1994

The brain-based theory of learning and multimedia

Denise Marie Laflamme

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THE BRAIN-BASED THEORY OF LEARNING AND MULTIMEDIA

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education: Instructional Technology

by
Denise Marie Laflamme
March 1994
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2-21-94
Date
ABSTRACT

The Brain-Based Theory of Learning and Multimedia

The brain-based theory of learning, an eclectic theory that incorporates the cognitive and humanistic views, was researched. Multimedia, a technology which supports the principles of brain-based learning, was then selected as the vehicle to present historical material to students. The goals of the current California History/Social Science Framework as well as new California methods of assessment were addressed during the multimedia design process.

This author contributed to the creation of JFK, The Final 100 Hours, a software package currently being designed by students from California State University San Bernardino, as well as by students from Texas and Florida. This author designed the section of the prototype entitled "Issues." This prototype was presented at the National Educational Computing Conference in Dallas, Texas in June, 1992.

The "Issues" section was designed based on the brain-based theory of learning, the goals of the current California History/Social Science Framework, and changes that have taken place in regard to assessment within the state of California.
ACKNOWLEDGMENTS

This project is dedicated to the memory of my grandparents,

Earland and Veronica Brailey

My appreciation goes out to Dr. Rowena Santiago for her guidance throughout this project, and to Bret Knight for his assistance with graphics. Thanks also to Elke Noetzel, who cut down on my commute.

Special thanks to Dr. Susan Cooper, who was there for me in the Fall of 1989 for that introductory computer course. Fortunately she's still here now. I truly appreciate her dedication.
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INTRODUCTION

On July 10, 1987, the California State Board of Education adopted the new History/Social Science Framework for California Public Schools: Kindergarten Through Grade Twelve. With that adoption came a set of curricular goals that differs greatly from those set forth in the past. "The object of the present revision of the history/social science curriculum is to set forth, in an organized way, the knowledge and understanding that our students need to function intelligently now and in the future" (California History/Social Science Framework, 1988).

Some of the goals of the new framework include:
* The correlation of history/social science with other disciplines.
* The importance of studying major historical events and periods in depth as opposed to the superficial skimming of enormous amounts of material.
* The use of new technologies, original source documents, debates, simulations, role playing, or whatever means that will bring the students into close encounters with powerful ideas, great events, major issues, significant trends, and the contributions of important men and women.
* The use of video resources such as video programs and laser discs, computer software, and newly emerging forms of educational technology.

* Print and nonprint materials that present history and geography in a holistic manner, integrated with the humanities and the social sciences.

* Instructional materials that present history as an exciting and fascinating story. Materials that students can read (or view or use) with interest, enthusiasm, and pleasure (1988).

The goals stated above illustrate that the authors of the new framework want history and social science to be more engaging for students. The California History/Social Science Curriculum Committee states, "We hope that, as ambassadors to the next generation, educators are able to use this framework to develop students who have a passion for the subject area" (California History/Social Science Framework Framework, 1988).

Changes have not only taken place in regard to curriculum in California. Methods for assessment are being updated to remain in step with the new curriculum. Dale Carlson (1990), the California Assistant Superintendent of Public Instruction and President of the National Council on Measurement in Education states that achievement testing must
change in order to fully implement the "meaning-centered, 'thinking' curriculum that we have been working hard to move from vision to reality" (1990, p. 1). Hamm and Adams (1991) support this view. They point out that with teaching methods such as whole-language learning, meaningful mathematics, thematic science, and cooperative learning, teachers cannot adequately measure student abilities through the use of multiple choice tests.

Carlson (1990) states that California is moving away from such testing strategies and is instead implementing authentic, performance-based assessment. He points out that hundreds of districts across the state are exploring many forms of alternative assessment. Some examples include open-ended problems, journals, notebooks, lab reports, and portfolios (Hamm & Adams, 1991).

It has been illustrated that the history/social science curriculum and methods of assessment have undergone changes during the past few years. This author has examined these changes and has developed a learning tool that will meet the demands of the new social studies curriculum and methods of assessment.

Multimedia, a form of technology, was chosen as the vehicle for the historical material. Multimedia addresses many of the goals of the new social studies framework. In addition, multimedia was selected because it lends itself to
new methods of assessment such as performanced-based assessment and journal writing.

According to Blanchard and Rottenberg (1990), multimedia is a mixture of technologies controlled by hypertext. Information presented through multimedia is linked in a non-sequential manner. Multimedia may incorporate information from a variety of video and audio sources such as animation, film, graphics, text, still images, music, speech, and newsreels.

Furthermore, Yeager states that, "Multimedia is, in part, about presenting information through more than one of the senses....[It] is about condensing the amount of information and packaging it in a way that makes it more palatable and understandable" (1991, pp. 154-155).

To fulfill the goals of this project, this author chose to contribute to JFK, The Final 100 Hours, a multimedia project presently underway at California State University, San Bernardino. It will chronicle the last one hundred hours of John F. Kennedy's life. This author contributed to the prototype that was presented at the National Educational Computing Conference in Dallas, Texas in June, 1992. Her portion of the project was designed with the new social studies framework goals in mind. New assessment methods were incorporated as well.
The principles of the brain-based theory of teaching and learning were used as a basis for the design. Brain-based learning parallels many of the views of the cognitive theorists as well as the humanistic theorists. These theories will be discussed in depth. The behaviorist views will then be presented as a contrast to brain-based learning. Upon examination of these theories, a knowledge base will be established. This knowledge base will be applied to the project's design, in order to create a product that is educationally valid.
CHAPTER II
LITERATURE REVIEW

This author designed her portion of the JFK, The Final 100 Hours prototype using the principles of brain-based learning. In order that a better understanding of brain-based learning may be reached, several learning theories will be discussed. The beliefs of the cognitive theorists and the humanistic theorists will be detailed first. Brain-based learning incorporates views from both these theories. The behaviorist views will also be discussed so that a contrast may be formed between the behaviorist and brain-based views. Finally, the brain-based theory of teaching and learning will be detailed as will multimedia, the technology used to create JFK, The Final 100 Hours.

THE COGNITIVE THEORISTS

Woolfolk and McCune-Nicolich interpret Jean Piaget's theory of cognitive development as the process of how people make sense of the world by gathering and organizing information. This development takes time, therefore there are limitations on the types of material that can be taught at any given time in a young person's life. According to Piaget's theory, young people develop in accord with their genetic potential. As this occurs, they change their
behavior to adapt to their environment. Such changes lead to a "stable and predictable pattern of changes in cognitive organization and structure" (p. 50).

According to Ginsburg and Opper (1988), Piaget stated that people tend to organize these cognitive structures. These structures are constantly combined and reorganized to become more sophisticated and effective. These changing structures are called schemes. These schemes represent objects, thoughts, or actions in our world. Data from our world are organized into patterns so that we can make sense of what is encountered. For example, a red traffic light has been incorporated into a scheme to represent the need for a vehicle to stop. We are able to make sense of the red light because we have experienced it before and have learned the appropriate action. Included within the same pattern would be the ability to proceed for a green light, and slow to a stop for a yellow traffic light.

New schemes develop through experience and interaction with the environment. Piaget believed that humans constantly attempt to interact more satisfactorily with the environment. Assimilation, one process of adaptation, involves attempting to understand something new by trying to fit it into what is already known. Accommodation refers to completely changing existing schemes in response to a new situation (Mayer, 1987).
Piaget believed that there were four factors that influence development. These are: maturation, experience, social interaction, and equilibration. Maturation refers to biological changes that take place within an individual. Experience involves handling, moving, and thinking about concrete objects, and thinking through processes involving them. Social interaction refers to learning from others. Equilibration is the search for balance or equilibrium (Charles, 1974).

Piaget theorized that humans prefer a state of equilibrium as opposed to disequilibrium. New information is continually assimilated by fitting it into existing schemes. If the new information does not fit, accommodation takes place and schemes change (Mayer, 1987).


**Sensorimotor** (0-2 years)
* Begins to make use of imitation, memory, and thought.
* Begins to recognize that objects do not cease to exist when they are hidden.
* Moves from reflex actions to goal directed activity.
Preoperational (2-7 years)
* Gradual language development and ability to think in symbolic form.
* Able to think operations through logically in one direction.
* Has difficulty seeing another person's point of view.

Concrete Operational (7-11 years)
* Able to solve concrete (hands-on) problems in logical fashion.
* Understands laws of conservation and is able to classify and seriate (order items from large to small).
* Understands reversibility.

Formal Operational (11-15 years)
* Able to solve abstract problems in logical fashion.
* Thinking becomes more scientific.
* Develops concern about social issues, identity.

These four stages are cumulative. Each stage builds on the one that precedes it. In addition, Piaget pointed out that simply knowing a child's age does not guarantee that the child has reached a certain stage of development (Mayer, 1987).
The tradition of cognitive-developmental psychology goes back to the work of John Dewey. Like Piaget, Dewey thought that development occurred sequentially, or in stages (Ozmon & Craver, 1990). Dewey saw the child as an active participant in the learning process. He felt that children learn by doing, "maintaining that we do what we learn and we learn what we do" (Strom & Bernard, 1982, p. 133). Dewey viewed the person as: engaged continually in transactions with the world; sensing problems and opportunities; creating solutions; and acting to reach personal goals (Cronbach, 1977).

In his book Experience & Education, John Dewey described the relationship between teaching—providing students with useful experiences—and learning—the acquisition of knowledge. According to Dewey, "All genuine education comes about through experience" (Dewey, cited in Mayer, 1987, p. 8). Dewey also felt that students should participate in the planning of classroom activities (Cronbach, 1977).

He emphasized the need to make learning relevant to the student's life. According to Dewey, "When primary attention is focused upon subject matter rather than on the contents of the child's own experience, children may, [for example] be able to quote Shakespeare without seeing how Shakespeare's works can inform them about their own lives" (Dewey, cited in Ozmon & Craver, 1990, p. 144).
Jerome Bruner, another cognitive theorist, is probably best known for his contributions to the "discovery method" of teaching and learning. The discovery approach is closely linked to Dewey's emphasis on learning by doing. "Bruner would like to see pupils discover for themselves the principles, relationships, and generalizations that encourage insight and bind concepts together" (Strom & Bernard, 1982, p. 497).

According to Bruner (cited in Mayer, 1987), students learn better when they discover the rules. Learning in such a manner allows the child to organize the material in a meaningful way. For example, telling a child that an insect has three main body parts, six legs, and two antennae is not as effective, according to Bruner, as allowing a child to examine various insects and determine these characteristics himself.

Bruner further states that learning depends on the presence of (1) stimulation or an opportunity for growth, (2) an attitude of play, (3) identification with positive role models, and (4) freedom from excessive drive and anxiety (Bruner, cited in Culross & Jenkins-Friedman, 1988). Bruner also states that "The major activity of all human beings is to extract meaning from their encounters with the world" (Bruner, 1990, p. 345).
Gopnik (1990) illustrated three themes that Bruner emphasizes. The first theme is: Knowing is doing; Knowing is not only doing, it is doing something; and Knowing is doing something with someone else. These themes illustrate Bruner's belief that the child should be actively involved, with other students, in discovery learning.

To continue with the theme of discovery learning, Seymour Papert has made important contributions to this theory. Papert believed in placing children in an environment that allows them to discover and explore on their own. He felt that children are responsible for their own learning and that concepts and skills will be attained through such discovery. Papert "believed in the notion that children learn best when they are constructors of their own knowledge" (Thornburg, 1991, p. 62). Papert advocated the use of the programming language LOGO as a tool to facilitate discovery learning.

One of the features of the LOGO programming language is a "turtle" that moves around on the screen, leaving lines where it goes. The child inputs commands such as "Forward 10 spaces," or "Right 90," (for a 90 degree turn). The child can then create drawings. Once the child creates a drawing, it can then be named and recalled at a later time. "According to Papert, as children explore LOGO, they develop 'powerful ideas' concerning how to solve problems
procedurally" (Mayer, 1987, p. 156). Thornburg (1991) points out that LOGO is a positive addition to the classroom because it lets all children express their ideas regardless of their intelligence level. Martin adds that LOGO "will assist in the development of the child's 'thinking skills' by making him actively react mentally to learning situations. LOGO can in this way be claimed to have across-the-board educational relevance" (1986, p. 9).

To conclude, cognitive theorists believe that there are stages in development. Children who have not attained a higher stage cannot be forced to learn something that they are not yet ready to learn. Also, cognitivists believe that events that are encountered within our world are incorporated into patterns, or schemes. These schemes help us make sense of the world. As illustrated by the methods of Dewey, Bruner, and Papert, "discovery learning," or "learning by doing," is felt to be an effective method of instruction.

In addition, Woolfolk and McCune-Nicolich (1984, p. 195), state that "the cognitive view of learning sees people as active. They initiate the experiences that lead to learning, seek out information, solve problems, rearrange and reorganize what they already know to achieve new learning."

The cognitivists, unlike the behaviorists, feel that people are not passively influenced by environmental events. They believe that "people actively choose, decide, practice,
pay attention, ignore, and make many other responses as they pursue goals" (Woolfolk & McCune-Nicolich, 1984, p. 195). This action on the part of the person is at the heart of the cognitive learning theory.

THE HUMANISTIC THEORY OF LEARNING

Humanistic psychology is linked to cognitive psychology in the way both theories explain how humans learn. According to Strom and Bernard (1982) humanistic theorists believe that people play an active role in the psychological processes. Miller points out that "we are not passive learners or receivers of knowledge, we are active participants in learning pursuits" (cited in Strom & Bernard, 1982, p. 530). This belief parallels that of the cognitivists previously discussed.

The humanists believe that teachers should emphasize the curriculum, but should move beyond the curriculum as well. Humanists emphasize oft-ignored human qualities such as love, creativity, values, ego transcendence, identity, objectivity, and autonomy. These qualities are generally not included in the prescribed curriculum.
Kershenbaum (cited in Strom & Bernard, 1982, p. 518) directed attention to ways educators may emphasize these qualities in the classroom:

* Anticipating lifelong tasks of choice and decision-making by permitting students to make choices in their school lives.
* Devising curricula that are pertinent to the lives of students.
* Emphasizing lifestyle skills such as values clarification, human relations, personal identity, motivation, and responsibilities of students.
* Emphasizing the whole person.
* Focusing on individual felt concerns of students.
* Moving from teachers as instructors to teachers as learners, with students and teachers as partners in learning adventures.

This is not new curriculum to be added, but the reorganization of the methods of delivery of the curriculum. One change educators could make would be to communicate constantly with students. They would thereby discover the students' needs and desires. Strom & Bernard (1982) stress that teachers must become sensitive to the child's world to
communicate effectively. Also, educators should practice active listening so that they focus on their students' needs.

THE BEHAVIORISTS

In direct contrast to the cognitive view of learning, behaviorists consider learning to be a change in behavior or a change in the way a person acts in a particular situation. This change comes about through experience and the interaction of a person with his or her environment. Many behaviorists focus solely on observable behavior and behavioral changes. Concepts such as thinking and emotion are often not discussed because they cannot be observed directly (Woolfolk & McCune-Nicolich, 1984).

One of the earliest behavioral psychologists was Ivan Pavlov. Pavlov devised a number of conditioning experiments to study reflex actions in humans and animals. Pavlov worked with dogs in a laboratory setting. Essentially, he would ring a bell, and then feed the dog. Eventually, the dog began to associate the bell with food. Hence the dog would begin to salivate when the bell was rung. He also used a metronome to achieve the same effects. The bell and metronome are known as a conditioned stimulus. The conditioned response was the salivation. The food was considered the reinforcement. Pavlov also discovered that a
conditioned response could be extinguished when reinforcement was removed.

Another pioneer behaviorist was J. B. Watson. He wanted to convert psychology into an experimental science that would consider objective data. Watson, in one of his most well-known experiments, and against popular view, "argued that he could, by environmental manipulation, turn a normal baby into any kind of person desired--doctor, lawyer, merchant, thief" (Strom & Bernard, 1990, p. 221).

Watson performed a series of experiments to test for instincts in children. Children were expected to instinctively fear such animals as black cats, reptiles, white rats, pigeons, and dogs. He observed no such fear. Therefore, he posed the following question: "How does an infant, who came into the world with practically no fears or instincts of avoidance, become a child who is fearful of so many things just a few years later?" His hypothesis was that such fears are learned through interaction with the environment. He tested his hypothesis by deliberately building up fears in an infant, and then removing those fears (Strom & Bernard, 1982).

At the conclusion of Watson's experiments, he pursued a different aspect of conditioning. He received a grant from the Rockefeller Memorial fund and worked with Mary Cover Jones on a project involving the elimination of children's
fears. The research findings indicated that environmental influences have a great deal to do with shaping behavior (Strom & Bernard, 1982).

E. L. Thorndike believed that anything which exists, exists in some quantity of being measured (Ozmon & Craver, 1990). Thorndike's "reactive" psychology is symbolized by the $S \rightarrow R$ formula. According to this formula, a stimulus acts on an organism to produce a response (Strom & Bernard, 1982).

Thorndike believed that the central theme in education is an externally manipulated change in the learner. He felt that "education" referred to "changes." According to Thorndike, "no one is educated who stays as he was" (cited in Mayer, 1987, p. 8).

Thorndike conducted many experiments to test his "Law of Effect." Essentially, the Law of Effect states that if a behavior is followed by satisfaction, it will be more likely to occur again in the future. If a behavior is followed by discomfort, it is less likely to be repeated (Mayer, 1987).

Thorndike transferred this theory to education. He explained that children will not find satisfaction if teachers choose educational activities that children find annoying. He encouraged noise, movement, play, and freedom in the classroom. In addition, topics that allow students to
share experiences and utilize several senses are recommended (Strom & Bernard, 1982).

B. F. Skinner based his findings on observations and controlled scientific experiment. He advocated the use of extrinsic rewards to immediately reward desired behavior. Extrinsic rewards can be replaced by more intrinsic ones at a later date (Ozmon & Craver, 1990).

According to Ozmon & Craver, "The primary aim of behavioristic techniques is to change behavior and point it in more desirable directions" (1990, p. 214).

Skinner believed that children should know immediately when they are right or wrong. He therefore supported such methods as immediate reinforcement, programmed learning, and teaching machines. Skinner believed in using only positive reinforcement, whereas many behaviorists use negative reinforcement as well (Ozmon & Craver, 1990).

Skinner also advocated the use of the "teaching machine." His teaching machines allowed the child to learn in small steps. He believed that the child should be successful. If a child missed a question or two, he should be allowed to continue. The teacher would remove a child from a program if he was unsuccessful. Skinner emphasized many benefits to using the teaching machine: immediate reinforcement, quality programming, and learning in small steps to avoid failure (Ozmon & Craver, 1990).
Skinner is also known for his work with operant conditioning. His "Skinner Box" was the means used to conduct his experiments. The experiments involved reinforcement. The animals inside the box obtained reinforcement (bits of food) by pressing a lever. There was no stimulus so Skinner termed the conditioning "operant" since the animal operated on its environment (Strom & Bernard, 1982).

Skinner emphasized that "All humans learn those actions that are rewarded" and "Children are conditioned to misbehave when they get attention only if they misbehave obnoxiously" (Strom & Bernard, 1982, pp. 469-470).

In summary, behaviorists believe that learning is a change in behavior. That change must be observable and measurable. In addition, they feel that behavior is determined by the environment. Behaviorists directly contrast with the cognitivists and the humanists. They do not look for internal changes in an individual. As Skinner pointed out,

We need to look outside individuals rather than inside them for a solution to our problems. As long as psychologists continue to look inside, they are misdirecting us. And that could prove quite serious, because I doubt there is anything inside that can really be changed (Skinner, cited in Strom & Bernard, 1982, p. 471).
Brain-based learning theories are founded upon cognitive and humanistic views. One such example is Hart's Proster Theory. To formulate his theory, Hart also researched the neurosciences, anthropology, computer science, information processing, and evolutionary studies (Hart, 1983). Proster Theory defines learning as "the acquisition of useful programs" (Hart, 1978). According to Della Neve (1986), a program is a set of steps required to accomplish a goal.

Nummela and Rosengren subscribe to Hart's Proster Theory. "Prosters" or "program structures" are defined as "a collection of stored programs, related to a particular pattern, such as walking, running, letter recognition, and related concepts" (Hart, cited in Nummela & Rosengren, 1986, p. 50).

Nummela and Rosengren emphasized the need for educators to have a basic understanding of what is happening inside the brain as information is received. First, the student receives external sensory input followed by internal processing. Next, the student attempts to assimilate the input. Thus, "in an attempt to store new information, the brain 'calls up' or matches, compares, and patterns incoming information with similar...factors already stored in an individual's memory" (Nummela & Rosengren, 1986, p. 50). This theory was
described by Piaget, but he used the term "schemes" instead of "prosters."

The authors further stated that "the most effective learning occurs when external sensory input challenges the student's brain to (1) 'call up' the greatest number of appropriate programs, (2) expand an already existing program, and (3) develop new programs" (p. 49).

But how is such learning facilitated? First, educators should create a learning atmosphere that is low in threat (R. N. Caine & G. Caine, 1990; Della Neve, 1985; Hart, 1981). R. N. Caine and G. Caine refer to this as "relaxed alertness," a mental state produced when an environment low in threat and high in challenge is provided.

A second factor that affects the building of effective programs is the exposure of the student to "real-world" situations. Is the material to be learned meaningful to the child? Does it relate to the student's world? Theorists emphasize that "real-life" situations should be a part of the curriculum (Della Neve, 1985; Nummela & Rosengren, 1986). Such examples would include the use of metaphor in the classroom, and the inclusion of field trips that are an integral part of the curriculum (R. N. Caine & G. Caine, 1991).

Moreover, material should be presented in huge quantities. Such input, according to Della Neve, "provides
the raw materials from which students extract patterns. A brain-compatible program should aim for a tenfold increase in input over the conventional classroom" (1986, p. 146).

Hart (1978) also points out that the brain does not always assimilate input in a linear fashion. Therefore, material should be presented in a variety of ways. A positive beginning for educators is to increase the quantity and quality of teaching methods used in the classroom. Such an approach will reach the greatest number of learners. Hart (1978) advocates the use of "self-learning" opportunities, which promote the acquisition of useful programs. R. N. Caine and G. Caine (1991) suggest the implementation of discovery learning. In addition, educators can adopt a holistic approach by integrating the subject areas. As Nummela and Rosengren point out, "the most comprehensive learning includes...the careful orchestration of multidimensional teaching strategies" (1986, p. 49).

Crowell also advocates such approaches. He states that presently,

We have separate subjects, separate skills, separate objectives, separate evaluations, segmented continuums, linear methods, behavioral techniques, and isolated classrooms. These practices are not necessarily wrong, but they are based on assumptions that apply less and less to the new understandings we have of the world. Moreover, they convey to students a world of knowledge unrelated to meaning and a world in which outcome is independent of process (1989, p. 61).
Crowell (1989), believes that brain-based learning is an approach to teaching that will create a more "integrated and cohesive" atmosphere in our schools.

Another concept that brain-based theorists stress is that each brain is unique. There are a variety of learning styles within each classroom of students. A final consideration is that of learning preference. Teachers should make allowances for visual, tactile, and auditory learning preferences (R. N. Caine & G. Caine, 1991).

To conclude, brain-based learning supports the views of the cognitive and humanistic theorists. However, the theory builds on those views to include research from many other fields, including the neurosciences. Proster Theory calls on educators to produce a learning atmosphere that is low in threat and high in challenge, to increase brain input by a factor of ten, and to expose children to real-world learning experiences.

In order to accomplish these goals, educators must increase the quantity and quality of teaching methods used in the classroom. Various teaching strategies have been presented.

In addition, R. N. Caine and G. Caine point out that,

There are signs of an emerging awareness that creating educated human beings is a complex and skillful process, warranting a grasp of how the brain learns. Examples include the California Frameworks in History/Social Science (1988), English/Language
Arts (1988), and Science (1990), which spell out the need to acknowledge information on brain functioning in designing the curriculum....The History/Social Science Framework calls for incorporation of the arts into the social studies classroom and encourages holistic approaches (1991, p. 10).

Framework committees are taking brain-based theory into consideration when designing curriculum. Many of the social studies framework goals aforementioned, such as studying history in depth and the use of holistic approaches, are advocated by brain-based theorists.

Furthermore, new methods of assessment adhere to the brain-based approach. R. N. Caine and G. Caine state that "testing and evaluation have to accommodate creativity and open-endedness" (1991, p. 8). Hart (1983) adds that evidence of learning should be based on performance, not answering questions. These brain-based views complement the new assessment methods listed earlier. California is stressing the use of authentic, performance-based assessment. Such examples include open-ended problems, journals, notebooks, lab reports, and portfolios.

Finally, the views of the brain-based theorists support the use of multimedia, a technology that incorporates the goals of the current California History/Social Science Framework, as well as the new California assessment strategies.
According to McCarthy, interactive multimedia can be defined as "the integration of text, audio, graphics, still image, and moving pictures into a single, computer-controlled, multimedia product" (McCarthy, as cited in Schroeder, 1992, p. 59). A multimedia workstation might include a videodisc player, a CD-ROM player, a scanner, a music synthesizer, and a high resolution monitor, all connected to a computer (Schroeder, 1992).

Schroeder (1992) goes on to state that an interactive multimedia system consists of four components: (1) the information or data system; (2) the software for accessing the information; (3) the hardware or technology; and (4) the communications system needed to connect all these parts. The information or data system include storage media such as laser videodisc and compact disc. The software component includes such programs as Hypercard, Toolbook, Linkway, Quest, Guide, and Notecards.

The hardware component includes such equipment as a CD-ROM player (for compact discs), a videodisc player, an audio digitizer, a video digitizer, and a digital scanner. These are connected to a single computer system.
The communications system consists of networks that connect the hardware to the multimedia databases, in case the equipment is shared among workstations (Schroeder, 1992).

Literature suggests that there are many advantages to teaching with interactive multimedia. Schroeder (1992) and Park (1991) both emphasize the fact "learner control" is a benefit of multimedia. Park states that "the instructional principle of 'learner control' has been an appealing issue in education because of its potential possibility to increase student motivation, to develop self-learning ability, and consequently, to yield the best learning achievement" (1991, p. 27). This control helps to create proactive learners as opposed to passive receptors of knowledge. "The kids, after all, have to take the initiative in following the paths and clicking into the stacks" (McCarthy, 1989, p. 30). This style of learning follows the beliefs of the brain-based theorists, who believe that students are responsible for their own learning. They also feel that when a child must act to initiate learning, the learning becomes more meaningful (R. N. Caine & G. Caine, 1990).

Multimedia also accounts for the need to address different learning styles. D'Ignazio states that multimedia "allows the learner to select information in the format or formats best suited to his/her learning style, ability level, and information needs through one unified system of access."
Lanza stated that multimedia "allows learners to access knowledge from multiple perspectives for various purposes and via different learning strategies" (1991, p. 21). Brain-based theorists stress the need to allow for differences in learning strategies.

Lanza also emphasized that multimedia promotes thinking skills. Roselli (1991) adds to this point by stating that "this kind of learning environment obliges the learner to make decisions continually and to assess constantly his state of progress, forcing him to apply higher-order intellectual powers" (p. 42). Schmuck and Schmuck, as cited in Cummings (1992, p. 9), "suggest that when students are given opportunities to make choices, they will be more likely to perform up to their intellectual capabilities." R. N. Caine and G. Caine, two brain-based theorists, refer to this ability as "active processing" (1990). The child reflects on what has happened and what will happen.

We, as educators, need to give students the opportunity to use multimedia. Students will never learn to assume responsibility if we do not give them opportunities to do so. Access to multimedia presents such an opportunity. Cummings (1992) emphasizes the need for employees who are "critically thinking individuals" and are capable of "self-directed learning." He states that businesses will seek out such individuals. Kelly (1991, p. 380) points out that "we have
been experts at teaching facts; now we need to become expert at helping all students learn how to think." We must begin "educating students of today for the challenges of tomorrow" (Kelly, 1991, p. 380). R. N. Caine and G. Caine stressed that workers will be needed who can govern themselves, who are problem solvers, decision makers, adept negotiators, and thinkers who are at home with open-endedness, flexibility, and resourcefulness. The "learner-control" aspect of multimedia allows children to develop such qualities.

CONCLUSION

Multimedia is a learning tool that supports the brain-based theory of learning and teaching. This theory incorporates many cognitive views, including the belief that people are active learners. They do not passively receive information. Multimedia allows students to act. In fact they must act to progress through the software. Brain-based theorists support meaningful learning. Multimedia is a meaningful technology. It may help prepare a child for the adult world. In addition, this technology permits students to develop "self-learning" strategies, which are advocated by brain-based theorists. Multimedia is also holistic in nature. Students can study a period in history by calling up stories from the time, famous artwork, or original diary
entries. They can write journal entries within the program. They can even study medicinal cures of the time. A wealth of programs is available that covers a wide curricular area. Finally, multimedia accommodates various learning styles. It allows for visual, auditory, and tactile learning strategies.

Multimedia also fulfills many of the goals of the History/Social Science Framework. Multimedia correlates history and social science with other subject areas. As R. N. Caine and G. Caine (1991) pointed out, this framework encourages holistic approaches. Multimedia takes one topic and covers it in depth as opposed to skimming broader time periods. It can present history as an exciting and fascinating story. In addition, the authors of the new framework stress the need for "new technologies, original source documents, debates....or whatever means that will bring the students into close encounters with powerful ideas, great events, major issues, significant trends, and the contributions of important men and women." They also stress the need for laser discs, computer software, and newly emerging forms of educational technologies. These goals are also fulfilled by the use of multimedia.

To conclude, multimedia lends itself to new assessment strategies as opposed to outdated "multiple choice" type
tests. For example, students could demonstrate their knowledge of the subject matter by word-processing journal entries. The journal entries may be stored on a computer disk, then placed in the student's portfolio.
CHAPTER III
STATEMENT OF GOALS AND OBJECTIVES

The primary goal of this project was to develop a multimedia software package based on the brain-based theory of teaching and learning. This eclectic theory was selected since it incorporates both the cognitive and humanistic views. The principles of brain-based learning were utilized as a foundation for the software design.

In order to carry out the goals of this project, a knowledge base was established. First, the cognitive and humanistic learning theories were examined. They were then contrasted with the behaviorist views.

Once this knowledge base was established, the software package was designed according to two objectives. First, the software incorporated the goals of the current California History/Social Science Framework. Second, new California assessment strategies were integrated into the software.
CHAPTER IV
DESIGN OF THE PROJECT

BACKGROUND: JFK, THE FINAL 100 HOURS

This author became involved in the *JFK, The Final 100 Hours* project while enrolled in the Interactive Multimedia class at California State University, San Bernardino during the Spring, 1992 quarter. The leaders of the project, Dr. Susan Cooper, Dr. Rowena Santiago, and Frank Slaton, were seeking Instructional Technology M. A. students to contribute to the project. To qualify for involvement in the project, a statement was required detailing technological experience and expertise. After the candidates were selected, each was assigned to a team. Dr. Cooper led the research team; Frank Slaton led the scanning and audio team; and Dr. Santiago was in charge of design and scripting. The scripting (authoring) was to be prepared in HyperCard, an authoring program designed for the Macintosh computer. This author was assigned to Dr. Santiago's team.

The design and scripting team met to divide tasks. The project would consist of several sections, each to be assigned to a team member. The sections included a mapline (which would detail Kennedy's movements during the one hundred hours), a datebook (which would include an itinerary
of Kennedy's appointments and appearances), a biographical section detailing Kennedy's life, a notebook (where students could take notes), and an "Issues" section describing pertinent issues of the Kennedy administration.

This author chose to work on the "Issues" section. She contacted Frank Slaton, who possessed a copy of the issues to be researched. Only one issue was to be included in the prototype, and "The Peace Corps" was selected.

"ISSUES" - THE STACK

Screen Organization and the Development Process

Figure 1 illustrates the overall design of the "Issues" stack. When students open JFK, The Final 100 Hours, they see a title screen (see Figure 2). There is a "Credits" button that students may click on to view the contributing authors (see Figure 3). Clicking on the "Credits" button a second time will remove the credits. Students may then click on the forward arrow button to proceed to the main menu (see Figure 4). From the main menu students may select any section by clicking on the menu bar. To proceed to the "Issues" section, students click on the "Issues" icon, a question mark. A question mark icon was chosen to indicate that many
Figure 1. JFK, The Final 100 Hours - Organizational Structure of "Issues" Stack.
Figure 2. JFK, The Final 100 Hours - Opening Screen.

Figure 3. JFK, The Final 100 Hours - Credits.
This prototype project was created as a collaborative effort by students and faculty in the MA program in Instructional Technology at CSUSB, the History and Art Departments, CSUSB, as well as students and faculty at Moreno Valley High School, California through the Christopher Columbus Consortium.


Figure 4. JFK, The Final 100 Hours - Main Menu.
of the students' questions about JFK issues would be answered. 

After clicking on the "Issues" button, students arrive at the front page of a newspaper (see Figure 5). The "Issues" section was designed using a newspaper metaphor. The newspaper is entitled "The New Frontier Gazette," named after Kennedy's program for change. The newspaper is appropriately priced for the year it represents. Back issues of newspapers were reviewed to ensure accuracy. The date and volume number were chosen because they fell during the JFK Administration. The front page explains the meaning of "The New Frontier." It also explains that the newspaper covers the issues of the JFK Administration. Students are instructed to click on the topic of their choice in the mini-index.

The photo of Kennedy was included because the design team had access to it. However, we did not yet have permission to use this photo. Therefore, the "Pending Copyright" button was included. This button was not intended to remain in the final program. Upon clicking on the button, relevant copyright information may be viewed. The "copyright team" was to attempt to get rights to use this photo. If they were unable to acquire such rights, a different photo would be inserted. If rights were obtained, the button would be removed.
Covering all of the JFK issues since December 1, 1961

Issues

This newspaper covers all of the issues of the Kennedy Administration. To learn about an issue, click on the topic of your choice in the index.

Index

Domestic Issues
Domestic Personalities
World Issues and Personalities

The New Frontier

Kennedy's Administration was known as "The New Frontier." The President was aware of problems facing the country such as: a lack of food, children suffering, and the cruel treatment of black people. The New Frontier was his name for the changes he would like to see take place in the nation.

Figure 5. JFK, The Final 100 Hours - "Issues" Introduction Screen.
Once students click on the index, they are taken to the "Issues" main menu (see Figure 6). The three topics to be researched were "Domestic Issues," "Domestic Personalities," and "World Issues and Personalities." These topics can be viewed in Figure 5. They were not included in Figure 6 because they detracted from the "newspaper look." Newspapers make use of eye-catching headlines. Therefore, the topics were changed accordingly. "Domestic Issues" became "Kennedy's Top Priority Domestic Issues Announced." "Domestic Personalities" became "Time Magazine Lists Domestic Personalities of Interest." Finally, "World Issues and Personalities" became "In World News."

The screens were designed to promote ease of navigation. There is a left arrow that takes users to the previous card in the stack, a right arrow that goes to the next card, and a "go back" arrow that goes to the card that the user had last used. These three arrows are located in the same section on each card.

The United States Flag was selected because most newspapers contain photos or advertisements on many of their pages. Also, the use of scanned images throughout the stack would allow for the inclusion of multimedia options such as videodisc or CD-ROM. The prototype team was constrained by a RAM limit. Therefore, links to videodisc and CD-ROM were omitted.
## Issues and Personalities of the JFK Administration

<table>
<thead>
<tr>
<th>Domestic Issues Announced</th>
<th>Time Magazine Lists Domestic Personalities of Interest</th>
<th>In World News</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CIA</td>
<td>Lyndon Johnson</td>
<td>Fidel Castro's Cuba</td>
</tr>
<tr>
<td>The Civil Rights Movement</td>
<td>Jacqueline Kennedy</td>
<td>Cuban emigres in the U.S.</td>
</tr>
<tr>
<td>The Economy</td>
<td>Joseph Kennedy</td>
<td>Nikita Kruschev, U.S.S.R.</td>
</tr>
<tr>
<td>The F.B.I. and J. Edgar Hoover</td>
<td>Robert F. Kennedy</td>
<td>The Peace Corps</td>
</tr>
<tr>
<td>NASA and The Space Race</td>
<td>Kennedy's leading Republican rival</td>
<td>The Progression of the Vietnam War</td>
</tr>
<tr>
<td>Organized Crime</td>
<td>Marilyn Monroe</td>
<td></td>
</tr>
<tr>
<td>The Revamping of the Military</td>
<td>Publicity Surrounding the &quot;Rat Pack&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Texas Politics</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 6. JFK, The Final 100 Hours - "Issues" Main Menu.*
The "Peace Corps" button is the only active button on this screen. When students click on "The Peace Corps," they are taken to "The Peace Corps" main menu (see Figure 7). There is a marked difference in this screen's arrangement in comparison to the previous screens. Since this is no longer a "front page," the numbering system has changed. This is page A-2 of the newspaper. It is designed to resemble a newspaper index. It will be noted that both "Kennedy and The Peace Corps" and "The Peace Corps--Defined" are on page A-3. This is due to the fact that they are included on the same screen within the stack.

The main screen for "The Peace Corps" includes a photo of a Peace Corps volunteer (in rear) helping with roof repairs. A link to videodisc could later be added here so students could "see" Peace Corps volunteers in action. The screen design for the newspaper title and date are arranged differently to reflect that this is no longer the first page of a section. Clicking on either "Kennedy and The Peace Corps" or "The Peace Corps--Defined" will take users to page A-3 of the newspaper (see Figure 8).

A portion of JFK's inaugural address was included at this level. These graphics may later be enhanced by a link to CD-ROM containing Kennedy's speech. Students could then hear the speech by clicking on it after the link is created. This
The Peace Corps

Kennedy's Vision of Peace Throughout the World

Index

Kennedy and The Peace Corps A-3
The Peace Corps—Defined A-3
Goals and Functions B-3
History of the Peace Corps B-1
Volunteer Requirements C-1
JFK Editorial Activities D-1

Figure 7. JFK, The Final 100 Hours - "The Peace Corps" Main Menu.

World Freedom?

With the continued spread of Communist influence, and the threat of nuclear war, Kennedy wants Americans to lend a helping hand to aid poor countries to insure freedom throughout the world. So the Peace Corps was formed on March 1, 1961 with the hope that it will bring social and political reform, and help fight poverty.

"...And so, my fellow Americans, ask not what your country can do for you—ask what you can do for your country.

My fellow citizens of the world: ask not what America will do for you, but what together we can do for the freedom of man."

-from JFK's Inaugural Speech

Peace Corps Defined

The Peace Corps consists of men and women who volunteer to work in developing countries.

Figure 8. JFK, The Final 100 Hours - "Kennedy and The Peace Corps."
screen is similar to page A-2 in design. The "go back" arrow icon will return the user to "The Peace Corps" main menu.

Students may select a second item from the index on page A-2, "Goals and Functions" (see Figure 9). The scanned image of the children holding hands was included to represent world peace. This image did not scan in clearly. It was necessary to use a HyperCard function called "FatBits" to adjust the pixels within the image.

Another index topic, the "History of the Peace Corps" (see Figure 10), was formatted as page 1 of the "B" section of the newspaper. The difference is found in the heading. An appropriate font was not found that could generate this italicized version of "History," so the word was scanned and the pixels were adjusted. The "History" article, which explains William James' role in the formation of the Peace Corps is cross-referenced to page B-5.

Since newspapers often do this, the metaphor becomes more realistic and relevant. When users click to cross-reference, they are taken to page B-5, where the article's information is found (see Figure 11). A photo of William James and President Kennedy was added to enhance the information provided. However, the final version of the project may omit the photograph due to its poor quality. Rescanning the image using more memory is one possible
There are three main goals that Peace Corps volunteers try to achieve:

- to help the poor
- to promote world peace
- to help Americans better understand the people of other nations

Before Peace Corps volunteers go to work, a host country must request their presence. After a request for aid, the Corps speaks with the host country's government to determine the skills that the volunteers will need. Many projects that volunteers undertake are designed to raise the standard of living in villages. The Corps works to improve health care, housing, transportation, food production, and other community needs.

Volunteers serve in Africa, Asia, Latin America, and on various islands in the Pacific Ocean.

William James Aims For Peace in 1904

William James was a philosopher who first suggested that a "peace army" be created. After WWII ended in 1945, private groups created international work camps. Other groups sent young Americans to different countries to share their skills.

By 1960, an official government program was desired by Richard L. Neuberger of Oregon and Congressman Henry S. Reuss of Wisconsin. They wanted Congress to create an official "Peace Corps."

Senator John F. Kennedy of Massachusetts used the idea of a Peace Corps during his 1960 presidential campaign. He said, "There is not enough money in all of America to relieve the misery of the under-developed world in a giant and endless soup.

Please see William, B-5.
William
Continued from B-1

kitchen. But there is enough know-how and knowledgeable people to help those nations help themselves."

Peace Corps
Time Line
Kennedy elected - 1960
Peace Corps established - 3/1/61
The first volunteers trained at Rutgers University - 1961

Figure 11. JFK, The Final 100 Hours - "History of The Peace Corps" (continued).
solution, or a new photograph could be included. For the prototype, the photo was included.

The "Volunteer Requirements" screen is on page 1 of section C in the newspaper (see Figure 12). The page is set up as an advertisement. Students are informed that clicking on the forward arrow will take them to the "Classified" section, where they will learn more about how to apply as a Peace Corps volunteer. The "Moon Phases for June" was added as a space filler and for a "newspaper" effect, but does not represent actual moon phases for June, 1961.

The "Classified" section (see Figure 13) was designed to resemble a classified page. The only section of the screen that will react when the student clicks on it is the Peace Corps advertisement. A field detailing more Peace Corps information pops up when students click on the advertisement. To close the field, the students click on it.

The "JFK Editorial" page is on D-1 of the newspaper (see Figures 14 & 15). These activities are included to assess the student's understanding of The Peace Corps. Answers are entered into a notebook (see Figures 16 & 17). Students have access to their notebook at any time while using the JFK program. There is a "pull-down" menu (not visible on these print outs) that grants them access to it. The notebook was created by another member of the prototype team.


Join the Peace Corps!

We're searching for dedicated men and women over the age of 18 who possess the following qualities:

- can learn skills
- can adapt to cultures
different from
- can work well with people their own

* No college training is required.
* Married couples may apply, but both must have skills that are useful to the host country.
* Special consideration given to applicants with experience in agriculture and medicine.

For information on how to apply, turn to the Classified Ads by clicking on the forward arrow.

Moon Phases for June

<table>
<thead>
<tr>
<th>New</th>
<th>First</th>
<th>Full</th>
<th>Last</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1</td>
<td>June 7</td>
<td>June 15</td>
<td>June 21</td>
</tr>
</tbody>
</table>

For information on how to apply, turn to the Classified Ads by clicking on the forward arrow.

Figure 12. JFK, The Final 100 Hours - "Volunteer Requirements" (of The Peace Corps).

Figure 13. JFK, The Final 100 Hours - "Volunteer Requirements" (of The Peace Corps - continued).
If I Were JFK? Who Would You Choose?

Pretend that you are JFK. The date is June 5, 1961. You have started sending Peace Corps volunteers to destinations around the globe. Write an editorial in your notebook. Explain the need for this program to the people of your country. Write with feeling! You want to convince them that this program is vital.

You are screening applications from people who would like to volunteer for work in the Peace Corps. You must make a decision as to who would be the best volunteer for this particular country. Examine the information at the right. Then choose the person you would select and explain your reasoning. Remember, there are no right or wrong answers. Use your notebook to write your response.

<table>
<thead>
<tr>
<th>Country - Ethiopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mary Costillo</td>
</tr>
<tr>
<td>2. Joseph Brunard</td>
</tr>
<tr>
<td>3. Elsie Carter</td>
</tr>
<tr>
<td>4. Carolyn Johnson</td>
</tr>
<tr>
<td>5. John Martel</td>
</tr>
</tbody>
</table>

If I Were JFK? Who Would You Choose?

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</tr>
<tr>
<td>4. Carolyn Johnson</td>
</tr>
<tr>
<td>5. John Martel</td>
</tr>
</tbody>
</table>

*Click on a name for info*
Figure 16. JFK, The Final 100 Hours - "Notebook" Personalization Screen.

Figure 17. JFK, The Final 100 Hours - "Notebook" Screen.
These screens and their organization were designed based on the principles of brain-based learning. In addition, the new social studies framework goals as well as current assessment strategies were considered in the design and development of the stack.

Stack Highlights

"Issues," Brain-based Learning, and the California History/Social Science Framework

The "Issues" section of JFK, The Final 100 Hours incorporates many brain-based principles. First, the stack provides a learning environment that is low in threat. This was accomplished by allowing the students to proceed at their own pace. In addition, ease of navigation was included in the stack design. Arrows that allow the users to go forward and back are in consistent locations on each screen. Students quickly become confident with their use. Customized "pull-down" menus are also included to permit the students to access their personal notebooks, or return to the JFK main menu (see Figure 4). All these features aim to engender a feeling of self-confidence with repeated stack use.

Also, the stack was designed with the intention that the learning environment be meaningful for the users. A
"newspaper" metaphor was used, since this format would be familiar to most students. Newspapers are a part of the students' world, something to which they can relate. Much effort was put forth to ensure that each page was a faithful reproduction of a newspaper section.

Another tenet of brain-based learning is that the students should have access to large amounts of input. Multimedia was created with that goal in mind: to include enormous amounts of material in a compact package without overloading the students with information. Many "Issues" screens allow the user to access further information related to the topic. The "Classified" section (see Figure 13), as well as the "Editorial" page (see Figure 14) are such examples.

Furthermore, the "Issues" section allows the users to develop "self-learning" strategies. This stack has enough options that challenge students to learn how to access information, and to determine a learning path in the order with which they are most comfortable. Multimedia has allowed the stack to be non-linear, a characteristic which brain-based theorists advocate. Hart (1978) stated that the brain does not always process information in a linear fashion.

Holistic approaches are advocated not only by brain-based theorists, but the California History/Social Science Framework Committee as well. The "Issues" stack is holistic
in nature. It incorporates history, reading, written language, and geography.

It covers one area of history, the issues of Kennedy's presidency, in depth. Moreover, students are required to read screen information in order to proceed through the stack. The "Issues" section supports written language by allowing students to take notes from any location within the software. Geography is integrated into the "Editorial" screen (see Figure 14). Users must be familiar with Ethiopia, both its location and culture.

Lastly, the stack responds to the California History/Social Science Framework's call for the use of technology. "Issues," a multimedia stack, is such an example.

"Issues" and New Assessment Strategies

Assessment has changed dramatically in California. No longer is the "multiple-choice" test the accepted norm. It has been replaced by new methods of performanced-based assessment such as journal writing and the use of portfolios. Students must now demonstrate their competence in curricular areas by explaining what they have learned.

The "Issues" stack incorporates such assessment strategies. Students can demonstrate their learning by
proceeding to the "Editorial" page of the "newspaper" (see Figure 14). There they respond to assessment questions that are of the problem-solving type. These questions require that students apply not just the recall of historical facts but an analysis and synthesis of acquired information. This information is then applied to real-life, decision-making situations.

These editorial activities place the students in critical situations. For example, in one activity they take the role of the president. In the second, they screen Peace Corps applicants. What better way to make learning meaningful? The students are required to reflect on what they have learned, and formulate appropriate responses. These responses are written in their "notebook" (see Figures 16 & 17), which is accessed by a "pull-down" menu.

The teacher can give feedback to the students on-line, using the same field in the stack as the students. Hard copy print-outs of the students' responses are also available. Thus, assessment is not limited to the usual "pencil and paper" tests. It extends to using various media that allow students to elicit performance and package their learning in many ways.
Design Limitations

The "Issues" stack was a prototype and thus was designed and developed with full awareness of the possible limitations that technology may bring. The prototype had RAM constraints, as well as hardware limitations, which prevented the design of a complete multimedia package. Links to videodisc, CD-ROM, and video were not included. However, images were scanned into the software so that links could be added at a later date if desired.

Another design limitation is the fact that only the "Peace Corps" menu selection is active (see Figure 6). The scope of this project did not allow for the completion by one person of other issues related to the JFK administration.

CONCLUSION

This author was successful in creating a multimedia prototype that complements the brain-based theory of learning, the goals set forth by the California History/Social Science Framework, and new methods of assessment in California. Hardware limitations did not allow for the inclusion of links to videodisc, CD-ROM, or video, but these could be added at a later date. Instead, efforts were concentrated in guaranteeing a strong, instructional
product by designing and developing a stack that was founded on brain-based learning principles.

An unexpected benefit was the experience of working with a team to create something of such magnitude, and this was quite beneficial. People from Florida, Texas, and California collaborated to create the software. This author had never before worked on something of such grand scale.

Designing a project to be presented at a major conference was quite challenging. The team leaders demanded a product of the highest quality, and team members met the challenge by working diligently. The entire process, from conception to completion, was rewarding, and will aid this author in designing software in the future.
GLOSSARY

active listening - sometimes referred to as attentive listening. Whenever a person is speaking, all other people acknowledge the speaker with full attention and eye contact (Gibbs, 1987).

button - by using a mouse and clicking on a button, the user will cause something to happen. Buttons may have different shapes and characteristics. For example, they may be visible or invisible (Goodman, 1990).

card - contains one piece of information related to the contents of the entire stack (Goodman, 1990).

CD-ROM - compact discs used to store information. CD-ROM stands for "Compact Disc - Read Only Memory" (Bove & Rhodes, 1990).

click - press the mouse.

curriculum - the courses of study offered by an educational institution (The American Heritage Dictionary, 1983)

FatBits - In FatBits, the user can see an area of 64 by 43 pixels. It is as if one area of the screen were magnified. Pixels can be adjusted from white to black or from black to white using the FatBits mode (Goodman, 1990).

field - textual information that changes from card to card in a HyperCard stack exists in fields (Goodman, 1990).

HyperCard - authoring software designed for the Macintosh computer. HyperCard uses a notecard metaphor. HyperCard programs are called stacks. These stacks contain cards. Each card (screen) contains graphics, text, and buttons. Each card is linked to another card (Goodman, 1990).

hypermedia - Hypermedia extends the concept of hypertext to include other media -- graphics, animation, scanned images, voice, sound, music, still video, and full motion video (Van Horn, 1991).

hypertext - information linked in a non-sequential manner (Blanchard & Rottenberg, 1990).
**icon** - an image, figure (Guralnik, 1976).

**link** - connects two cards together (Goodman, 1990).

**monitor** - primary output device for a microcomputer, a videodisc player, and a videotape player (Van Horn, 1991).

**mouse** - an input device controlled by hand. The mouse is connected to the keyboard via the keyboard (Van Horn, 1991).

**multimedia** - a mixture of technologies controlled by hypertext. Multimedia can include information from video and audio sources such as music, text, animation, film, graphics, speech, newsreels, and still images (Blanchard & Rottenberg, 1990).

**pixel** - picture elements, or dots, that show on a computer screen (Goodman, 1990).

**pop field** - a field that appears and disappears by clicking with a mouse (Goodman, 1990).

**portfolio** - a purposeful collection of student work that exhibits the student's efforts, progress and achievements in one or more areas (Paulson, 1991).

**RAM** - (random access memory) - The memory that is used to run applications and perform other necessary tasks when the computer is on. When the computer is turned off, all information in RAM is lost (Microsoft Corporation, 1990).

**scanner** - captures an image from paper (or other sources) and converts the image into digital information (Bove & Rhodes, 1990).

**stack** - a collection of cards. The information is limited to one subject (Goodman, 1990).

**technology** - the knowledge and methods used to create a product (Websters Dictionary of Computer Terms, 1990).
videodisc - the size of a 33 1/3 rpm phonograph record but contains either thirty minutes or one hour of video per side. There are 54,000 frames on each side of a disc. A good player can randomly access any frame in a few seconds. Also referred to as laser disc (Van Horn, 1991).
REFERENCES


HyperCard. [Computer program]. Apple Computer, Inc.


