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EDITORIAL

Providing educational access to underserved populations continues to be one of the primary functions of distance education programs. This issue of DEOSNEWS describes how a branch campus of the University of Alaska is using a multimedia approach to deliver biology courses to the place-bound residents of rural Alaskan villages. Dennis Schall discusses the development of a HyperCard-based biology course and of a supporting laserdisc designed to be contextually relevant for the Eskimos of southwestern Alaska.

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TEACHING BIOLOGY BY HYPERCARD

Dennis Schall

University of Alaska Fairbanks

Kuskokwim Campus

P.O. Box 368

Bethel, Alaska 99559

ffdgs1@aurora.alaska.edu

INTRODUCTION: THE UNIVERSITY OF ALASKA FAIRBANKS

The University of Alaska Fairbanks with its five branch campuses serves a geographic area as large as Texas. This rural area consists of most of the state outside the Anchorage, Fairbanks, and Juneau

areas. The Kuskokwim Campus, located in Bethel, is one of the branch campuses and serves the Yukon-Kuskokwim Delta region in southwestern Alaska.

The School of Education and College of Rural Alaska are two units of the University of Alaska Fairbanks. The mission of the School of Education and College of Rural Alaska, in part, is to provide access to a bachelor's of education degree for students in rural areas of Alaska. The Kuskokwim Campus (KUC) has a specific commitment to provide quality distance-delivered courses to meet the educational needs of the region. The university takes a leading role in the development and utilization of distance-delivery technology and participates in regional and statewide distance education programs. The audioconference program at KUC delivers approximately 50 developmental through graduate level courses each semester through the telephone lines.

THE CONTEXT

The majority of the students we serve live in remote villages in rural Alaska with limited or no access to the traditional university campus with its face-to-face teacher-student classroom. In the villages outside of Bethel, Yup'ik Eskimos and Athabascan Indians make up well over 90 percent of the population. In many of the villages, English is the second language. This is especially the case in the coastal Yup'ik villages, where many of the elders cannot read or write English.

The Yukon-Kuskokwim Delta region, a treeless tundra

encompassing an area equivalent to the state of Oregon, is located in southwestern Alaska. Yup'ik Eskimos and Athabaskan Indians make up about 85 percent of the 20,000 residents of the Delta. This population resides in about 55 villages of 50 to 850 people each. It is without doubt one of the most traditional Native American enclaves in the United States. Most of the residents live a traditional subsistence lifestyle of hunting, fishing, and gathering, and over 30 percent of the residents have cash incomes well below the federal poverty level. The Yup'ik language is spoken by a vast majority of the residents, especially those residing in villages outside of Bethel. Bethel, with a population of over 5,000 with half Native and half non-Native, is the metropolitan city of the region. The local TV station, KYUK TV, broadcasts news and other programs in Yup'ik Eskimo. There are virtually no roads in the region, and Bethel is the service hub for the region. Travel in the region is by small bush plane year round, snowmobiles (snowgos) in winter, and by boats on the rivers during the short warm season.

Communications in the region is limited and expensive. The U.S. mail delivery is entirely by small plane, weather permitting, to villages of the region. All telephone calls between the villages and to the rest of the world are long-distance by satellite and are costly.

The Yukon-Kuskokwim Delta has a high-school graduate rate of 46 percent for individuals over 25 years of age. This compares to a graduation rate of 82 percent for Bristol Bay, 56.4 percent for Dillingham, and 77 percent in the Aleutians. The annual cost of

providing a high-school education to students in the region is over $13,000 per student per year. These statistics are alarming.

The university is able to distance-deliver most of its curriculum, including education courses, to meet the requirements of its B.Ed. degree. The distance delivery of these courses includes audioconference courses and some correspondence courses. However, the core curriculum for the bachelor's degree requires eight credits in two laboratory science courses. It is this science laboratory requirement that is the greatest barrier to rural Alaska students obtaining their degree. For many reasons, residents of the Delta are place-bound to their rural villages and prefer not to move to a small city such as Anchorage or Fairbanks for a traditional college education.

It is in this context that I have attempted to design, develop, and distance deliver a general biology laboratory science course for all residents of rural Alaska, especially the Yukon-Kuskokwim Delta region.

THE GENERAL BIOLOGY COURSE

During the 1990À91 school year, I learned HyperCard and HyperTalk as a way of developing digital instruction. At the time, HyperCard was one of the few applications that were genuinely multimedia (Hutchings, Hall, & Thorogood, 1994). It was relatively easy to incorporate sounds and graphics into the stacks. Within a few months, HyperCard supported QuickTime (TM) movies. HyperCard's ability to link text, fields, graphics, sounds, cards, and

other stacks in a nonlinear fashion provided the learner with a new level of control over the instructional material. This control is limited only by the instructional design. In addition, HyperCard can also be designed to control a laserdisc player for quality visuals.

The course was general biology (Biol. 103, Biology and Society), which fulfilled a core requirement in the curriculum. The initial course consisted of 11 HyperCard stacks. A "program" stack presented an overview of the HyperCard course, directions on how to use the stacks, and a main menu card that was linked to each of the 10 major topic stacks. The 10 major topic stacks were: (1) Biology Introduction, (2) Foundation of Life, (3) Organic Chemistry, (4) Cell Structure and Function, (5) Enzymes, (6) Biochemical Pathways, (7) DNA and Protein Synthesis, (8) Mitosis: Cell Copying Process, (9) Meiosis: Sex Cell Formation, and (10) Mendelian Genetics.

All 10 instructional stacks were designed with as much consistency as possible. The first card was a title card, the second card contained the learning objectives of that particular stack, the third card contained a specific textbook reading assignment that corresponded to the HyperCard stack content, and the fourth card contained an assignment of several questions. The fifth card was the main menu. The main content of each stack was between the main menu card and the last card, which contained the vocabulary.

The main menu card showed the content topics of each stack. Selecting or clicking on any topic took you directly to the content

cards of that topic. The last card of each stack was a glossary card with relevant vocabulary and definitions. The buttons at the bottom of the main menu card were found on all cards. These buttons let the learner determine where they wanted to go, and were an addition to the forward and reverse arrows found on most cards. These buttons linked the cards and their information in a network or web fashion. The HyperCard stacks contained many of the design features that HyperCard and other multimedia applications incorporate. This version of HyperCard did not support color. Some animation was used, and the text was limited, with lots of graphics, diagrams, and pictures. Selected terms and vocabulary were linked to the glossary as hypertext. Sound was used very selectively due to its memory requirements, but some difficult terms were pronounced. Extensive use was made of pop-up fields for additional information without cluttering individual cards. Most molecular terms such as glucose, ATP, or pyruvic acid were linked to cards that showed their molecular structure.

HOW IT WAS USED

In the past three years, these stacks have been used in a limited manner. This limited use has hindered quality analysis of their effectiveness as instructional material. The initial use of these stacks was on a trial basis just after they were developed. The initial users were seven students scattered in rural Alaska. The stacks served as the main instructional format for the course content. Audioconferences of an hour and a half per week served for

discussion of the readings, HyperCard stacks, and laboratories. The laboratories were self-contained in a kit that I developed and designed to complement the HyperCard stacks.

The HyperCard stacks were used a second time as a tutorial supplement to a traditional on-campus course in Bethel. The stacks were placed on several Macintosh (TM) computers in a computer laboratory and in a student study area. The students were required to do the assignment questions for each stack and turn them in. They were free to use the stacks on their own schedule and time as supplemental instruction to the traditional lecture.

The third use of the biology HyperCard stacks was in a format similar to the first time. The course was sent to 10 students, with 9 finishing the course. The stacks had undergone considerable revision, editing, and expansion of some content. The laboratory kits also were used with very little revision.

The biology course syllabus, laboratory kit, textbook, and HyperCard stacks were sent to the students at the beginning of the semester. The HyperCard stacks were on five 800K disks. The students were required to have access to and working knowledge of a Macintosh computer with the application Hypercard.

Two different versions of the biology HyperCard stacks were developed. These were identical in content; however, one version (version LD) had laserdisc driver resources in it. This allowed the user to set up and select one of several types of laserdisc players. Buttons on the cards selected the specific relevant material on the

laserdisc. This arrangement required the student to have a laserdisc player and Macintosh serial port cable. In this setup the HyperCard stack (on the Macintosh) had complete control over the laserdisc display, and the student only had to observe the video.

The laserdisc (CAV format) was developed in-house by the author and a colleague, Dr. Barry Sponder. The title was ™ Yup'ik Science,ú and it contained many still frames of flora, fauna, habitat, and environmental phenomena of southwestern Alaska. Video segments of many of the Yup'ik Eskimos from KYUK TV were included, along with transmission and some electron microscope images. The laserdisc contained a total of 18 minutes of motion and still video.

The author scripted the biology HyperCard stacks for specific laserdisc frames or motion segments that were contextually relevant to the content. Some of the cards would display a certain laserdisc frame number when the card was opened. Specific words would be bold text or have an asterisk to indicate that they were linked text. This allowed the stacks to be designed so that certain images were shown regardless and other images were viewed only when the student chose to select (click) on the text. For example, various cellular organelles (the mitochondrion) on the HyperCard stack would display electron micrographs of that specific organelle when selected. In another example, the HyperCard content was about lipids and membranes and the corresponding laserdisc material showed some segments of seals being skinned and the layer of fat being removed.

This combination of biology HyperCard stacks and Yup'ik Science laserdisc has not been used in a distance education context since the laserdisc was produced. The author has not taught the distance delivery version of the Biology 103 course, and very few students have access to a laserdisc player. Some of the local school districts have the equipment, but access remains the issue for our rural students.

Dr. Barry Willis, director of Statewide Distance Education, University of Alaska (Willis, 1992) provided valuable formative evaluation feedback of the HyperCard stacks during their development. Nick Eastmond from Utah State University, an expert in instructional design, conducted a positive summative evaluation of the Yup'ik Science laserdisc when it was completed.

Even with carefully chosen words, it is difficult to describe the look, feel, sound, and interactivity of the biology HyperCard stacks. If one believes the old adage that a picture is worth a thousand words, then the biology HyperCard stacks say much and the additional digital laserdisc images say even more.

This type of multimedia instructional material and associated technology have opened the doors to new paradigms of teaching and learning experiences. The HyperCard stacks provide sounds for auditory input, especially for some of the more difficult and less familiar terms such as "mitochondria," "phospholipid," and "endoplasmic reticulum." It allows repetition in that certain sounds, animations, or graphics can be heard or viewed many times. It

provides for learner control so that the learner can interact with the content in a nonlinear fashion. But most important, this type of instruction frees students from the time and place constraints of our traditional learning mode. Students can use the material at 2:30 a.m. if they wish. They can use it for 20 minutes at a time or three hours. It is their choice; their learning is not limited to a specific instructor, in a given classroom, at a specified time.

STUDENT ASSESSMENT

The HyperCard stacks were evaluated by biology students in two on-campus courses, first in the fall of 1992 and again in the fall of 1995. Both were small classes of 12 to 15 students. The HyperCard stacks were used by an audioconference biology class in the spring of 1991 and evaluated by the students. One audioconference student who lived in the interior of Alaska worked three-week shifts on an oil drilling platform in Cook Inlet. He thought the flexibility and freedom of the course structure was great. Dr. Barry Willis, an expert in distance delivery and assessment, also evaluated the HyperCard stacks and provided valuable formative assessment during the final development phase.

Students were asked to identify the three general weakness of the HyperCard program on the assessment. The main weakness noted was the need for computer and HyperCard skills and knowledge. Other weaknesses were the need for an exit button, more animation, and some type of stack map or layout card.

The general strengths of the HyperCard program were clear, concise

explanations, nice graphics, and animation. The organization of and logical progression through the content was good. The button links and navigation through the content were not confusing. The glossary was convenient but of minor importance to the majority of the students. One interesting comment was that the stacks "didn't overuse the technology." There was very little value placed on the ability to go back for unlimited review of the material on the student's own time schedule.

Generally, it was felt that the HyperCard stacks were not a complete course and would be a great supplement. A textbook and reading assignments should definitely be used with the HyperCard stacks. The main things that students would change about the program would be to have more audio and graphics, and to incorporate more topics.

THE YUP'IK SCIENCE LASERDISC

The laserdisc was developed, designed, and produced with a grant from the U.S. Department of Education. The purpose in producing the laserdisc was to develop visual materials that were contextually relevant for the Eskimos of southwestern Alaska. It was designed so that the visual material could be adapted for use at levels from kindergarten through college. The laserdisc is a combination of video clips and still images in the CAV format where each frame can be accessed and displayed. The laserdisc contains many slides of birds, mammals, fish, plants, and environmental phenomena of Alaska. There are many video segments of Yup'ik Eskimo activities,

demonstrating the technology and science that have traditionally been part of their everyday lives, and there are graphics of villages, runways, transportation mechanisms, and recreation. In addition, a microscope with a video camera was used to produce many histology slides of protista, bacteria, and types of cells. Electron micrographs of cellular organelles were also included.

This laserdisc represents digital data that is stored permanently on the disc. This digital material can now be reused in HyperCard stacks as graphics or QuickTime movies and distributed in any of the formats described above without worry of copyright infringement.

THE FUTURE

The laboratory exercises present obstacles and barriers similar to those described by Naber and LeBlanc (1994) and Koshy, Bonata, and Faasalaina (1994). They require considerable time to develop, and the laboratory kits included a number of chemicals that are difficult to transport or ship because of current regulations. They also present a potential danger to the student using them and to family members or friends who may be associated with the student. Safety is always a concern in this situation. Additionally, chemicals degrade and make the kits useless over time. The laboratories require a disproportionate amount of detailed instructions, because there is no instructor close by to answer questions. Cost is also a problem. The materials had to be cheap and most of the kit had to be disposable. Microscopes, spectrophotometers, and other costly

laboratory equipment are just not available to the students.

A digital Protista Laboratory was developed as a self-contained laboratory with all the microscopic images and many QuickTime movies. This was also HyperCard-based, but with all video and images it consumed more than 20 megabytes of space. This memory requirement overwhelms our current ability to package and distribute digital material in rural Alaska. However, there are possible solutions available.

The fundamental solution to providing biology distance-delivered to rural Alaska students is to have everything developed in digital form. With the course as digital data, many options for distribution are possible. It would be possible to send the entire course content to students on a hard disk with enough megabytes to hold all the material. Students would simply return the hard disk when they finish the course. Another possibility would be to upload and download the digital course with the appropriate technology such as a satellite and conduit equipment or through the use of a bulletin board service such as FirstClass. Both of these require that specific equipment be in the hands of the students. The University of Alaska Computer Network (UACN) could provide text transfer to students with modem connections who were willing to pay toll charges to slowly download files from the university system, but the transfer of sound, graphic, and video data is not a reality with the current UACN system. The sounds, graphics, and video are the characteristics that gives the biology HyperCard its multimedia

format.

A major revision of the program is now in progress to design, develop, and produce the biology HyperCard stacks on CD-ROM. The stacks are being redesigned to address the weaknesses indicated by the assessment. More sound will be incorporated into the stacks, more graphics added, and appropriate images from the Yup'ik laserdisc and other video sources will be included. Additional topics will be developed and added. The CD-ROM could hold far more data than necessary for the entire course, including laboratories, and could easily be distributed to the students (Miller & Hamilton, 1992). This would require that students have access to a computer with a CD-ROM drive, a reasonable requirement since CD-ROM drives are standard components of most computer systems today. The CD-ROM will provide the necessary memory for sound, color graphics, and QuickTime movie clips, which was limited by the floppy disk format. HyperCard 2.3 will be used in the redesign of the stacks. This version of HyperCard will make the incorporation of sound, graphics and video into the stacks much easier than in past versions. A FirstClass (TM) bulletin board service and audioconferences could provide for additional interaction, feedback and, most importantly, assessment (Koshy, Bonata, and Faasalaina, 1994).

The University of Alaska Fairbanks School of Education has committed resources to facilitate this project. The delivery of laboratory science courses has been a major barrier to rural Alaska

students in the B.Ed. programs.

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