ED296812 1988-01-00 Motivating American Indian Students in Science and Math. ERIC Digest.

ERIC Development Team

www.eric.ed.gov

Table of Contents

If you're viewing this document online, you can click any of the topics below to link directly to that section.

Motivating American Indian Students in Science and Math. ERIC Digest..... 1

ERIC Identifier: ED296812
Publication Date: 1988-01-00
Author: Cajete, Gregory A.
Source: ERIC Clearinghouse on Rural Education and Small Schools Las Cruces NM.

Motivating American Indian Students in Science and Math. ERIC Digest.

THIS DIGEST WAS CREATED BY ERIC, THE EDUCATIONAL RESOURCES INFORMATION CENTER. FOR MORE INFORMATION ABOUT ERIC, CONTACT ACCESS ERIC 1-800-LET-ERIC

TEXT: Many American Indian students tend to drop high school math and science courses which are not specifically required for graduation, with the result that they do not acquire the necessary skills to enable them to pursue scientific or technical careers. This digest will summarize the major characteristics of American Indian student needs in the disciplines of science and math and then offer constructive ways in which students can be motivated for greater achievement.

WHAT ARE SOME OF THE CAUSES OF THE LACK OF STUDENT ACHIEVEMENT

IN SCIENCE AND MATH?

Notwithstanding the failure of science and math curricula to provide focus and challenge or to foster concept-building, American Indian students do achieve relatively high scores on standardized tests in those subjects from kindergarten through fourth grade (PROCEEDINGS, 1983).

However, by the time they reach junior high, many American Indian students avoid science. Some of the factors contributing to avoidance are: 1) conflicts between home and school regarding the purpose and importance of school; 2) an abrupt movement away from lessons in context and interdisciplinary approaches to teaching science and math in earlier grades toward more structured and linear approaches in junior high; and 3) a social organization of lesson presentation which is less group oriented and more authoritarian (Leap, 1982).

Another explanation cited is that American Indian students possess a cultural world view that is significantly different from that of American society at large. This, in turn, affects students' perceptions and receptivity to science and math. Additionally, many American Indian students have unique learning characteristics by which they perceive and process information. Therefore, an approach that is different from the usual one is required to present science and math content to these students (Cajete, 1986).

WHAT ARE SOME IMPORTANT AREAS TO BE CONSIDERED IN DEVELOPING MOTIVATIONAL TOOLS FOR STUDENTS IN SCIENCE AND MATH?

Linguistic differences of American Indian students can add to the problems which they encounter in science and math, especially if the student comes from a predominately native language-speaking background. Most American Indian languages do not categorize or abstract concepts in the same way that English does. As a result, many concepts in science are not readily translatable into those languages. Consequently, learning science or math becomes not only a problem of acquiring new words but also one which requires learning an entire specialized language (Schindler and Davison, 1985).

American Indian languages and culture make use of descriptive examples of practical experience and knowledge which personify an intimate understanding of natural phenomena. It is possible to use this cultural understanding of nature to enhance American Indian student motivation in science and math courses. The key tactic is facilitating the attitude among American Indian students that they can accommodate both perspectives. This allows students to see how their traditional and practical experience can be integrated into the more formal content approach of "school" science (Cajete, 1986).

Underpreparation of many teachers in elementary science and lack of culturally relevant

coursework often condition students to expect "boring" science and math classes and to believe that American Indian culture has nothing in common with science and math education. Therefore, increased preparation combined with cultural sensitivity on the part of science teachers becomes a priority (Cornell, 1985).

A large proportion of science teachers and schools adopt content- oriented and competency-based science and math curricula. Sole emphasis on this content competency without an understanding of the learning and thinking process can further manifest problems with the socio-cultural dimensions of science and math education (Cornell, 1985).

WHAT ARE SOME MAJOR CHARACTERISTICS OF AMERICAN INDIAN STUDENTS' LEARNING STYLES WHICH MAY AFFECT THEIR MOTIVATION IN SCIENCE AND MATH COURSES?

1. Seeing and Listening. Historically, many aspects of American Indian culture were transmitted orally and visually through stories, ritual, art and practical example. Since developing auditory learning, observation skills, and memory by means of storytelling, oratory, and experiential learning are still part of the informal education of many American Indian students, these modalities should receive serious consideration for use in enhancing motivation in science and math.

2. Practicality. Many American Indian students have less difficulty understanding science/math concepts that are concrete or experiential. For greater effectiveness, the teacher should begin with concrete examples and practical applications which lead to the abstract. In addition, emphasis should be placed on course content which is functional and relevant to daily living.

3. Caution. Many American Indian students are cautious when faced with unfamiliar situations or activities, since learned behavioral patterns make them sensitive to the reactions of others. Therefore, to the extent possible, class presentations should be made informal and open. Friendliness and sincerity on the part of the teacher are key factors in easing self- consciousness.

4. Field Sensitive Orientation. Many American Indian students express field-sensitive behavioral tendencies in social interactions. These tendencies directly implicate affect learning modalities. They include the tendencies to respond more readily to personal encouragement and guidance from the teacher, to base motivation for learning on an affective relationship with the teacher, and to respond favorably to learning formats which begin with group orientation (Cajete, 1986).

WHY IS IT IMPORTANT TO TEACH SCIENCE AND MATH AS CREATIVE PROCESSES AND CULTURAL SYSTEMS OF KNOWLEDGE?

Every cultural group has developed a philosophy and technology for the application of

knowledge about the natural world. Likewise, mathematics is a cultural system which springs from a cultural group need to "count," "quantify," "manipulate," and "calculate" those things which that culture values. Yet this dimension is rarely addressed in science and math curricula (D'Ambrosio, 1986).

Science and math at every turn involve a creative exploration of natural phenomena and practical problem solving. Creativity in both disciplines follows a discernible pattern, beginning with learning the basics, practicing, internalizing, taking apart, and reassembling for greater synthesis and understanding. This process "ideal" is implied in the scientific method and in mathematical problem-solving. Creative teaching in this respect involves facilitating creative thinking abilities through content which is both personally and culturally relevant to American Indian students (Cajete, 1986). This can be accomplished as follows:

1. Derive creative content from the immediate environment of the student, making "the commonplace" the "creating place" for both student and teacher. Contexts, situations and phenomena in the immediate environment, the home, community or school are all sources for gleaning scientific content (Cajete, 1986).

2. Integrate contemporary American Indian issues and concerns with related scientific information. Areas such as health, natural resource management, ecology, self-determination, tribal government, history and relevant social issues provide a wealth of content for scientifically relevant exploration and discussion (Cajete, 1986).

3. Utilize American Indian culture-based content. Activities such as field trips, the study of artifacts or ethnographic information, and guest speakers can provide descriptive examples which personify American Indian knowledge of nature while illustrating concepts in science and math. American Indian cultural content can be developed through discussions and projects in astronomy, psychology, botany, medicine, nutrition, agriculture, architecture, engineering and many other science related fields (Cajete, 1986).

4. Establish learning situations which are experientially based and help students develop inquiry skills by setting up a scientifically challenging situation that stimulates creative problem-solving. Eskimo students at Gambell, Alaska have, for example, shown that they are quite capable of winning at state and international levels of future problem solving competitions. Contrary to myth, many American Indian students avidly participate in team competitions, especially if such competitions reflect group prestige. These students can excel at scientific research providing they see a clear and immediate purpose for their study (Guthridge, 1986).

5. Incorporate creative writing as a part of the presentation of science/math content. By having students write about "their" thoughts and feelings about topics like overpopulation, nuclear disarmament, AIDS, energy development on reservations, and

American Indian health and social problems, they learn to do research, see the relevance of science and widen their own sense of engagement concerning these issues (Blake, 1985).

6. Present art as an ideal vehicle for creativity in science and math. Activities involving drawing, construction, or artistic exemplification of science or math concepts allow for a fuller expression of culturally-related ideas and for more complete involvement in the learning process (Cajete, 1986).

7. Explore the effects of technology on human lifestyles. Areas which may be explored include comparison/contrast of American Indian traditional technology with that of modern society, the traditional role of education in American Indian society, and lifestyles and the environmental impact of both cultures. Role playing, experiential learning, community research, and "what if" scenarios are all excellent methodologies for discussions. Teachers can help students to recognize that science and math are both creative processes and cultural systems of knowledge. Insights are gained through combining and exercising learning abilities. This is the nature of science and math "in the making" (Cajete, 1986).

WHAT GENERAL ROLES SHOULD THE TEACHER, COUNSELOR AND ADMINISTRATOR PLAY IN ENCOURAGING AMERICAN INDIAN STUDENTS TO EXCEL IN SCIENCE AND MATH?

Motivation is a two-way street, and it requires the active participation of both teacher and student. The teacher must begin by attempting to understand and appreciate what the American Indian student brings with him or her in the form of cultural knowledge, values, creative abilities, and interests. These are the foundation for creating motivational tools and facilitating active learning. The teacher must combine affective teaching with cultural sensitivity in dealing with American Indian students. Creative teaching strategies must be implemented which more completely involve American Indian students in the thinking processes of science and math. Furthermore, the teacher must develop a working knowledge of learning styles and teach to those styles at every opportunity. Also, increased preparation in science/math education allows the teacher greater flexibility in tailoring lessons to meet the needs of American Indian students in those subjects.

The first step in the development of a strategy of motivation begins with researching American Indian cultural content related to basic concepts in science and math. The next step is incorporating instructional approaches into the curriculum which utilize local, environmental, cultural and community resources to further enhance the teaching for motivation and interest by the American Indian learner.

Finally, counselors and administrators must play an active role in informing American Indian students of academic requirements and related careers in science and math, and

they must improve their own understanding of science-related professions. In addition, administrators must make a tangible commitment to support teachers, curriculum, and program development focused on improving the performance and self-image of American Indian students. Motivating American Indian students in science and math requires continuous enthusiasm, high expectations, and commitment on the part of teachers, counselors, and administrators. It is challenging, but it can achieve the result of getting American Indian students excited and eager to learn about science and math.

FOR MORE INFORMATION

Ameduri, Robert A. "Creative Science Through Laboratory Analysis." SCHOOL SCIENCE AND MATHEMATICS, (1977): 365-370.

Blake, William E. "Science and Creative Writing: An Ad(d)verse Relationship?" SCIENCE TEACHER, (1983): 30-33.

Cajete, Gregory A. "Ethnoscience: The Things of Nature and the Nature of Things." KUI TATK (Native American Science Education Association, Washington, D.C.) (1985): 2.

Cajete, Gregory A. "Science: A Native American Perspective (A Culturally Based Science Education Curriculum)." Ph.D. diss., International College/William Lyon University, San Diego, CA, 1986.

Cornell, Elizabeth A. "Preparing Teachers to Teach Science," KUI TATK (Native American Science Education Association, Washington, D.C.) (1986): 1-2.

D'Ambrosio, Ubirantan. "Socio-Cultural Bases for Mathematics Education," KUI TATK (Native American Science Education Association, Washington, D.C.) (1986): 2.

Guthridge, George. "Eskimos Solve the Future." ANALOG SCIENCE FICTION/SCIENCE FACT (1986): 64-75.

Leap, William L. DIMENSIONS OF MATH AVOIDANCE AMONG AMERICAN INDIAN ELEMENTARY SCHOOL STUDENTS. Washington, D.C.: National Institute of Education, 1982. ED 244 748.

PROCEEDINGS: SCIENCE AND MATH EDUCATION, HEARINGS BEFORE THE COMMITTEE ON BUDGET. UNITED STATES SENATE, NINETY-EIGHTH CONGRESS, FIRST SESSION. Albuquerque, NM, February 1983. ED 234 982.

Schindler, Duane E., and David M. Davison. "Language, Culture and Mathematical Concepts of American Indian Learners." JOURNAL OF AMERICAN INDIAN EDUCATION (1985): 27-34.

This publication was prepared with funding from the Office of Educational Research and Improvement, U.S. Department of Education, under OERI contract. The opinions expressed in this report do not necessarily reflect the positions or policies of OERI or the Department of Education.

—
Title: Motivating American Indian Students in Science and Math. ERIC Digest.
Note: Because this Digest was published in colored ink, on colored paper, and in reduced type size (for compression), a full-size typescript version has also been included here.
Document Type: Guides---Non-Classroom Use (055); Information Analyses---ERIC Information Analysis Products (IAPs) (071); Information Analyses---ERIC Digests (Selected) in Full Text (073);
Target Audience: Practitioners
Descriptors: American Indian Education, American Indians, Cultural Differences, Elementary Secondary Education, Family School Relationship, Learning Activities, Learning Motivation, Learning Strategies, Mathematics Instruction, Relevance (Education), Science Instruction, Student Characteristics, Student Motivation, Student Needs, Teacher Role, Teaching Methods
Identifiers: ERIC Digests
###

—

[Return to ERIC Digest Search Page]