Diversity in Science Education

Multicultural education is an educational reform movement and philosophy designed to change the total educational environment so that students from diverse racial and ethnic groups, both gender groups, exceptional students, and students from each social-class group will experience equal educational opportunities in schools, colleges, and universities (Banks, 1995).

Science curricula and science classrooms have been devoid of relevant cultural inclusion or multicultural education. Many science educators believe “science is pure” and thus escapes the influences of current pedagogy, trends, and especially cultural influences. Even though science processes are generic or “culture free,” if students cannot and do not identify with information that are “processing,” they may internalize the notion that they cannot perform science or are not expected to process scientific information. The process of validating and/or correcting perceived notions depends on one’s culture. Multicultural science or culturally inclusive science is believed to be an enhancement for students of color.

What is sought and needed in science classrooms is a model that integrates the learning of the traditional science with the cultures within the classroom. Culturally inclusive science integrates the learner’s culture into the academic and social context of the science classroom to aid and support science learning (Baptiste & Key, 1996). The culturally inclusive model demonstrates that the equity pedagogy and the content integration dimensions are not mutually exclusive (Key, 1999).

Student achievement is influenced by many factors, including student attitudes, interests, motivation, type of curricula, relevancy of materials, and the culture of the students. To understand how culture may influence science and other disciplines, one must be aware of the five dimensions of multicultural education (Banks & Banks, 1995).
• **Content integration** encompasses the extent to which teachers use culturally relevant examples, data, and information from a variety of cultures and groups to illustrate key concepts, principles, generalizations, and theories in their subject areas or disciplines.

• **Knowledge construction** involves the procedure by which social, behavioral, and natural scientists create knowledge, and the manner in which the implicit cultural assumption, frames of reference, perspective, and biases influence the ways that knowledge is constructed within each discipline.

• **Prejudice reduction** describes the characteristics of children’s racial attitudes and suggests strategies that can help students develop more democratic attitudes and values.

• **Equity pedagogy** consists of using techniques and methods that facilitate the academic achievement of students from diverse racial, ethnic, and social-class groups.

• **Empowering school culture and social structure** is used to describe the process of restructuring the school’s culture and organization so that students from diverse racial, ethnic and social-class groups will experience educational equality (Banks & Banks, 1995).

Some strategies that enhance the science learning and achievement of students of color are cooperative learning and inquiry. Other concepts that also enhance students of color achievement when addressed and used properly are congruency, locus of control, and field dependency.

### Cooperative Learning

Cooperative learning is advantageous for all culturally diverse students. African American students’ achievement is enhanced when cooperative learning groups incorporate group rewards based on group members’ individual learning (Irvine and York, 1995). The following cooperative learning strategies make learning more personable and less threatening for many students.

• **Strategically mix students to form groups.** Group students of different backgrounds, academic achievement levels, and social skill levels. A mixture of different abilities, ethnic backgrounds, learning styles, and personal interests works best for productive student teams. One of the benefits of cooperative teams is the mixing of students who have not interacted before (Johnson, et al. 1986).

• **Demand group responsibility.** Group members should be interdependent, working to accomplish a common goal. The teacher structures the assignment so each member must contribute to successfully meet the group’s goal. Allowing one or two to dominate the activity does not result in greater understanding for all.

• **Demand individual accountability.** Assignments should be structured so each member accomplishes a specific task. Try to provide opportunities for every group member to make a unique contribution. Students who work together in groups without differentiated tasks (for example, to prepare a single worksheet) have not shown significant achievement benefits. Therefore the teacher should use assessments that measure group and individual achievement.

• **Introduce students to social or interpersonal skills.** Skills such as making eye contact, encouraging fellow group members, using quiet voices, and disagreeing without hostility are habits that will become part of the cooperative group’s repertoire.
Inquiry

Inquiry is the most appropriate vehicle for accommodating all learning modalities. Inquiry teaching is a means by which all children are able to construct processes, products, and attitudes in unique and valid ways that result in meaningful and lasting learning. Constructivism says that all children learn in different ways and inquiry provides the means. Inquiry methodology allows children to develop their own investigations to address questions they raise themselves. It encourages children to take charge of their own learning and children who take charge of their own learning have a greater tendency to develop an internal locus of control. The teacher can implement inquiry methodology by allowing students to figure out what caused what (cause-and-effect activities), to recognize and name variables, and define them operationally, and by employing discovery learning methodologies.

Congruency

Congruency is the alignment between a student’s learning style and the teacher’s teaching style. Multicultural advocates and experts believe that the closer the match between a student’s learning style and a teacher’s instructional methods, the more likely the student will experience academic success (Irvine & York, 1995).

Students of color were less successful when assimilation vs. accommodation of their learning styles occurred. They are more successful when accommodation of the teaching style is made to their learning styles (Irvine & York, 1995).

Locus of Control

Locus of control is the concept or belief about the source of one’s fate and destiny. It is a powerful predictor of academic achievement (Brookover, et al., 1979). A student with an internal locus of control believes personal successes or failures are due largely to his/her own abilities and efforts. A student with an external locus of control believes their successes or failures are due largely to external factors, luck, other people’s actions, or difficult situations. Many students of color have been found to have an external locus of control. Teachers can help students to convert to an internal locus of control by encouraging students to evaluate the outcomes of investigations, encouraging students to suggest ways of changing variables, and by encouraging them to suggest additional ways of investigating a given phenomenon. The teacher could also employ cooperative inquiry, cooperative grouping, mentoring, and always use appropriate wait time with scaffolding and prompting. Students should be encouraged to speculate (hypothesize) by asking questions. Students can also suggest topics for investigation and to set their own goals and evaluate their own progress. These strategies encourage students to trust their judgment, become more independent, and establish an internal locus of control.

REFERENCES


Field Dependency

Field dependency is the inability of persons to recognize camouflaged information. Students with field dependency see things holistically. They tend to rely on external cues and are less able to differentiate part of a field as discrete from the field as a whole. In contrast, the field independent persons have the ability to recognize camouflaged information very easily. The field independent student has the ability to ignore unnecessary details and surrounding camouflaging information.

Science teachers can use several strategies to enhance the skills of a field dependent student. Well-organized, structured materials help to enhance the understanding of field dependent learners. They can use constructivistic method, process-inquiry methodology, puzzles and board games, and computer games, organizers for science lessons, concept maps, and process skills (Martin, 1996).

Graphic organizers are tools for organizing science information to help make concepts easier for different types of learners. There are various styles and they are concept driven. They are very helpful to the field dependent learners. Some graphic organizers include charts, tables, graphs, concept maps, different types of webs, T-charts, KWL charts, and many others.

Graphic organizers can aid all learners to organize, analyze, and reflect upon science concepts. They have been extremely effective in helping the field dependent learner to focus on key patterns and issues, to look at background information that is normally missed, and to ask questions that lead students to discover properties or qualities (Jonassen & Grabowski, 1993).

To begin to address diversity in your science classroom:

- Plan your science lessons or topics as usual.
- Include the researching of persons of color and other cultures that have contributed to the lesson topic or concept as one of your objectives.
- Use appropriate strategies to help accomplish the lesson with maximum achievement for the students, e.g. use cooperative learning, inquiry and graphic organizers.
- Integrate this information “into” the guided practice, independent practice, and/or assessment of the lesson.
- Use the names and information within the lesson text as well as in the questions and assessment materials.
- Assign authentic assessments to discuss and use this culturally rich information.
- Use the cultural inclusion typology (Baptiste & Key, 1996), culturally inclusive science model (Key, 1999), and multicultural education dimensions (Banks, 1995) to vary the methods and increase students’ knowledge.
- Repeat this with all lessons on a daily basis.

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