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Understanding Mathematics and Culture in Rural Contexts. ERIC Digest.

Scholarship and writing about culture and mathematics covers a wide range of topics:

the cultural bases for mathematics, mathematics development in different cultures, the historical culture of mathematics, effects of culture on how people learn about and are disposed toward mathematics, and the political effects on societies of mathematics and mathematics education. This Digest provides an overview of "concepts," "writers," and "tenets" associated with the study of mathematics and culture, and offers researchers a framework for the field, particularly with regard to rural contexts.

DEFINING ETHNOMATHEMATICS

Ubiratan D'Ambrosio, a Brazilian mathematician, coined the term "ethnomathematics" in the 1980s and offered this definition: "Ethnomathematics is the way different cultural groups mathematise (count, measure, relate, classify, and infer)" (D'Ambrosio, 1984). In other words, ethnomathematics examines how different cultural groups use mathematics.
In subsequent writing about ethnomathematics, he and others struggled with the meaning of the term. While many scholars contributed to that debate, D'Ambrosio's evolving definitions reflect the full spectrum of discussions--from very specific: "The mathematics which is practiced among identifiable cultural groups such as national-tribal societies, labour groups, children of certain age brackets, and professional classes." (D'Ambrosio, 1985, p. 45), to very broad: "The arts or techniques developed by different cultures to explain, to understand, to cope with their environment" (D'Ambrosio, 1992, p. 1184).

Barton (1996) grouped discussions about ethnomathematics into two categories: mathematics and mathematics education. In each category he identified four primary topics:

Mathematics

* Cultural nature of mathematics

* Mathematics thought in other cultures

* Cultural history of mathematics

*Politics of mathematics

Mathematics Education

* Mathematics learning in other cultures

* Situated cognition, including language and bilingualism

* Societal effects of mathematics education

* Relationships between mathematics and mathematics education

Barton then synthesized a definition of ethnomathematics intended to embrace all of these topics: "Ethnomathematics is a research programme of the way in which cultural groups understand, articulate and use the concepts and practices which we describe as mathematical, whether or not the cultural group has a concept of mathematics" (p. 214).

According to Barton, this definition implies that "(a) ethnomathematics is not a mathematical study, it is more like anthropology or history; (b) the definition itself depends on who is stating it, and it is culturally specific; (c) the practice which it describes is also culturally specific; and (d) ethnomathematics implies some form of relativism for mathematics" (p. 215).

CULTURE, MATHEMATICS, AND MATHEMATICS EDUCATION

Professional discourse and literature relating to culture, mathematics and mathematics education can be characterized by the following domains of study: culture and mathematics, culture and mathematics education, and the effects of culture on mathematics achievement.

Culture and Mathematics

Many scholars believe that mathematics activity is highly cultural. Topics of study include:

* The cultural nature of mathematics. Dossey (1992) asserted that mathematicians do not agree on the nature of mathematics, debating whether or not it is bound by culture ("interna-lists") or culture-free ("externalists"). Interna-lists such as Alan Bishop (1976, 1983, 1986, 1988) believe, in Bishop's words, that mathematics is "a cultural product which has developed as a result of various activities" and that counting, locating, measuring, designing, playing, and explaining are all part of that cultural product. Others, including critics of ethnomathematics are externalists who believe that mathematics thought is virtually culture free.

* Mathematical thought in other cultures. A body of anthropological research focuses largely on intuitive mathematics thinking developed in largely undereducated cultures. These studies examined populations varying from native peoples of Australia, Africa, the Pacific Islands, and North America to construction workers in Brazil. This work is enumerated and summarized in Barton (1994).

* Cultural history of mathematics. Studies in this area attempt to identify the historical mathematical contributions of different cultures across the world. Early examples include D'Ambrosio's (1980) review of the evolution of mathematics and his call for incorporating ethnomathematics into the history of mathematics (D'Ambrosio, 1985).

* Politics of mathematics. These works, such as Bishop's (1990) essay on the powerful influence of Western mathematics and D'Ambrosio's (1990) discussion of the role of mathematics in building democratic and just societies, examine how mathematics has affected non-academic areas of society.

Culture and Mathematics Education

Mathematics education can both reflect and influence the political and social dynamics of a culture. Topics under this heading include:

* Mathematics learning in other cultures. This body of writing focuses on the importance of using culturally specific contexts in teaching and learning mathematics, including a) using relevant examples from the student's own culture; and b) exposing students to a variety of cultural contexts (multiculturalism). Examples in the first category include

making mathematics curricula more accessible to Native Americans, African Americans, and Hispanic Americans. Examples in the second include using multicultural children's literature to teach mathematics and integrating ethnomathematics principles in middle and elementary school classrooms.

* Situated cognition including language and bilingualism. This research focuses on culture's influence in learning mathematics. Situated cognition refers to the intuitive mathematics needed for specific tasks rather than the formalized, codified mathematics learned in school. In this vein researchers have studied groups as varied as Brazilian candy vendors (Saxe, 1988) and American dairy farmers (Schribner, 1984). Studies on bilingualism's effect on mathematics learning also falls into this topic.

* Societal effects of mathematics education. This research includes, for example, work examining such issues as how mathematics may be used to create and reveal power and oppression--the critical mathematics pedagogy theory of Frankenstein (1997)--and the Mathematics and Society curriculum of Abraham and Bibby (1988).

* Relationships between mathematics and mathematics education. Work on integrating ethnomathematics and teacher preparation (Presmeg, 1998) and on relationships between African Americans' perception of mathematics and their motivation to learn mathematics (Walker and McCoy, 1997) fall under this heading.

Effects of Culture on Mathematics Achievement

Researchers have sought to identify cultural factors that might explain differences in mathematics achievement and attitudes, investigating differences across lines of national origin, ethnicity, and gender. This body of research identified the following general cultural influences on mathematics performance and dispositions:

* Popular media. Media shape and reinforce popular beliefs about ethnic and gender differences in mathematical abilities and achievement (Leder, 1992; Malloy, 1997).

* Parents. Parent expectations consistently show strong effects on student performance and attitudes. This is reflected in work that contrast Asian parents' beliefs that effort results in successful performance with American parents' belief that innate ability largely affects performance (Stevenson, 1987) and a wide range of other work examining parents' attitudes and expectations.

* Teachers. Cross-cultural comparisons of curricula and teaching routines show widely varying expectations of student performance and abilities. To cite just one example, Zhonghong and Eggleton (1995) found that mathematics curricula in the United States reveal low expectations for performance, while Chinese curricula challenged its students. In another vein, Bradley (1984) observed that many Native American students had extensive knowledge of mathematics deeply rooted in their culture and traditions; few teachers, however, tapped into this reservoir of traditional knowledge (Kawagley, 1990; Pomeroy, 1988). Leder (1992) documented subtle differences in the way teachers interacted with male and female students in mathematics classrooms.

* Students' own beliefs. Research consistently finds that student attitudes and beliefs often differ in ways that reflect varying cultural heritage, an observation not surprising considering that cultural heritage and parental beliefs and attitudes shape students' beliefs and attitudes.

* Language. Researchers have examined how language differences for Chinese, (Geary et al., 1996), Spanish-speaking (Valverde, 1984), and Native American (Moore, 1994) students helped or hindered their learning mathematics concepts.

A RESEARCH AGENDA FOR CULTURE AND MATHEMATICS IN RURAL CONTEXTS

Barton (1996) outlined a classification scheme for research in ethnomathematics in three dimensions: time, culture, and mathematics. We might apply his scheme to our attempt to understand how mathematics is situated in a rural context in this way:

* Time: Examples include how early rural settlers used mathematics or how modern rural entrepreneurs use mathematics.

* Culture: Examples include the extent to which rural male teens value mathematics, whether rural girls are encouraged to pursue careers based on mathematics, or how rural teachers incorporate community issues or activities in mathematics lessons.

* Mathematics: Examples include the formal conceptions of mathematics held by rural teachers, their students, and community members or how mathematics is intuitively used by rural craftsmen and farmers.

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