Science Motivation in the Multicultural Classroom

Students construct science knowledge through active participation

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When the 1998 Third International Mathematics and Science Study (TIMSS) examined one million high school students from 41 countries, the United States placed 16th in overall academic performance (National Center for Education 1998). This result motivated many educators to examine the educational process in the U.S. and ensure that all students are included. Hispanics, for example, are a growing population with strong scientific potential if U.S. teachers consider the culture and interests of these students as motivational tools in preparing lessons.

One way to address these results is to integrate into the curriculum the interests of children of all ethnic backgrounds—not just Hispanics. Curriculum and instruction should guide learning toward (1) understanding and fulfilling basic human needs and facilitating personal development; (2) maintaining and improving the physical environment; (3) conserving natural resources so they are used wisely; and (4) developing and understanding the interdependence among people at local, national, and global levels—that is, a sense of community (Bybee 1993). The curriculum should reflect the values and knowledge of the persons who construct it and the interests of the students for whom it is intended.

Student interest and attitudes are critical aspects of science education. These psychological concepts help motivate students and make the educational process more pertinent (Colletta and Chiapetta 1994). Teachers are an integral part of making this happen. When teachers consider students' interests, teachers will not only be motivating students but will be helping them become scientifically literate. The American Association for the Advancement of Science (AAAS) defines scientific literacy as:

"Scientific literacy, which encompasses mathematics and technology as well as the natural and social sciences, has many facets. These include being familiar with the natural world and respecting its unity; being aware of some of the important ways in which mathematics, technology, and the sciences depend upon one another; having a capacity for scientific ways of thinking; knowing that science, mathematics, and technology are human enterprises and knowing what that implies about their strengths and limitations; and being able to use scientific knowledge and ways of thinking for personal and social purposes. Thus scientific, mathematical, and technological processes are important factors in improving society, along with thinking skills and scientific knowledge." (1989, p. 20).

One way to help students become active agents in their society is by making the educational experience more pertinent, especially regarding science. Students can be motivated to learn a scientific concept and discover the importance that such experience has to offer. When a student has the opportunity to pick what they find interesting in science, the child feels a sense of control and greater responsibility and enthusiasm toward their learning. Recommendations like the one from *Mathematics and Science for Hispanics* (Triana and Rodríguez 1993) emphasize this trend of thought:

FIGURE 1

Rubric for multicultural contributions to science.

Area of Evaluation	1 Beginning	2 Developing	3 Accomplished	4 Exemplary	Score
Investigates contributions of diverse cultures to science	Information only gathered	Information and some interpretation of the value of the scientific contribution to humanity	Information and some interpretation of the consequences of the discovery	Demonstrates an appreciation for the evolution of humanity due to multicultural contributions to the advancement of science	
Demonstrates ways of thinking and acting inherent in the practice of science	Relates the bare minimum of the experiments done by the scientist	Interprets the experiments done	Explains the implication of the discoveries made	Shows how ideas were modified based on investigations; demands evidence for data claims; asks questions for clarity	
Demonstrates the ability to interpret and explain information sought in reference sources	Minimal interpretation of references	Some sources are interpreted; some predictions are made	Reliable sources; some interpretation of the references; no predictions based on data	Finds reliable sources, includes interpretation of references, accepts peer review during presentations, makes predictions based on data	
Demonstrates positive attitudes toward science and its relevance to the individual, society, and the environment, and demonstrates confidence in their ability to practice science	Unsure of one's ability to interpret science	Some development of the ability to interpret science discoveries and its relevance to society	Confidence in interpreting science and some exploration of the role of science in society and culture	Demonstrates belief in one's ability to understand science; explores role of science in society and culture	

"Additional criteria should stress educators' sensitivity to the differences of Hispanics and other minority cultures, involvement of the local community with emphasis on outreach to parents, involvement in the local Hispanics professional mathematics and science organizations, use of culturally relevant science and mathematics perspectives and demonstrations of exemplary teaching techniques that utilize cooperative teaching methods" (p. 18).

When students actively participate in science, they can also become active participants in the educational process. At the same time, science teaching will gain a more pertinent role in society and in the students' culture because their learning will be based on the students' interests and needs.

Carl Roger's theory of learning states, "Significant learning takes place when the subject matter is perceived by the student as having relevance for his own purpose" (Rogers 1983, p. 158). According to Rogers, a person will only learn what they think is important to them in order to maintain or improve their state of being. Learning also occurs at a higher rate if the person is interested in the knowledge. Rogers explains that a student who is an active participant in the learning process will feel a sense of responsibility for the knowledge acquired in the educational process.

Wlodkowski (1997) summarizes by assigning four motivational goals to the teacher of diverse classrooms: establishing inclusion by grouping, developing a favorable attitude by allowing choice, enhancing meaning by including purpose and values, and engendering competence by having the students restate the value of the lesson learned. While doing lesson plans, the teacher needs to incorporate these motivational techniques to accommodate the multicultural classrooms and increase student achievement.

A sense of relevance

As one example when planning lessons, teachers can harmonize (Bonner and Hairston 2001) and motivate students by incorporating the results of a student interest survey. If the teacher responds with appropriate topics and activities, students can feel a sense of relevance and respect for the knowledge learned in the science classroom and be motivated to achieve.

Another sample lesson would be to investigate the contributions of diverse cultures to science. Students can demonstrate an appreciation for the evolution of humanity due to multicultural contributions to the advancement of science. Students can demonstrate positive attitudes toward science and its relevance to the individual, society, and the environment and demonstrate confidence in his or her ability to practice science. Students can also demonstrate belief in one's ability to understand science; explore the role of science in society and culture.

After introducing the sample lessons, student discussion can begin with the student responding to questions about scientific discoveries they remember best. "Who discovered…" and "What was the contribution…" responses are recorded on the board.

Groups are formed and cultures that have contributed to science are listed so that students choose where their interest lies (McCombs 1996). The student investigates the group's assigned area, keeping an eye on the rubric (Figure 1, p. 65) for the final class presentation. Students may use books, magazines, interviews with adults, and the Internet to gather information.

PowerPoint presentations with references would be ideal for this activity. Working on a floppy disk would allow for cutting and pasting individual group data for the class to follow up with a comparison of cultures on a printout.

Oral presentations and discussion

As each group presents their findings, students point or place a pin on a world map to explain from where the ideas are emanating. (Students should begin to feel the sense of a world community solving riddles and advancing scientific knowledge.)

The teacher uses the following questions to guide the discussion that follows the class presentations:

- Do you think intellectual curiosity occurs universally in all cultures?
- Do discoveries/laws/theories always lead to successful improvements in the quality of life of the people that live following the written report? Do you think the scientific pronouncements cause a change in the shape of life 100 years later? Give examples of what you have perceived in life around you.
- Can you think of an example of a disastrous result due to a scientific investigation? Can you give an example of cultural prejudice where the discoveries of another country are ignored or criticized?
- Does cultural prejudice affect who you study with…, eat with…, listen to…?
- Does advancement in the intellectual arts depend on the variety of thoughts that …?

The students then make a timeline, which consisted of a clothesline across the room with clothespins and note cards at approximate intervals, giving a sense of proportion. The ideal units might mean that two strings be used: one above with gross time intervals and one below that comes from a spot on the upper level and expands the final centuries so that the increased activity can be demonstrated, especially in the last decade.

Although TIMMS demonstrated that students in U.S. multicultural classrooms do not appear to be internationally competitive, a strong multicultural curriculum and instruction can make significant changes in motivating students in science and mathematics. ■

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