Evaluation of Hypermedia and Interactivity in the Museum:
A Constructivist Approach to Instructional Design

Andrew J. Peterson, Ph.D.
Santa Fe Educational Foundation
San Diego, California

Contemporary educational communications and technology have brought new ways for presentation of museum content. Advances in telecommunications, computers, videography and printing are revolutionizing the grounds on which people encounter art, science, and culture. This technological change is causing scientists and educators to re-think the formats for their material in our museums and, eventually, in our homes. Sensible perspectives on evaluation are needed to guide the use of the old content in the new venues. One convenient source for a checklist of principles for evaluation of interactive exhibits is the Responsive Environments Program developed by Dr. Omar K. Moore. This paradigm has been applied educationally to many technological innovations as they have come forth in the past four decades. The principles are fourfold: Perspectives, Productivity, Personalization and Autotelicity. Exhibit designers are encouraged to consider the playforms or "folk models" which the visitor would assume during the interaction with the hypermedia. While the environment does promote free exploration and creative application, there is expert feedback throughout the experience.

Museums have become leading players in the introduction of educational technology to the world. Because program content is so crucial to the success of the new electronic dreams, museums will be increasingly important partners in the development of multimedia software. Furthermore, there is a steady parade of new and innovative projects in museums applying a wide variety of interactive, multimedia formats to the presentation of traditional material. The technological change provides the museum scientists and educators with a window of opportunity to examine the "what" as well as the "how" of their exhibits. Museums are not mere storehouses or showcases for old things. They are places for instruction, and their visitors will be learning something for better or for worse. Teaching is an inescapable part of exhibition regardless of the medium. This paper will present a brief update on the new technological options for the museum designer and a theoretical perspective for the design and evaluation of hypermedia and interactivity in museum education.

The Design of the Electronic Museum Educational Technology

In our time quantum leaps are made regularly in telecommunications, computing, video, audio, and print. Distance education is practiced in more settings (Saba, 1989 and Moore, 1990). The price of computer memory storage continues to decrease even as the capacity of such devices increases. With the increase in speed and memory comes the ability to represent complex graphics to the point of photographic realism. New software from Apple Computer Company, QuickTime, allows the developer to paste video clips into a digital file. Thus, a dynamic sequence can be called up as easily as a word processing text file. Resolution and speed of the images is becoming increasingly natural because of the compression algorithms. The fidelity of auditory resolution, as well, has become expected due to the huge success of the affordable players for audio compact discs. Finally, print materials of the very highest quality can be generated on the desktop.

These new tools are impressive in their own right, but as designers it must be remembered that the tool is just a means to an end. The substantive content and instructional design of a presentation remain the crucial factors. A noted jazz musician once said, " You can only play as far as your concept" (Miles Davis). Great video and stereo enhance good content and design but they cannot cover for bad ideas. Therefore, a knowledge of formal instructional design is important for the museum educator who would implement hypermedia and interactivity.

Educational Design

Through the history of instructional design there have been three dominant psychological views as theoretical bases: behaviorist, cognitivist, and constructivist. These paradigms have guided the work of instructional designers over the past 50 years regardless of media. "You can only play as far as your concept." The view of the learner and how he learns are the ultimate guidelines for the one who constructs a museum exhibit. Seeing the learner through a behaviorist lense is to look for those stimuli which will lead to certain desired responses (Skinner, 1954). What do you want your visitors to do upon entrance and exit from your institution? What sorts of things are discriminative cues for these desired responses? What rewards will be effective to maintain the attention and targetted behavior of the participant. This empiritcal method relys heavily on planning specific responses and investigating the experiences that reinforce the goals of the exhibit.

The cognitivist proceeds in a somewhat similar way (Gagne, 1985). There is the same commitment to a scientific, mechanistic view of man. The big difference is the attention to the internal ideation of the participant. Based on the information-processing model, i.e. man as computer, this paradigm accounts for the individual mental processes of interpretation which go on as one interacts with the museum exhibit.

A more subjectivist approach to instructional design is based on the Constructivist psychological base. Learning is more a process of constructing knowledge than merely receiving facts which produce pre-selected responses (Behaviorist) or are processed with

pre-set algorithms (Cognitivist). Thus, the Constructivist model has the theoretical horsepower to conceptually cover creativity on the part of the user. Recommendation coming from Constructivism emphasize setting up an optimal environment rather than dictating responses or thinking. Please note that there are times when behavioral and cognitive processes should be dictated. But it is vital that the museum visitor be engaged creatively. Thus, Constructivism should be the instructional theory of choice for museum exhibits.
Changes in Museum Presentations

The case for the Constructivist approach to development and evaluation is even stronger in light of technological progress. Contemporary computer workstations are able to mix and match a number of media on the same platform. Whether slide or film projectors, multiple audio tracks, or innovative input devices, the digital revolution is creating a common format for the interaction of variety of forms and colors.

In recent times electronic communications has been a matter of delivering an active message to a passive recipient. In the past decade there has been a great emphasis on the interaction between the receiver and the medium. For example, interactive videodisc has been the most acclaimed new technology in museum and education. With the wide choice of media and the interactive capabilities of the digital computer, creative production has become a standard expectation--as opposed to the passive reception of information.

The image of man presented in S-R behaviorism and information-processing cognitivism is mechanistic--discrete input and specific output by design. On the other hand, constructivist design considers how the learnier makes innovative use of the variety of media to produce some intelligent and aesthetic product. Rather than preselected response, the surprise of creativity is anticipated. Thus, the museum experience should lead to an intellectual or material product which is the result of a productive enterprise on the part of the visitor. No more snake--that trail of elementary students shuffling through the day at the museum. the goal is nothing less than to move the museum from a dusty archive to a shiny new paradigm of modern communcations with interesting content.

How can one present interesting, engaging challenges in the contemporary museum? Design of information-rich, sensory-exciting exhibits requires a sufficiently sophisticated model of instruction. Such guidelines can be found for instructional design in the work of social psychologist Omar Moore. (For standards of mechanical design of exhibits see the work of Donald Norman (1988), a leading cognitive scientist with a Constructivist viewpoint.)

Principles for the Responsive Environment in the Museum

One of the best exemplars of the Constructivist view is the work of Omar Khayyam Moore and the Responsive Environments Program (1969, 1980). This ongoing R&D effort has addressed educational technology according to mechanical, cultural, theoretical, and logical concerns. It has characteristically invented new machines, educational programs, social science models, and mathematical representations for human activity. The Responsive

Environments Program has been both eminently practical and philosophical. The principles developed over the forty-year research project are apt direction for exhibits with hypermedia and interactivity. The following four principles are standards by which digital museum projects may be evaluated.

Perspectives

Moore and his colleagues use four basic principles to guide instructional design: Perspectives, Productivity, Personalization, and Autotelicity. In any educational situation an effort is made to place the participant in four different control perspectives. (1) If a learner is in full control of the operation of the exhibit then he has the agent perspective. This is that of the scientist, a puzzle-solver. (2) If there is no control then he is a patient. Much like the gambler playing a game of chance, significant elements are beyond regulation of the operator. (3) If a visitor to the exhibit can interact with another person in the course of working the presentation, then he is a reciprocator. The challenge of this social situation is to solve problems as one takes the other participant into account with every move in a strategic contest. (4) If the student is to make normative judgements, aesthetic or ethical, then he has the perspective of the referee. There is a values-dimension to any responsive environment. Interestingly, this is the one perspective for which Moore could not find a mathematical model.

In the course of his research on the logic and social psychology of problem-solving, Moore noticed the importance of games. Having read Georg Simmel on games and play-forms, i.e. roles in play as preparation for roles in society, he knew there was great cultural significance to all the fun (Moore, 1952, 1990). This led to an exploration of the cross-cultural files at the Yale University library in search of commonalities in games aroung the world. Moore found these four general types of playful activities which serve as models for instructional design: the puzzle, the game of chance, the game of strategy, and the arts. The Perspectives principle is a useful tool for thinking about how to present the subject with a variety of operational and social contexts. There will be individual differences in tendency to enjoy one or more of these social structures, but the ideal learning situation will be to give an opportunity in each of the perspectives. Multiple perspectives lead to more enjoyable and greater enrichment, i.e. productive learning. The museum exhibitor can use these formats as a checklist for the instructional design of the presentation.

Productivity

The second principle is Productivity. When one experiences an exhibit, one should learn information or procedures which help in future situations. The insights and processes that are gained in a museum exhibit should help to understand other parts of that exhibit, other parts of the museum or elsewhere in the world. Learning a concept or fact should have relevance to later understanding. Again, note that this is far from a passive view of the museum visitor--there is an expectation of enrichment.

Hypermedia implies movement within an environment abounding in important information. If hypermedia is a mere shuttling of sights and sounds from one location to another,

then it becomes a superficial chaos. If, however, one encounter in the exhibit leads to progress in competence or understanding, then there is productivity. The participant is enriched as well as entertained.

Personalization

Another set of heuristic guidelines within the paradigm developed by the Responsive Environments group is summed up as Personalization. How do you engage the observer? It can be done via both responsiveness and reflexivity.

Whether training sailors to learn symbolic logic, retarded children how to read or treating museum visitors to a great afternoon, a personalized environment will include: permission for exploration,

- presentation of immediate feedback,
- allowance for self-pacing,
- promotion of discovery, and
- provision for interconnectedness.

The following example shows the responsive features of the personalization principle. A prototype of this illustration can be found on Verbum Interactive: CD-ROM Multimedia Magazine (Dayton, 1991). In a science museum an exhibit might be done on a space theme, e.g. Space Art with Michael Carroll. Great artwork, graphics, and photographs are arranged in a responsive environment on a CD-Rom driven by a computer with ample memory and speed. The user can choose which planet to visit. A smart design gives help when needed and makes navigation easy. In a comfortable position, the visitor may pause to ponder a landscape from Mars or hurriedly go from Pluto to deep space. In the course of visits to planets new insights about landforms and strange physical properties will be presented via digital audio by the artist-scientist-teacher himself, Michael Carroll. These discoveries will be thematic and often related to other facts about space or procedures employed in space travel. Hypermedia and interactivity on a Star Trek leit motif!

Along the journey another goal would be to allow the user to see himself as a space traveler. He could get a sense for the look and feel of being an astronaut. This is the second major component of the Personalization principle: reflexivity. Human beings can conceptualize actions, thoughts, and feelings with objectivity. Self-perception is crucial for evaluation of intellectual or motor progress. Furthermore, the emphasis on reflexivity guarantees relevance. The exhibit is more than a series of abstractions about the space program. What if I was really exploring the solar system right now?

Autotelicity

The museum is the perfect place to develop a responsive environment. The final principle has to do with the choice of a person to participate in our exhibit. Optimal learning requires motivation and choice on the part of the user. Because museums are not compulsory, like schools, they tend to allow autotelic decisions regarding engagement in

available activities. Not all constraints are removed from the museum visitor, there are always ethical boundaries, but a large measure of freedom of choice may be given. When such choice is provided, motivation and enjoyment increase greatly. This sort of motivational set is required to participate with an interactive exhibit--you cant just sit there!

The principles of the responsive environment program--Perspectives, Productivity, Personalization, and Autotelicity--are ideal for hypermedia and interactivity. Based on a Constructivist model, they guide the development of museum exhibits which lead to engagement and enjoyment. Given true and beautiful content, digital equipment will be the tool to deliver a new generation of worthwhile museum experiences. As Bill Atkinson remarked in a recent interview in which he was critical of applications of computers for children as an exclusive answer to the problems of education:

If you're looking at multimdedia as a way to dress up information so it can be more entertaining, thats what multimedia does. And this as a solution to the burning problem (of education) is analogous to high-definition television as a solution to lack of content in television programming. The problem with leaning doesnt have to do with information delivery -- it has to with motivation. And multimedia, even though theres nothing wrong with it -- its great, its wonderful, just like sharper television is wonderful -- draws focus away fromn the real problem. People say, well, we used multimedia to beef up our schools. I think theyre kidding themselves. What I hear about multimedia now sounds to me like people going around in the 70s saying bitmap displays were going to solve all their problems with computers. (Dayton, 1991, p. 2, Look and Feel feature).

We return to Moores fourth folk-model, the referee perspective. Normative judgements about the content and style of a school curriculum or a museum exhibit are an inescapable part of evaluation, regardless of the medium. Judgment of the aesthetic and ethical dimensions of multimedia in the museum will be as important as evaluation of the emotional impact on the participants and the effectiveness of information delivery. It is time to consider carefully the standards by which content and design are critically esteemed.

REFERENCES

Couch, J. & Peterson, A. (1991, February). Multimedia curriculum development: A K-12 campus prepares for the future. *Technological Horizons in Education,* pp. 87-92.

Dayton, L. (1991). Multimedia in education: an interview with Bill Atkinson and Santa Fe Educational Foundation. *Verbum Interactive: CD-ROM Multimedia Magazine*, 1.0.

Duffy, T. & Jonassen, D. (1991). Constructivism: New implications for instructional technology. *Educational Technology,* pp. 7-12.

Gagne, R. M. (1985). *The conditions of learning.* (4th Ed.). NY: Holt, Rhinehart, and Winston.

Moore, O. K. (1952). Nominal definitions of culture. *Philosophy of Science*, 19, pp. 380-388.

Moore, O. K. (1969). Some principles for the design of clarifying environments. In D. Goslin (Ed.), *Handbook of socialization theory and research.* Chicago: Rand-McNally.

Moore, O. K. (1980, February). About talking typewriters, folk models, and discontinuities: a program report on twenty years of research, development, and application. *Educa tional Technology,* pp. 15-27.

Moore, O.K. (1990). Simmel on the ratio of subjective values to objective cultural possibilities. In M. Kaern et al (eds.), *Georg Simmel and contemporary sociology,* pp. 199-224.

Norman, D. (1988). *The psychology of everyday things.* New York: Basic Books.

Skinner, B. F. (1954). The science of learning and the art of teaching. *Harvard Educational Review*, 24, 86-97.

