Section 2. History of Multimedia in Education

1. Introduction

What is multimedia? What is the difference between multiple media and media-mix used in audio-visual education's tradition? This section takes up cases of two historical multimedia examples. Reviewing the difference between the two multimedia examples, the term "multimedia" will be discussed. This discussion will confirm that the currently used term "multimedia" indicates use of computers rather than meaning "multiple media," and that using the term "multiple media" is not so bad.

2. First multimedia materials in the world: *Voyage of the Mimi*

The Voyage of the Mimi is multimedia produced by the Bank Street College of Education in the U.S. The material plan was selected from among applicants in a multimedia development scheme for science/mathematics education by the U.S. Department of Education in 1981. It was completed in 1984, taking 40 months of development and receiving about 7 million dollars of subsidies. It is an adventure story centered around a scientific investigation of whaling and is targeted on students from grades 4-8. It was developed for school use, and is still widely used even today. The materials place importance on "doing science," not merely teaching scientific knowledge. Accordingly, it tries to show the process of scientific exploration and to use scientific approaches. Samuel Gibbon (project chief for mathematics and science education) who directed the production is a former producer of *Sesame Street* (Iiyoshi, 1989; Hamano, 1988).

The Voyage of the Mimi, which is a package of instructional materials combining various educational media effectively, was advertized with the copy "World's First Authentic Multimedia Material" (Hamano, 1988). It consists of a TV drama series as the main media, a TV documentary, a textbook, wall maps, computer software, etc. as shown in Table 3-2.

Table 3-2. Multimedia Components of *Voyage of the Mimi*

[1]	TV drama (13 episodes of 15 minute programs) A sailing boat named "Mimi" makes passage to the North Atlantic Ocean for the purpose of a scientific investigation on whaling. Although the Mimi is shipwrecked on a desert island and other things happened on the way, the adventure ended with a safe return home. The interesting and realistic story context of "biological research on whales" is introduced in order for students to deal with scientific tasks easily. Characters include grandpa captain, a female oceanographer, a female assistant (with hearing disability), a male high school teacher and his female student, Rachel, an African-American high school student called Arthur (good at PCs), and main character, C.T. (male junior high school student; grandson of the captain).
[2]	TV documentary (13 episodes of 10 minute programs) Actors playing Arthur, Rachel, and C.T. visit museums and research laboratories where people are doing interesting scientific work. They give interviews and report on experiments on location. It is a documentary program in the real world, and in one episode, Mary Tanner playing Rachel says, "You may wonder why 15-year-old Rachel is driving a car. I'm Mary Tanner, and actually I'm 20."

[3] Textbook
The textbook explains contents of the TV drama and documentary with various color photographs and pictures. It contains classroom assignments at the same time. There is also a teachers' manual.

[4] Hanging scroll and charts
The materials include wall hangings for classroom use, such as a map, sea chart, and diagram of sea animals.

[5] Computer software (4 items for Apple II)

- Sea chart and navigation
  The software consists of three CDs of "Pirates' Gold", "Hurricane", "Lost at Sea", and a CD for application practice of the above three as a "Rescue Mission." In Pirates' Gold, students search for lumps of gold at the sea bed using a sea chart. In Hurricane, they guide the ship toward the destination island avoiding a hurricane. In Lost at Sea, they rescue the lost ship using identification signals (beacons). In Rescue Mission, students go to rescue a whale trapped in the net of a trawler using what they have learnt in the three above software items.

- The wale and its environment (accompanied by sound, light, and temperature sensor for experiments)
  Connecting various sensors to a PC, which is used as a multipurpose sensor, experiments are carried out. Appliances and software are the same as those used in the TV drama. The students can enjoy the feeling of taking on the roles of the main characters.

- Ecosystem simulation
  It is a game aimed at learning the basics of the ecosystem through simulating a food chain. Selecting four from among 9 kinds of plants and animals living on the land including owls, bears, turkeys, rabbits, caterpillars, and raspberries, so that the selected animals and plants can maintain a sustainable balance. If students are successful, they can go on to try the next 9 kinds of creatures living in ponds. Then, the three characters who have drifted to a desert island where the selected 8 animals and plants are living try to survive maintaining the island's ecosystem. Depending on the selected items, changes in the number of animals and plants on the island are indicated by a graph.

- Introduction to computers
  This includes a game called "Searching for whales," where students operate a ship using commands of the LOGO (a computer language) in order to search for whales, "Turtle Step," in which students move a turtle to let it walk and eat bait, and "Drawing Board," in which students freely draw.

[6] PC communication
An online service host site for PC communication was established in order to support utilization of the *Voyage of the Mimi* and to enable teachers to exchange ideas. Information on open classes using the *Voyage of the Mimi* is also posted on the site.

Saga (1989) reported that there were many enthusiastic responses in the interviews with

teachers who used the *Voyage of the Mimi*. Among the comments are: "It was attractive material for teachers and children." "The materials, which combine the use of videos and computers, were very effective because children liked the both media." "It was the best material in my 18 years of teaching." "It promoted group work such as collaborative work involving several children recording data." "It gave children an opportunity to enjoy science, stimulating their imagination through different yet complementary approaches." "Showing the video twice was effective; firstly for simply letting children enjoy it, and secondly for searching for something specific." "It changed the role of the teacher; the teacher didn't have to face the blackboard, and became a promoter to help children concentrate on what they were interested in. Since *Voyage of the Mimi* was sent first put on the air by public broadcast all over the U.S., it has continuously been utilized by many schools.

3. *Second Voyage of the Mimi* and "Palenque"

The Second Voyage of the Mimi was produced as the second arc of the *Voyage of the Mimi*, which was a great success, during 1985-1987 by Bank Street College of Education. Funds exceeding 10 million dollars were granted by the U.S. Department of Education and the National Science Foundation.

With the TV drama as the key material (12 episodes of 15 minute programs), the "Mimi," chartered by an archeologist for scuba diving in a seabed investigation, visited Palenque, ancient Mayan ruins in the Yucatan Peninsula (Mexico). In the drama, students study Mayan civilization, archeology, and relevant scientific phenomena. Characters of the drama include grandpa captain of the "Mimi," his 13-year-old grandson C.T., a female scuba diver with one leg, Pepper (the daughter of a comrade of the captain; the documentary introduced the actress playing Pepper, actually a member of the US Disabled Ski Team), a female African-American archeologist; Terry, her daughter, Chee, and a male co-researcher, Victor.

Taking over the structure of *Voyage of the Mimi*, *Second Voyage of the Mimi* is produced in the form of a package by integrating various education media effectively. The package consists of a TV drama as the key medium, a documentary, a textbook, wall hanging charts (map of Mexico, Maya ruins chart, etc.) and PC software. One episode introduced the life of a real scuba diver with one leg, her prosthetic leg, and her days until she received an operation. In another documentary episode the research laboratory visited three years ago was re-visited. One of the PC software is called "Sun Lab (Sun Laboratory)," through which students can simulate the movements and relationships of the Sun, the earth, and the moon. The Sun Lab was introduced because the Mayan civilization had excellent astronomical knowledge. Another PC software is called "Maya Math (Maya's Mathematics)," which explores the base-20 number system. With this, students are also able to establish an artificial number system on their own.

At the same time, Video-disc materials called "Palenque" (for IBM-PC) were experimentally produced, funded by a private organization. They are aimed at making an optical disc prototype for children at home. "Palenque" adopted a system in which one-hour animated images can be recorded using a DV-I (Digital Interactive) compression technique in order to build a multimedia database for children to search things of interest. Through this, all animated images, still images, and textual information become retrievable through the PC monitor (Iiyoshi, 1989). Palenque, which starts with an explanation of the software contents and instructions for use, given by the main character C.T. in the TV drama, had functions listed in Table 3-3.

Table 3-3. Major Functions of "Palenque"

- Exploration mode
  Exploration mode is a function which enables children to walk round the virtual Palenque ruins using a joystick (common in PC games). By indicating the place and direction you want to go to or enter, you are able to view 360 degree panoramas, walk around the ruins, and go down the steps inside the ruins. Moving pictures (2,000 sheets are stored) can be shown and you can simulate your visit to the ruins with a realistic feeling.

- Museum mode
  Museum mode presents four rooms, "Map room," "History room," "Maya language room" and "Rain forest room", depending on the theme. Using a mouse, a multimedia database including text data, still images, pictures, movies, sounds, narration, etc. can be retrieved. Data is hierarchically structured.

- Game mode
  Personal effects are scattered around the rooms of the Museum. This game puts them together and forms the original state.

- Simulation tools
  Tools including a camera, album, compass, cassette, and magic flash (with a function to reproduce the building's ancient state) can be used in the museum.

4. What is multimedia? : From the *Voyage-of-the-Mimi* type to "Palenque" type

The term "multimedia" has various meanings depending on the professional domains of users and the context where it is used. As the prefix "multi-" means "more than one," it is easy to understand this part of the word. The problem here is what "media" means.

The word "media" generally means something that links one thing to another, as the word "mediate" imples. It has, however, a wide range of meanings including expressing information, communication means, educational appliance, or mass media. When we regard a means to communicate information for human interaction as media, media in instruction includes blackboards, textbooks, OHPs, TVs, computers, as well as the teacher's voice. Accordingly, it could be said that all everyday instruction that uses at least textbooks, the teacher's voice, and a blackboards is utilizing "multimedia."

The Voyage of the Mimi, which effectively combined various media used in instruction frequently into a package, is a masterpiece in the history of multimedia. In *Instructional Technology: Definition and Domains of the Field* published by the Association for Educational Communications and Technology (AECT) in 1994 (Seels & Richey, 1994), multimedia is referred to "as a collective entity of materials on some different media, or a work designed to be indicated by more than one media" (p.131). Media here means educational appliance/hardware.

On the other hand, media (as an educational appliance/hardware) used in the "Palenque" is only a computer. It is material with which a child directly uses a computer and learns things. The material is regarded as simulation type CAI software. By applying digital technology, it

made possible to deal with sounds, graphics, animated images, and still images, in addition to texts and numerical data the computers have long used, in an integrated manner. This is called "multimedia" in the sense that it uses more than one form of expressing information (media). *Educational Technology Handbook* (Hackbarth, 1996) defines multimedia as "a collection of related audio and graphic information on a magnetic disc or CD-ROM to which accessing in any order is enabled by interactive computer technology" (p.301).

In this case, all types of information are digitalized and presented by the PC. The media used is only one computer from the perspective of *Voyage of the Mimi*. It should be noted that "Palenque" is called multimedia because multimedia is virtually integrated into a single PC, although the educational appliance/hardware is pulled together into single PC (unification of media). When the term multimedia is used in the IT industry, it has this Palenque-type meaning. When unification of communication services responding to multimedia through digitalization and packetization (ISDN, etc.) is mentioned in the communication industry, the word multimedia also has the Palenque-type meaning.

In audio-visual education tradition in schools, an effect by superimposing messages is sometimes called media-mix (in the original meaning, it is rather appropriate to call it message mix). In broadcasting/communication/publication industries, digitalizing information prepared for one mass media and used for another media (for example, publishing a book using images originally prepared for a broadcast program) is called media-mix.

5. Multimedia materials after *Voyage of the Mimi*

The relationship between the development of multimedia materials and element technology supporting them is illustrated in Figure 3-10 using examples from Gayeski's summary (Gayeski, 1996) among others. In the flow of audio-visual education, there were multimedia, or materials adopting more than one media which had been thought of and used before the educational use of computers. *Voyage of the Mimi* was a work involving computers as one of the multiple media used in the package.

As a separate flow, programmed learning that attached importance to interaction has been implemented since the 1960's. The programmed learning was then linked by computer technology which enables random access, and developed into Computer-Assisted Instruction (CAI) in the 1970's. Multimedia progressed in the IT industry, and interactive video disc materials came into the world in the 1980's. Popularization of digital technology and the built-in CD-ROM helped a lot in producing contemporary multimedia materials. As the pioneering material which foresaw the development of this flow, "Palenque" was completed in 1987.

Regarding pioneering efforts in Japan, the Japan Audio-Visual Education Association (JAVEA) developed *Bunkyo Bungaku Kan* (Bunkyo Literature House) in FY 1988/1989 subsidized by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The virtual museum was created by combining the existing digitalized educational films on video discs as a key material and 814 virtual cards of added information on the computer as the database. Those cards include information in the form of texts, maps, illustrations, sounds, etc. *Bunkyo Bungaku Kan* established the pro forma of multimedia research and development. In the 3rd and 4th year of the research, it led to the development of *Hyper Science Cube* (JAVEA, 1989-1991). This research, trying to reproduce the educational films accumulated in the past, intends to make Palenque-type materials.

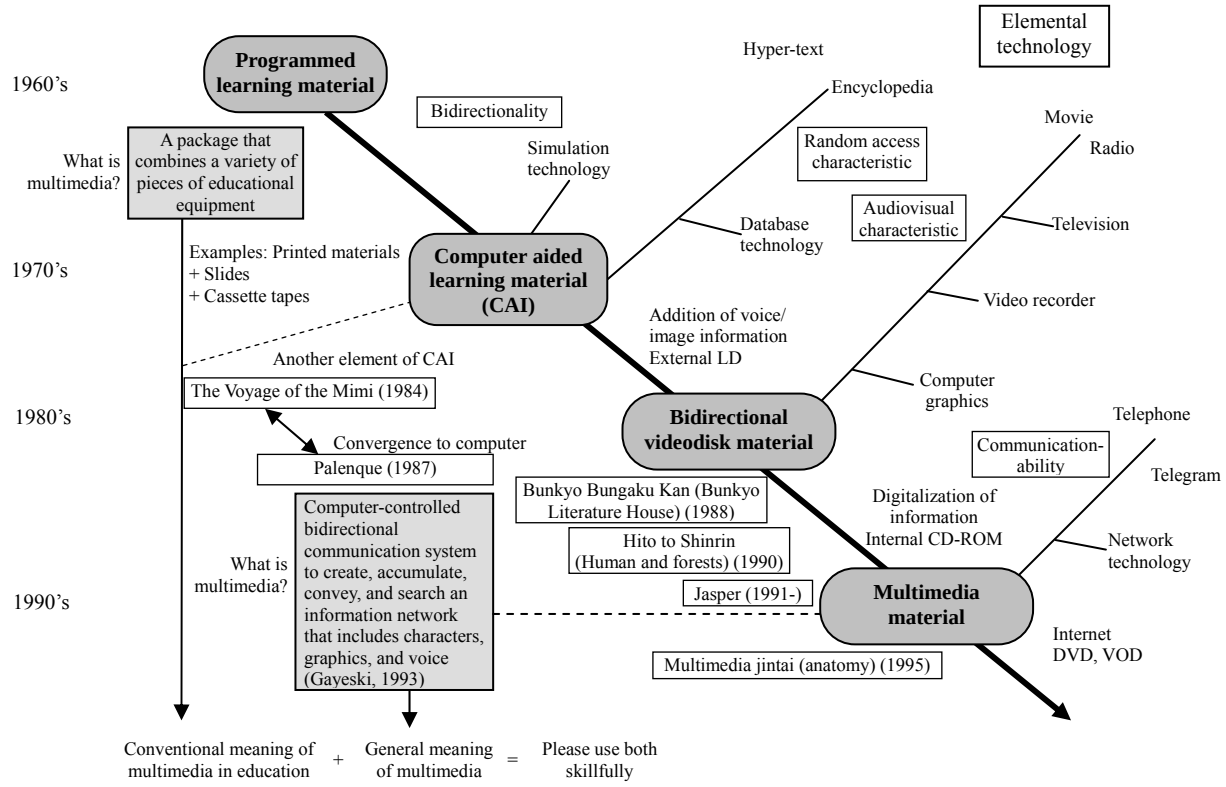

Figure 3-10. Flow of Multimedia and Development of Elemental Technology

In the 1990's, the School Broadcasting Program Department of NHK and Apple Computer Japan collaborated in a test production of *Hito to Shinrin* (humans and forests). The material consists of a high-definition TV (HDTV) program as the main part, a textbook published through digital printing using HDTV images and a multimedia learning system enabling partial viewing of the program and retrieval of related library shots (Hibi, 1990). The *Hito to Shinrin*, which is a *Voyage of the Mimi*-type material, tried to incorporate functions to support the delivery of multimedia information from children. Adopting a touch-sensitive PC display, the material prepared a function that leaves lines made as a child traces the part of the screen image to be emphasized, and a function with which children are able to produce their own multimedia reports, adding video images and photographs they took by themselves to the provided still images and videos. Practical researches to utilize the *Hito to Shinrin* were also actively carried out (Kihara and Mizukoshi, 1992).

In the U.S., influential materials corresponding to that of the *Voyage of the Mimi* have not emerged yet. However, many multimedia have been developed. Among them, arithmetic materials, *The Adventure of Jasper Woodbury* series, developed by the Vanderbilt University have drawn attention as a new attempt based on a constructivist approach to learning (Suzuki, 1995b). *The Jasper*, a set of video disc material, has been developed with funds from the National Science Foundation since FY 1991. As of 1996, five series of two video disc packages have been on sale. In *the Japer* series, children in a group take the place of the hero of the adventure story to solve the problems requiring arithmetical skills. Research outcomes with rich suggestions of multimedia utilization in the future have been published one after another. Among the suggestions are: various efforts to support children's exploratory learning activities, advice to teachers who indirectly support children, utilization of the material as the

core of cross-subject and comprehensive learning that develops areas from arithmetic solution scenes to social and scientific content.

Among the materials recently developed in Japan, *Multimedia Jintai* (multimedia anatomy) is worth noting. It was announced in 1996, and was created by converting an NHK special TV program, *Prodigious Microcosm: Human Body*, into CD-ROM data. It is a compilation of four-year's worth of research outcomes utilizing abundant CG data by the research & development team consisting of various members. It is on sale as a package of two CD-ROMs, and receiving a lot of praise. One of the CD-ROMs, called "Rescue Da Vinci," includes five kinds of navigation games in themes of human cells, organs, a coordination system, health maintenance and disease diagnosis. The other CD-ROM, "Documents of Da Vinci," is an encyclopedia with a function to support children's distinctive ways of retrieval, understanding, and communication of information. In addition to the work itself, a book entitled *Multimedia Design Theory* (Iiyoshi and Kikue, 1996), which introduces the development process and concept of the work, give us a lot of insights.

6. Multimedia in the future

Multimedia which has evolved from the *Voyage of the Mimi* type to the "Palenque" type is now entering a new phase. Integration into computers is accelerated year by year due to the advancement of high-speed processing computers and digital technology. On the other hand, the boundary between what is true multimedia and what is quasi multimedia is becoming obscure.

Kubo (1996) points out from a computer perspective that quasi-regression phenomena from multimedia "Palenque" back to the *Voyage of the Mimi* has been seen.

> The word "multimedia" was originally used to indicate a technology dealing with more than one mode of media, such as texts, sounds, images, etc. at the same time. However, computers came to play the roles of various media: newspapers, magazines, photographs, films, radio, TV, and even the telephones. Thus, the computer itself has become more than one medium, or maybe multimedia. (Kubo, 1996; p.204-205)

Compared with the *Voyage of the Mimi*, from a technical perspective, "Palenque" is far more advanced. In addition, the word "multimedia" is usually associated with "Palenque." Standard PCs came to have an internal CD-ROM drive. Prices of CD-ROM writers, by which users can create their own CD-ROMs, have become affordable. DVDs (digital video disc), which draw attention as digital recording media of the coming generation, replacing CD-ROMs, has been commercialized. In the future, digitalized multimedia data will be available in various forms. Accordingly digitalization will make the transmission of information from classrooms easier. It is important to explore ways to utilize this environmental change.

On the other hand, we should recall that the *Voyage of the Mimi* was developed for classroom use, and "Palenque" for use at home. We have to note, for example, that the existence of media to communicate the "voice of a teacher," or roles of a teacher other than those replaced by media have a considerable affect on learning. It is a hasty conclusion from an educational perspective to think that the use of "multimedia" as meaning the use of more than one traditional appliance/hardware is out of date, even though the word "multimedia" sensationally used today means integration into the computer utilizing digital technology. As

is clearly shown by the education practices in which the *Voyage of the Mimi*, which was completed 15 years ago, is still currently used, we should learn that new things are always almighty.

Kikue, who developed *Multimedia Jintai* (multimedia anatomy) as the director of TV program, compared TV program production with multimedia production. He pointed out that TV a director is like street venders who show things and tell stories attracting audiences and try not to loose their interest , while a multimedia producer is like the manager of a supermarket.

> A supermarket does not tell customers to buy this and that. It is the customer who decides what to buy. What the manager of the supermarket does is prepare various things that customers might want to buy, and lay them out so that customers can easily select what they want. In other words, the customer decides the scenario, and the manager thinks how to lay out the alternatives. That is "directing" in multimedia production, if you call it "directing." (Iiyoshi and Kikue, 1996; p.57)

If the use of multimedia indicates that "users can select and control information provided" (Tway, 1995; p.2), roles of teachers in instruction would correspond to that of "directing" in multimedia production, and so teachers would become supermarket managers, who try their luck by selection of goods, rather than street venders who tell stories attracting students by their narrative power.
