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EDITORIAL

The increasing availability of telecommunications technologies provides opportunities for educators in elementary and secondary schools to explore new ways to enhance learning, satisfy content area standards, and deliver education to underserved populations. The "Best Practices in K-12 Distance Education" conference, hosted by the American Center for the Study of Distance Education and the College of Education at Penn State, was held in State College, Pennsylvania, April 13-14, 1997, to encourage further discussion about the issues related to teaching, learning, and administration of distance education in the schools.

The goal of the conference was to provide a broad overview of elementary and secondary distance education initiatives in various school settings across the United States. The programs highlighted during this two-day conference represent a wide range of delivery methods and technologies -- from low-cost audio to fiber optics -- used to serve students in rural and urban schools, special student populations, as well as teacher training projects for K-12 professionals. In addition to providing background information for the projects, each presentation focused on several issues, including: planning and implementation, barriers and successes, learning outcomes, and future plans.

The current widespread growth of distance education has caused a resurgence of discussion on topics basic to the field, including classroom content, the use of technology, and the role of the instructor. The issues highlighted in this conference of two years ago continue to be relevant and important to today's distance education environment. The broad range of program descriptions presented at the conference can serve as points of reference to educators internationally at all stages.

This issue of DEOSNEWS offers the first in a series of papers presented at the "Best Practices in K-12 Distance Education" conference. Michael Sullivan describes Algebra Across the Wire (AATW), a distance education algebra course for high school students offered through the University of Texas Migrant Student Program. The course uses low-cost audioconferencing to provide education to migrant students in Texas. Later issues of DEOSNEWS will feature other programs presented at the conference.

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INCREASING MIGRANT STUDENTS' ALGEBRA SKILLS WITH AUDIOCONFERENCING

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BACKGROUND

Purpose of the Program

Children of migrant farm workers face numerous obstacles in pursuing their education. One obvious problem is the seasonal nature of the agricultural industry. Each year, migrant farm labor families in South Texas begin leaving the region as early as the end of March, returning sometimes as late as the end of October. This prolonged period of absence from school makes completion of a high school education very difficult for children in migrant families.

Arguably the biggest curricular obstacle to migrant students' completing their high school course load is algebra, a prerequisite for graduation in Texas schools and a course which does not lend itself well to students' being absent for a portion of the school year.

Another difficulty facing these students is the nature of the algebra class. Traditionally, the teacher provides a lecture, punctuated by examples, to illustrate both the conceptual knowledge and procedural skills of algebra. This teacher-centered, lecture method as a means of delivering instruction discourages the students from any significant interaction with the teacher. Students tend to adopt a passive role in their own learning, attempting to make sense out of sometimes highly abstract content through the students' listening skills and their note taking abilities.

Students' difficulties with algebra class are further compounded when students are not native English speakers, but English is the language of the classroom instruction. Students are then wrestling with the mathematical content, the vocabulary of the mathematical materials, and the linguistics difficulties that English as a second language (ESL) students consistently experience in an English-based classroom.

For these reasons -- students' migrating and thus missing class, inherent difficulties in a traditional algebra class, and additional linguistic difficulties faced by non-native English speakers -- migrant students need alternatives to the traditional algebra classroom.

Algebra Across the Wire (AATW) is a distance education algebra course for high school students and is one such alternative to the traditional algebra classroom. AATW is an offspring of the University of Texas (UT) Migrant Student Program, a high school graduation enhancement program created to provide alternative credit options for secondary migrant students. The AATW course is offered through UT's Migrant Student Program to school districts throughout South Texas, and other parts of the state.

Context of Course Offering

The course, AATW, is designed for migrant students who have attended any Texas secondary school, haven't graduated, and need to pass algebra. Instructional delivery for the course is designed to take advantage of "low-tech" delivery by using existing telephone lines and relying on audio communications as the primary form of student-teacher interaction. Groups of students ranging in size from five to fifteen in a group attend a designated site that is convenient to their summer locale. The number of sites where students meet is limited to three sites per class, and class size is (optimally) held to twenty participants (and occasionally exceeded.)

At their respective sites, each group of students is provided with an audioconvener for conference calls. Each student is also provided with a course study guide and a TI-82 graphing calculator.

The AATW course design also calls for the presence of an on-site facilitator who is literate in basic algebra skills, but not necessarily state certified to teach secondary mathematics courses. In previous semesters, these on-site facilitator have often themselves been ex-migrant students, now home for the summer and enrolled in a university. Often they are other mathematics teachers who are curious about alternate delivery systems of instruction. The inclusion of a knowledgeable, on-site resource person has added a powerful teaching dimension to the telelearning environment.

PLANNING AND IMPLEMENTATION

Barriers

There are several barriers that students must overcome to successfully complete the AATW course, or even initially enroll in the course. The first barrier deals with the financial conditions in which most migrant families find themselves. If the students are to stay at their home campus for the summer in order to complete the course, their families must either leave the students with relatives or postpone their family's summer migrating to agricultural employment opportunities in the northern tier of the country.

Another barrier is the traditional Hispanic attitude towards the role of women in the family unit. The need for females to receive access to higher education, or even complete a high school diploma, is not perceived to be of critical importance by many migrant families, and certainly not as important as providing boys the opportunities to complete their education.

Yet another barrier exists for those students who opt to migrate and work in the fields while taking the AATW course at night. One summer the program had one class whose students worked in sugar beet fields during the day, and attended class after work. The class was scheduled to begin after sundown local time to accommodate the extremely demanding work schedules of this type of labor. While course designers and/or instructors cannot eliminate these barriers, they need to be aware of them and the complications they can pose for students and plan accordingly.

Problems

Once successfully enrolled in the class, migrant students face an additional set of problems in comparison to their more traditional counterparts. It is not uncommon for an entire class of AATW students to have previously failed algebra. Sometimes, members of a class have failed three separate courses in algebra before enrolling in AATW.

Class rosters in AATW are usually 100% Hispanic. These students have a language barrier to overcome in any classroom, but in the mathematics classroom, an environment that demands mastery of highly specific, contextually dependent vocabulary, they must be able to understand the dialogue. Yet these are the very students who usually have a history of non-participation or lack of interaction. These are the students that tend to sit in the back of the traditional algebra class and remain very quiet. Girls entering the AATW are even more reticent to communicate than boys, a problem imposed by gender in any mathematics classroom, but further compounded by cultural factors.

Another problem facing these students is the changing nature of algebra curriculum and instruction. Texas Education Agency (TEA) requires covering a large amount of material in the algebra

curriculum and mandates an end-of-course (EOC) examination for all Texas algebra students to determine content mastery. The National Council of Teachers of Mathematics (NCTM), as described in the Standards, believes students need to be exposed to a much more meaningful curriculum and instruction than that of a traditional classroom. In the last decade, the NCTM has strove to de-emphasize the rote memorization of rules and procedures in algebra class and emphasize a more meaningful, problem-solving format.

This change in both curriculum and instruction places additional demands on students unaccustomed to a constructivist mathematics class. Migrant students have rarely had exposure to mathematics classrooms implementing the NCTM Standards, classrooms which emphasize problem solving, communications, reasoning, and making connections.

Successes

Since the course's inception in 1990, over 350 students have managed to complete their algebra course and go on to graduate from high school. In the class itself, students consistently report a much better feeling concerning their own assessment of their mathematical abilities and state that they feel less intimidated by the prospect of taking more mathematics courses after algebra. In terms of reaching its overall goal -- getting students to learn and appreciate mathematics and graduate from high school, thus creating more career choices -- the program is a success. The paper will now look briefly at the particulars of how students are succeeding.

DOCUMENTED LEARNING OUTCOMES

The AATW course objectives are:

- Students learn to communicate effectively using mathematics;

- Students can recognize when a problem exists that calls for a mathematical solution;

- Students can develop such a solution using a variety of tools and techniques and implement their plan of action; and

- Students can check the reasonableness of their solution and articulate the components of how that solution effectively solves a particular situation.

Students know from the outset what the expectations are. The course begins with an assessment of students' individual strengths and areas for rapid improvement. All students entering the author's course are given an initial assessment of their oral mathematics vocabulary and problem solving abilities, in particular, and their oral communications skills, in general. Not surprisingly, in a typical summer course offered to twenty-one students, only two could articulate a situation in which they envisioned using some form of mathematics for a solution.

The goal of learning how to communicate in mathematics is well suited to the form of instructional delivery used in the course -- audioconferencing. The nature of the audio-based delivery system forces all participants to become active communicators, both as listeners and speakers. For most students, active listening is not a skill that is taught in the traditional mathematics classroom. In the AATW

telelearning environment, however, students who enter as non-communicators in a traditional mathematics classroom exit the AATW course having each contributed at least two hundred meaningful mathematical interactions. These interactions are relatively easy to document for course instructors who simply use a tally sheet and coding system to record both quality and quantity of student communications.

Students' mathematics vocabulary increases dramatically with each week in a telelearning mathematical environment. In an intensive assessment conducted several years ago of classroom mathematical communications, forty hours of class were audio-taped and subsequently analyzed for types of student interactions and students' usage of relevant mathematical terminology. Analysis showed that students progressed from having essentially no ability for using mathematical words and phrases at the beginning of the course to demonstrating a mathematical oral fluency seldom found in any students in a traditional algebra class. This result has been confirmed in subsequent, less intensive analyses. This rapid and extensive increase in mathematical oral fluency is no surprise when the format of the class is considered and when one recalls that these students consistently have had limited, if any, experience communicating in their previous mathematics classes.

When mathematical communications are analyzed by gender, analysis shows that boys initially try to communicate more than girls do. As students learn telephone etiquette -- how to ask each other for help, elicit further explanation or elaboration, and compliment each other's mathematical acumen -- the number of mathematics communications by girls quickly catches up with that of boys, and in some cases, has significantly surpassed that of boys in previous summers. Interestingly, the incidence of non-mathematics communications is almost non-existent at the beginning of the class, perhaps as a result of students' not yet being accustomed to an audioconferencing format.

For many instructors, including the author, active listening is not a skill that was taught in traditional teacher preparation courses. Previous site facilitators who are also classroom mathematics teachers have consistently reported their individual teaching styles have significantly changed after an eight-week course in a telelearning environment. These mathematics teachers report feeling much more comfortable in allowing students wait time for responses, increasing their ability to build meaningful student dialogue, and becoming more aware of the need to have all students participate.

Students' problem-solving abilities and metacognitive strategies significantly increase in a telelearning environment. At the beginning of the course, students are given a practical, non-routine problem and asked to write down what types of strategies they could use to begin to solve the problem. On average, five percent of the students (1 in 20) begin with a knowledge of what their cognitive strategies are in a mathematics situation and how to monitor those strategies. With repeated metacognitive coaching from adult mentors, and with students' listening to each other explain their strategies in a variety of problem-solving situations, all students acquire a cognitive "tool box": the ability to monitor when it is appropriate to use a mathematical tool and the self confidence to use those tools.

FUTURE PROJECTS

It seems that no part of education is immune to the effects of the Internet. AATW is no exception. In the next two years, Web-based materials will compliment the existing course. We have begun this

process by posting a comprehensive Web site aimed at improving students' test taking skills for the state-mandated algebra end-of-course examination.

In long-term planning, the author is looking for the means to help provide migrant students a sense of connectivity to the rest of American society. Interpersonal interactions are critical to students of this age group in any learning environment. Currently, however, those interactions are limited to other migrant students. Perhaps learning can be enhanced by developing a new form of interactive environment for these students. It is possible that a higher level of learning can be achieved through developing highly collaborative and experiential-based learning environments (Jonassen et al. 1995) involving students from all classes of American society. Developing environments that go beyond migrant students' interacting with each other is a huge challenge.

Delivery for future courses offered to migrant students may become more elaborate. Interactive, full-motion video currently plays no part in the existing AATW course. While research shows that it may not be necessary for this type of mathematics learning environment (Hardy, Abbiatti, and Ashcroft 1995), it may be necessary to reassess the benefits of including this medium. We can speculate about what possible cognitive and affective gains can be made by placing migrant students in visual, real-time contact with other ethnic groups from different class backgrounds and structuring active participation with each other.

With emerging technologies, it is now possible to speculate about a new type of learning environment that can be constructed to include more diverse populations and new conglomerations of students working collaboratively while still being geographically dispersed across potentially broad regions. We can further speculate about what types of problem-solving, real-world learning through experience will be appropriate for these new types of distributed learning environments (Dede 1996). Future plans for AATW will look at an environment in which more diverse groups of students can contact each other through more technologically mixed delivery systems, involving students in more sophisticated learning environments. How will this come about? The answer may in part be held in an ancient Chinese adage, "It is very hard to make predictions, especially about the future."

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