Supporting Science Teachers Through a National Network:
The Access to English and Science Outreach Project (AESOP)

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The Access to English and Science Outreach Project (AESOP) pools the knowledge and expertise of high school science and language teachers, special education professionals, educational researchers, and university instructors. By sharing best practices and recent knowledge, instructional strategies are being tested that will raise deaf students' interest and achievement in science. To promote the use of best practices, this grant project, which is supported by the National Science Foundation and based at the National Technical Institute for the Deaf, begins with regional workshops. At the workshops, teachers focus on three areas that are crucial for deaf students studying science: self esteem, hands-on activities, and writing.

Self Esteem

Students--hearing or deaf, male or female--need positive self-esteem to succeed in school and in careers. Research clearly has shown greater achievement for students with positive self-esteem. Positive role models contribute to the development of self-esteem. Whatever their academic backgrounds, few teachers know of the significant contributions to science and technology made by deaf people: for example, that a chemical element, a comet, and numerous important scientific principles were discovered by deaf scientists. The fact that few deaf students know of these contributions, or even know a science teacher who is deaf, may contribute to their reluctance to consider scientific careers.

In the workshops, we present recently-published historical information on the contributions of deaf women and men to science and technology, and appropriate and stimulating ways to use this information in the classroom. Students are encouraged to read and write about well-known scientists like the inventor Thomas Edison and the rocket pioneer Konstantin Tsiolkovsky and lesser known scientists and researchers like the astronomer Annie Jump Cannon, and Donald Balantyne, a specialist in microsurgery. All were pioneers in their fields and most faced situational and attitudinal barriers because of their deafness. AESOP participants are also encouraged to contact living deaf scientists and invite them to their classrooms.

Hands-On Activities

Standard instructional delivery in science classrooms where there are deaf students is lecture and explanation. However, research has shown that deaf students who manipulate objects and are involved in hands-on activities and related discussions, achieve higher scores on science content tests than those who do not. Many teachers report that simple, inexpensive demonstrations of scientific principles are “worth a thousand words” in a

science class. In the AESOP workshops, we use empty pop bottles, paper cups, rulers, string and balloons to demonstrate learning activities that may easily be replicated by teachers and students. Both procedure and principle are emphasized. Students need to *DO* science to understand it. That is, they need to gather the materials and assemble the equipment whenever possible. They need to follow written instructions and write down procedures, observations and questions. By structuring the classroom so that students are involved in scientific procedure and by providing appropriate questions and the prompts for questions, the teacher sets the course for critical thinking about phenomena or perhaps discovering the scientific principle that is the object of the lesson.

Writing

Teachers of deaf students know that the language of science, especially its frequent use of structures like the passive voice and use of technical and semi-technical vocabulary is particularly challenging. These teachers know, and research has shown, that deaf students make hypotheses about the language similar to those made by other learners of English (for example, hearing students of English as a second language). They may not know that their students bring significant experience in functional and social writing to the classroom. They may not realize that their students have used writing (and their developing English language ability) as a tool for learning and communication outside of the classroom. Informal writing may be a powerful tool for teachers and students to use to learn the language of science and to reflect on key concepts.

Scientists use writing to comprehend scientific text, to record observations, to question, to report and to think about observed phenomena and key concepts. In the workshops, we demonstrate the use of "double-entries" (in a reading journal), note cards for generating questions and hypotheses, "vocabulary enhancement," that is, systematically adding technical and semi-technical terms to students' descriptions, and creative and reflective writing to learn science content.

Improving deaf students' access to the language and content of science and stimulating them to consider careers in science cannot be the responsibility of a single educator or field; such a change requires collaboration among professionals from different disciplines as well as with parents. This is why AESOP encourages cross-disciplinary teams in our efforts to identify and pilot "best practices."

The Network

Research has shown that innovative programs focusing on hands-on science activities are often sustained when teachers are enthusiastic and "claim ownership of the programs" (Kyle, 1985). Another goal of the workshops is to provide an opportunity for teachers to share their own best practices (strategies) with others and to begin designing an instructional unit that will make use of these strategies to teach a selected science principle. A regional workshop also represents the beginning of a local network of teachers focused on the teaching of science to high school students who are deaf. Following the workshop, the network expands for these participants as university instructors and researchers with experience in teaching deaf students make themselves available to consult on the design of instructional units. Strategies, designs, problems, and progress

are shared with the teachers in the national network through the AESOP newsletter and a World Wide Web site. AESOP's advisory board provides a national perspective and offers suggestions for addressing the critical issues related to access to science.

Hopefully, the network will allow us to gather experiences and data on successful classroom strategies. Teachers in the network who try the instructional units and record and share their experiences, provide valuable insight for the research component of the Project. Another objective of the Project is to determine what factors promote sustained implementation of innovation. In the past, research has shown that teachers have discontinued the use of new strategies for a variety of reasons, including a lack of appropriate inservice training. In AESOP, we are investigating factors leading to implementation of new strategies in teaching science to deaf students and the role the network plays in initiating and sustaining the use of these strategies over time.

To improve science instruction for deaf students--that is, to increase motivation to learn science, understanding of science principles, and access to the language of science--we are relying on the willingness of colleagues from different disciplines to collaborate and their willingness to reflect on why certain strategies are or are not effective. Our most recent experience with teachers in Rochester, Minnesota and Trenton, New Jersey shows us that not only are colleagues willing to cross discipline boundaries to create curriculum, they also find it stimulating and rewarding. Communication following the workshops indicates that when teachers take the time to reflect on their experience with new strategies, they have valuable insights for others. We expect that the growing AESOP network will be the right vehicle for exchanging these insights.

Bibliography

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