomly examine a wide range of species. To further attract visitors, the exhibit is programmed to play a sound of a desert animal at three minute intervals when left unattended.

Two types of menus are embedded in the program. The main menu allows visitors to choose among seven categories: Mammals, Birds, Reptiles, Arthropods, Plants, Animal Sounds, or Return to Picture Show. Selection of any of these categories, except Picture Show, presents viewers with the second type of menu which lists the common name of animals or plants from that category. Touching the name of an organism initiates a series of pictures and text about that species. Control buttons displayed on the screen allow viewers to peruse pictures and text about the selected species, move to another menu, or change to another method of investigation.

The third method of exploring the program, the Species Network, allows visitors to go from one organism to another, following a kind of ecological web. Into a series of pictures of a given organism, an image of an ecologically-related species is inserted. The accompanying text indicates the nature of the relationship. At this point, visitors have the option of networking to more information about the related organism or continuing with the original species.

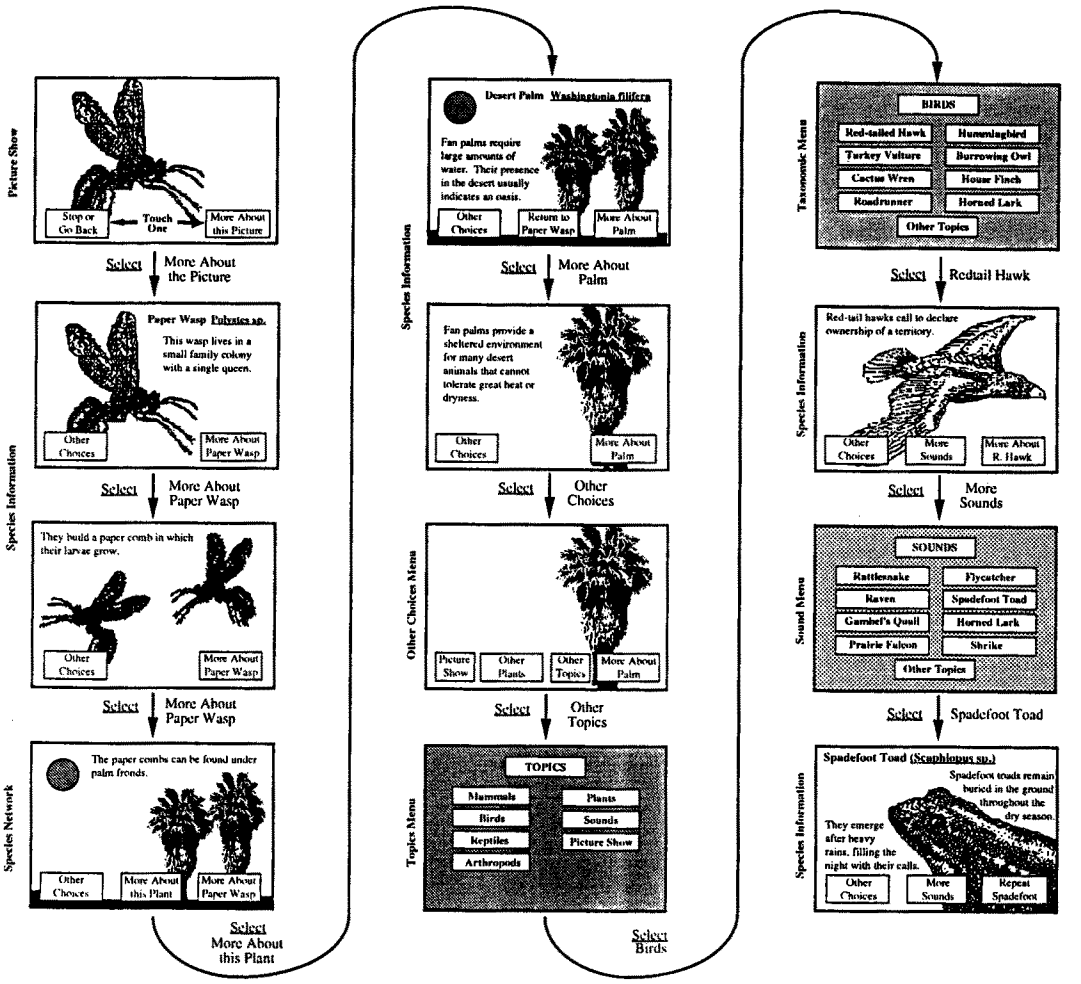
Figure 1 illustrates some of the branching capabilities of the program. A visitor, for example, may first stop the Picture Show on an image of a paper wasp. At this point, the visitor may decide to go back to the last image presented in the Picture Show or access information about the paper wasp. By selecting *More About this Picture* the visitor is presented with a series of images that contain text information about the wasp. As with most species contained in the program, an image of a related species, in this case a desert palm, has been inserted into the sequence of species information. This link to other species allows visitors to readily explore the breadth of the program without having to remember how to access different menus. At this point, the viewer may get more information about the desert palm, return to information about the paper wasp, or select an option labeled *Other Choices*. Other Choices presents the viewer with more options including the *Picture Show, Other Plants, Other Topics,* or *More about the Palm*. Selection of Other Topics brings the viewer to the main menu which includes options to see *Mammals, Birds, Reptiles, Arthropods, Plants,* the *Picture Show,* or hear a variety of *Sounds*.

In the example depicted in Figure 1, *Birds* is chosen, which brings the viewer to the submenu which lists all the birds included in the program. By selecting *Redtail Hawk,* the viewer can go through all the available information screens on the species. In this case, the first information screen contains a sound bite emulating the call of the hawk. Anytime a sound bite is provided, viewers are given the option to hear *More Sounds,* select *Other Choices,* or continue with more information about the selected species. From the Sounds menu, the viewer may choose to get information on and listen to the sounds made by other species or go back to the main menu. This example illustrates just one of the many different paths viewers may take as they explore the contents of the videodisc program.

Field Evaluation

A field evaluation was conducted to examine visitors' use of the videodisc program. The evaluation differed from those typically conducted for instruction (cf. Dick & Carey, 1990; Gagné, Briggs, & Wager, 1988; Popham, 1975) in its goals, methods, and use of data. To account for differences in setting, the evaluation focused on the program's ability to attract and hold viewers' attention, and visitors' interaction with the program. No test data were collected because the museum personnel were not interested in what or how much information visitors remembered about the videodisc exhibit. The quality and meaning of a museum experience is thought to be very personal (Wolf

Figure 1. ☐ Sample Interaction with Desert Explorations Videodisc Program.



& Tymitz, 1978; Zyskowski, 1981). Thus, a naturalistic approach, consistent with current museum practice, was used to yield qualitative information about the program's impact.

Method. Data were collected over two successive weekends immediately following the opening of the exhibit hall. Six hundred and eight visitors who entered the hall during four two-hour peak periods were observed to determine how many interacted with, watched, or ignored the videodisc program. The time 50 visitors spent viewing all the exhibits in the desert hall was recorded and the behaviors of 34 visitors who used the program were recorded, including the time they spent using the program, and their sequences of choices. In addition, 20 groups of visitors and six subject matter experts were interviewed immediately after they left the exhibit area.

Evaluation Results. Approximately 33% of the people who entered the desert hall interacted with the videodisc program. Another 33% watched others interact with the program, and the remaining visitors passed by without looking at the program for more than three seconds. Visitors spent more time looking at and interacting with the videodisc program than any other exhibit in the desert hall. They spent an average of 154 seconds using the videodisc program, 141 seconds viewing the 120-foot diorama, 35 seconds viewing the live animals, and 34 seconds viewing other displays in the hall's

entrance. Visitors usually did not interact with the program when others were already using it, or when the screen was inactive as they passed by.

Interactions were often by groups. Parents frequently read text information to children and people often asked each other about which option to choose. Typically, no more than three people interacted with the program simultaneously, while 10 to 15 visitors could view the program by watching the upper monitors.

Approximately 75% of those who interacted with the program used the menus as the primary means of accessing species-specific information. The other 25% used the Picture Show more to explore the program even though they were aware of the existence of menus. This suggests that while most users were interested in a particular group of organisms, a significant number preferred to broadly sample the contents of the exhibit.

In comparison to the Mammal, Bird, Reptile, Arthropod, or Plant menus, the menu accessing Animal Sounds was used twice as often as the others combined. When the relative use of the Mammal, Bird, Reptile, Arthropod, and Plant menus was compared, no significant differences were found. Apparently, people were more interested in listening to animal vocalizations than learning about any one particular type of organism.

About 25% of those who interacted with the program used the Species Network. However, use of this pathway appeared to be more a function of depth of exploration than preference; visitors who viewed more pictures of a particular species were more likely to network than visitors who viewed only one or two images.

Visitors who touched the screen continued to use the exhibit for an average of 4.4 minutes. On average, the observed users viewed five to six different desert species. The highest number of species viewed by one visitor was 24. Although the mean number of pictures available for any one species was 3.4, on average users examined only 1.7 pictures per species. Again, it appeared that visitors preferred breadth over depth, examining several different species but spending relatively little time on any one.

Five of the 20 groups of visitors interviewed said they were attracted to the videodisc by the sounds emitted by the program. Three said they were attracted by the bright, flashing pictures, and three looked at the program because others were interacting with it. Of the nine groups which did not look at the program, four said that they did not realize that there was a videodisc exhibit in the hall and three said it was because too many other people were around the exhibit. One group said they were not interested in the program, and another said they did not realize that they could interact with it by touching the screen.

The six subject matter experts interviewed indicated that they felt the program provided visitors with interesting options without overwhelming them with choices and that possible future additions of motion and/or animated sequences, more sounds, and the ability to print out information would enhance its overall impact.

In general, the visitors indicated that the videodisc was one of the best exhibits in the entire museum. A majority of visitors who interacted with the program said that they felt that the desert contains a greater number and variety of species than they previously imagined. While it was assumed that some visitors would use the videodisc to gain information about a particular organism that they saw in the diorama, no one linked the species information available on videodisc program with the content of the diorama. Eighteen of the 20 groups interviewed said that they would definitely interact with the program if they returned. No one reported any problems operating the disc. All groups said they enjoyed their experience in the hall and expressed a desire to see similar exhibits.

CONCLUSION

This case study illustrates how an instructional design model can be adapted to accommodate differences in user needs, desired outcomes, resources and constraints in museum settings.

Educational technologists and museum personnel were able to negotiate differences in practice typical of their respective design and development processes into a satisfactory learning opportunity for museum visitors. The Desert Explorations exhibit also demonstrates that effective interactive exhibits can be systematically designed based on commercially available videodiscs. In addition, evaluation data and experience gained through the development process highlighted the effectiveness of: (1) Using sound and motion to attract visitors to the exhibit; (2) producing prototypes to facilitate development; and (3) providing visitors with alternate pathways for exploring an interactive program. In this age of information and technology, adults and children can be expected to learn more and more from interactive programs encountered outside of classrooms. It is hoped that the use of systematic design principles in the development of such interactive programs will result in effective, cost-beneficial, and appealing learning systems for informal educational settings. □

Atsusi Hirumi is at the University of Houston-Clear Lake, Wilhelmina Savenye is at Arizona State University and Brockenbrough Allen is at San Diego State University. We gratefully acknowledge the contributions of Alan Bond, Judith Diamond, the staff of the San Diego Natural History Museum, and anonymous reviewers in design of this exhibit and preparation of this manuscript.

REFERENCES

Allen, B.S. (1986). A theoretical framework for interactivating linear video. *Journal of Computer-Based Instruction*, 13, 107–112.

American Association of Museums (1992). *Excellence and equity: education and the public dimension of museums* (ISBN 0-931201-14-4). Washington, DC: American Association of Museums.

Binder, R.H. (1987, April). Special report: museum applications of videodisc. *The Videodisc Monitor*, 1-A–1-D.

Bruman, R. (1975). *Exploratorium cookbook I: A consortium manual for exploratorium exhibits*. San Francisco, CA: The Exploratorium.

Clowes, M. & Wolff, L. (1980, November). *A preliminary evaluation of the "Birds of Canada" exhibit*. Ottawa, Canada: Ottawa Museum of Natural Sciences.

Diamond, J., Bond, A., & Hirumi, A. (1989). Desert exploration—A videodisc exhibit designed for flexibility. *Curator*, 32(3), 161–173.

Dick, W., & Carey, L. (1990). *The systematic design of instruction* (3rd ed.). Glenview, IL: Scott, Foresman and Company.

Falk, J.H. (1983). The use of time as a measure of visitor behavior and exhibit effectiveness. *Roundtable Reports: The Journal of Museum Education*, 7(4), 10–13.

Gagné, R.M., Briggs, L.J., & Wager, W.W. (1988). *Principles of instructional design*. (3rd ed.). New York: Holt, Rinehart and Winston.

Hipschman, R. (1980). *Exploratorium cookbook II: A construction manual for exploratorium exhibits*. San Francisco, CA: The Exploratorium.

Hipschman, R. (1987). *Exploratorium cookbook III: A construction manual for exploratorium exhibits*. San Francisco, CA: The Exploratorium.

Konikow, R.B. (Ed.). (1984). *Exhibit design*. New York, NY: PBC International.

Konikow, R.B. (Ed.). (1986). *Exhibit design 2*. New York, NY: PBC International.

Koran, J.J., Jr., Foster, J.S., & Koran, M.L. (1989). The relationship among interest, attention and learning in a natural history museum. *Curator*, 31(2), 36–43.

Koran, J.J., Jr., Koran, M.L., Dierking, L.D., & Foster, J.S. (1988). Using modeling to direct attention in a natural history museum. *Curator*, 31(2), 36–43.

Koran, J.J., Jr., Koran, M.L., & Longino, S.J. (1986). The relationship of age, sex, attention and holding power with two types of science exhibits. *Curator*, 29(3), 227–235.

Kulhavy, R.W., Schwartz, N.H., & Peterson, S. (1986). Working memory: The encoding process. In B. Phye & T. Andres (Eds.), *Cognitive classroom learning*, Orlando, FL: Academic Press.

Linn, M.C. (1981, April). *Evaluation in museum settings: Focus on expectations*. Paper presented at the annual meeting of the American Educational Research Association.

Morrissey, K. (1991). Visitors' behavior and interactive video. *Curator*, 34(2), 109–118.

Nash, C.J. (1992). Interactive media in museums: Looking backwards, forwards, and sideways. *Museum Management and Curatorship*, 11, 171–184.

Neal, A. (1976). *Exhibits for small museums: A handbook*. Nashville, TN: American Association for State and Local History.

Oppenheimer, R. (1986). Exhibit conception and design. *The Exploratorium*, 5–28.

Peart, B. (1984). Impact of exhibit type on knowledge gain, attitudes, and behavior. *Curator*, 27(3), 220–237.

Popham, W.J. (1975). *Educational evaluation*. Englewood Cliffs, NJ: Prentice Hall.

Rossett, A. (1987). *Training needs assessment*. Englewood Cliffs, NJ: Educational Technology Publications.

Screven, C.G. (1990). Computers in exhibit settings. In S. Bitgood, A. Benefield, & D. Patterson (eds.), *Visitor studies: Theory, research, and practice*. Proceed-

ings of the 1990 Visitors Studies Conference. Jacksonville, Alabama: The Center for Social Design. 131–138.

Shettel, H.H. (1973). Exhibits: Art form or educational medium. *Museum News, 52*(1), 32–41.

Van Rennes, E.C. (1981). *Exhibits enhanced by stand alone computers.* Bloomfield Hills: Cranbrook Institute of Science.

Wittlin, A. (1968). Exhibits: Interpretive, uninterpretive, misinterpretive—absolutes in exhibit techniques. In E. Larabee (Ed.) *Museums and education.* Washington, DC: Smithsonian Institution Press.

Wolf, R.L., & Tymitz, B. (1978). *A preliminary guide for conducting naturalistic evaluations in studying museum environment.* Washington, DC: Smithsonian Institution.

Zyskowski, G. (1981, October). *How not to conduct a naturalistic evaluation: Rueful reminiscences of a museum evaluator.* Paper presented at the annual meeting of the Evaluation Network, Austin, TX.

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