The World Role of Culture in Mathematics Education

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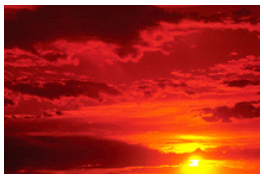
The sun shines on all: culture as a resource for meaningful mathematics learning



Culture consists of a complex of shared understandings which serves as a medium through which human minds interact in communication with one another.

(Stenhouse, 1967, p. 16)

Definitions of mathematics

- The language and science of patterns (Lyn Arthur Steen)
- The systematization of relationships (Ada Lovelace)
- The science of detachable relational insights (R. S. D. Thomas)

"Everything is mathematics" (like being swept away by a tidal wave) vs. "formal academic mathematics is the only valid representation of peoples' mathematical ideas" (like being stranded on a desert island)

(Wendy Millroy, 1992, pp. 11-13).

Whose mathematics is it?

Definitions of ethnomathematics: Ubiratan D'Ambrosio

- The way different cultural groups mathematize – count, measure, relate, classify, and infer (1984);
- The mathematics which is practiced among identifiable cultural groups (1985);
- The codification which allows a cultural group to describe, manage, and understand reality (1987);
- Ethno+mathema(ta)+techne's – communicated vertically and horizontally in time (1991).

Definitions of ethnomathematics: Paulus Gerdes

- Mathematics implicit or "frozen" in the cultural practices of Southern Africa (1986);
- A mathematical movement that involves research and anthropological reconstruction (1994).

Definition of ethnomathematics: Marcia Ascher

- The study and presentation of the mathematical ideas of traditional peoples (1991).

D'Ambrosio: *window on knowledge itself*
Gerdes: *cultural window on mathematics*
Ascher: *mathematical window on other cultures* (Barton, 1996).

Coming home to mathematics in local cultures

Principles for a mathematics course that takes culture into account

(Presmeg, 1998)

1. Each student is considered as having a unique sociocultural history; each student has ethnicity.
2. This ethnicity is a mathematical resource; mathematics may be developed from associated cultural practices.

3. Students can use their ethnicity in developing mathematical activities for sharing with their peers.
4. Since the sharing of elements of one's cultural or ethnic practices may be a sensitive issue, those who belong to a cultural group should be involved in making decisions about who should share the mathematics of its practices, and which practices should be shared.

Goals of multicultural education

- building tolerance of other cultures;
- eliminating racism;
- teaching the content of different cultures;
- teaching students to view the world from different cultural frames of reference.

(Spring, 1996)

Theoretical fields: potential to incorporate culture in math. ed.

- Historiography (D'Ambrosio)
- Cultural capital and habitus (Bourdieu)
- Borderland Discourses and cultural models (Gee; D'Andrade; Setati)
- Valorization (Abreu; Bishop)
- Situated cognition (Lave)
- Semiotics (Saussure; Peirce; Presmeg).

Historiography was the outcome of D'Ambrosio's original concern to valorize the mathematics of colonized and oppressed people (cf. Paolo Freire, 1970).

- Archeological and historical in nature;
- Visions of world knowledge through the sociology of mathematics.

- Helaine Selin's (2000) edited book, "Mathematics across cultures: The history of non-Western mathematics" (including mathematics of Iraq, Egypt, Israel, the Incas, Sioux of North America, Pacific cultures, Australian Aborigines, mathematical traditions of Central and Southern Africa, India, China, Japan, and Korea).
- Claudia Zaslavsky, Glendon Lean, Rijk Pinxten, and many others.

Cultural capital and habitus (Bourdieu)

- Sociological constructs of *capital: economic; cultural; symbolic, linguistic.*
- Ancient Aristotelian term *habitus:*

"a set of dispositions which incline agents to act and react in certain ways" (1995, p. 12).

- *Symbolic power and symbolic violence.*

Borderland Discourses (Gee)

Symbolic violence leaves a theoretical gap: individuals may choose, or choose not to, construct particular knowledge.

- *Borderland Discourses:* "community-based secondary discourses" between primary (home) and secondary (school) cultures (1992, p. 146).
- From cultural conflict to cultural mediation (Bishop, 2002).

Cultural models (Gee)

- "'First thoughts' or taken for granted assumptions about what is 'typical' or 'normal'" (1999, p. 60; used by Setati, 2003).
- *Folk model:* "A cognitive scheme that is interactively shared by a social group" (D'Andrade, 1987, p. 112).

Cultural models are treated within a culture as if they are obvious facts about the world.

Valorizing mathematical practices (Abreu, Bishop, & Pompeu)

- Research with Portuguese, Brazilian, and British children, who denied the value of mathematics in their out-of-school practices.
- Allied to *privileging* (Wertsch): children construct identities associated with mainstream or marginalized groups.

Situated cognition (Lave)

- Cognitive apprenticeship and *legitimate peripheral participation*.
- Interplay of knowledge on the societal and psychological planes.

BUT issues of intentionality and recontextualization separate apprenticeship and classroom situations.

Out-of-school activities differ from those in school

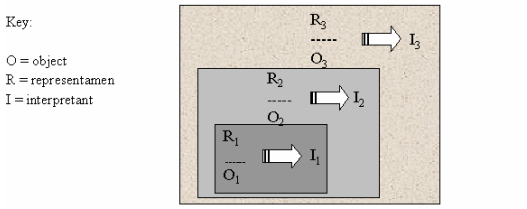
- The *goals* of activities in the two settings differ radically.
- *Discourse patterns* of the classroom do not mirror those of everyday practices.
- Mathematical *terminology* and *symbolism* have a specificity that differs markedly from the useful ambiguity of terms in everyday conversation.

Use of semiotics in linking out-of-school and in-school math.

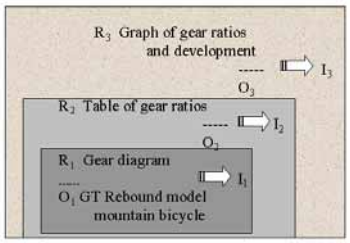
Bridging the apparent gap between out-of-school and in-school mathematical practices.

- Saussurean semiotics – chaining of signifiers;
- Peirce's triadic model of object, representamen, and interpretant – a nested lens, with webs of signification.

Components of a nested lens



Vivian's mountain bike mathematics



Linking home and school mathematical practices

Students' own ethnomathematics:

- sports such as baseball (USA) and golf (Scotland)
- American marching bands
- mathematical elements of the I Ching (China)

- national flags (Jamaica, South Korea)
- music, e.g., Gospel music, Italian music, Irish music
- counting in American sign language
- games around the world, e.g., bridge, mancala
- stick charts used in Pacific traditional navigation

Empirical fields that incorporate culture in mathematics education

- Linking mathematics learning out-of-school and in-school (Brenner; Civil; Cobb & Yackel; Moschkovich; Presmeg; and others - Laridon).
- Culture of mathematics in the workplace (FitzSimons; Magajna & Monaghan; Noss, Hoyles, & Pozzi; Smith) – *demathematization*, but contingently.
- Influences of technology on mathematical culture (Kelly; Paul Yu).

Culture and mathematics: learning together in harmony

"My words echo
Thus, in your mind.
But to what purpose
Disturbing the dust on a
bowl of rose-leaves
I do not know."

(T.S. Eliot: Burnt Norton)