

Ethnomathematics as a Fundamental of Instructional Methodology

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Abstract: Over the past two or three decades, various political, cultural, and educational forces have brought ethnomathematics and multiculturalism in general into widespread use. Thus, it is important to include ethnomathematical studies in teaching methodology and especially teacher education programs.

Kurzreferat: *Ethnomathematik als Grundlage der Unterrichtsmethodologie.* In den letzten 20 – 30 Jahren haben verschiedene Kräfte aus Politik, Kultur sowie Bildung und Erziehung für eine weitverbreitete Nutzung ethnomathematischer und multikultureller Ideen gesorgt. Es ist von daher wichtig, Ethnomathematik in den Unterricht und insbesondere in Lehrerbildungsprogrammen zu integrieren.

ZDM-Classification: D30

When ethnomathematics was proposed in the 1970s and 1980s as an area of study in mathematics education, it had the look of something new and exotic. The idea of looking at mathematics in other cultures and using these findings in an ordinary classroom may have seemed strange to most teachers and, at best, considered as a possible topic for enrichment. In many parts of the world, mathematics instruction was based entirely upon a European model of content, structure, and algorithms. School curricula as well as instructional practice had gone through reforms such as the “New Math” programs of the 1960s, but remained largely centered upon European (and later, American) patterns that had been established decades earlier.

The plenary address of D’Ambrosio, “Socio-Cultural Basis of Mathematics Education”, at the Fifth International Congress of Mathematical Education (D’Ambrosio 1984) was considered somewhat surprising in that social and cultural issues in mathematics education had not been extensively discussed beyond a few issues of gender comparison or similar comparative studies. The feeling was common that mathematics was mathematics, (and that usually meant mathematics was European mathematics). There might be sociological issues in terms of applications of mathematics, but the teaching and school content seemed constant and removed from issues of culture. History and culture of mathematics seemed to be little more than a frill of enrichment.

However, that was before the wave of multicultural studies swept over the whole areas of curriculum and instruction. It was before the recognition that populations in many countries of the world were becoming increasingly diverse. Also, it came before most educators noticed that mathematics education must reach out to attract the underrepresented groups for broader diversity and equity in mathematics. The civil rights movement in America, the new independence of many third world countries, and a more liberal view of education called for a wider curriculum. These concerns were to grow rapidly in the 1980s and 1990s (National Research Council 1989;

Trentacosta 1997). Multicultural examples were incorporated into the content of courses. Sometimes entire courses were developed on multiculturalism and it even became an option for a degree major in some universities.

The increased mobility of peoples around the world have brought diverse populations into many previously homogeneous societies with school children from many cultures meeting together as an everyday part of many classrooms. North Africans and Turks are part of the European school scene; as well as Indonesians in the Netherlands; and African, Caribbean, and South Asian students filling desks in Britain. Intracontinental migration brings newcomers to African schools; East Asians are in Australia; and the US, long a “melting pot” of cultures, hosts increasing numbers of East Asians and Latinos, in schools where sometimes as many as twenty languages are spoken by the students. In addition, in many countries where schooling had been a luxury for the elite, education has begun to be considered as a right for all, thus bringing a much wider range of students into the classrooms. It has become very relevant to make sure the content of the mathematics curricula reflects these diversities.

The past two decades have seen ethnomathematics and multicultural approaches become much more widespread – even commonplace – in the K-12 schools of America and around the world. An interesting comparison can be seen in Yearbooks of the National Council of Teachers of Mathematics (NCTM). In the years of the 1970s and early 1980s, there was no mention of cultural groups. The 1990 Yearbook (Cooney 1990), which was intended as general survey of mathematics education for the 1990s, had separate chapters on mathematics education for various groups – girls, Hispanics, African-Americans. The 1995 volume (House 1995) included several chapters with ethnomathematical themes, and in 1997, the entire yearbook (Trentacosta 1997) was devoted to diversity and equity issues. By 2000, the yearbook (Burke 2000), again intended as a forward-looking survey, has a chapter on international connections via the Internet and another on “mathematics equity pedagogy” where the cultural diversity is assumed and incorporated into the pedagogy.

Multiculturalism has become a part of many curricula at national, state, and local jurisdictions. National accreditation bodies (such as the National Council for Accreditation of Teacher Education, NCATE, in the United States) *require* teacher education programs to demonstrate diversity in curriculum, instructional approach, faculty, and student body.

Mathematics textbooks at all grade levels now include worldwide and multicultural themes in expositions, examples, and regular exercises, in addition to enrichment sidebars. A sampling of instructional materials includes the Mimosa large-format materials for young children, which show mathematical uses from around the world (Irons, Burnett, and Hoo Foon 1993) and the many multicultural mathematics posters from Swienciki (1981–), each with an artistic rendition of the mathematics of a particular cultural group. *Building Bridges to Mathematics: Cultural Connections* (1992) offered a set of problem and project cards for students to

practice mathematics from various cultures. Zaslavsky, who had written one of the earliest books to focus on African mathematics (Zaslavsky 1973), returned with several books of multicultural activities, games, and puzzles in mathematics (Zaslavsky 1993; Zaslavsky 1996). Catalogs and conference exhibitions now show many others with suggestions for classroom application of ethnomathematical examples and ideas. Histories of mathematics have broadened their scope to include mathematics from non-European sources. Examples include Boyer and Merzbach (1989) and Katz (1998), as well as Joseph (1992), which focuses entirely on non-European mathematics. Others, more theoretical or philosophical, e.g., Ascher (1991); Bishop (1988); Eglash (1999); Gerdes (1988); Nelson, Joseph, Williams (1993); and Powell and Frankenstein (1997); have now appeared to deepen teacher's understanding of the issues of ethnomathematics and give further examples of mathematical contributions from world cultures.

Conferences of mathematics teacher organizations often now have regular sections devoted to cultural issues. The Sixth International Congress of Mathematical Education, following from D'Ambrosio's address at the fifth ICME, offered one entire day for societal and cultural issues in mathematics education, and since then, there have regularly been Topic Study Groups on ethnomathematics. Similarly, in the US, the National Council of Teachers of Mathematics has included more and more sessions related to ethnomathematical themes. The International Study Group on Ethnomathematics has grown from its 1985 start and has flourished to the extent of organizing its own international congress in 1998 in Spain, with plans for another in 2002 in Brazil. A variety of other conferences and teacher workshops on local, national, and international levels have been organized.

No longer is ethnomathematics an add-on, a frill, or an enrichment topic. Rather it is at the heart of instructional methodology. Teachers see their diverse classrooms and must reach out to their entire class. Beyond boosting minority interests and self-esteem, it is necessary to prepare majority students to work in a diverse, multicultural world, with recognition that the majority is not the only group which has made or can make contributions to mathematics. Teacher education programs have incorporated study of multicultural classrooms into the pre-service preparation of teachers. Teachers must learn special instructional skills to accommodate different backgrounds and different learning strategies. It has now been recognized that culture can determine the student's feeling toward participation in class discussion, initiating questions, acceptance of authority, memorization of facts, seeking innovative ways of understanding, and many other aspects of classroom education. Misreading the cultural signs can cause teachers to misunderstand the student's learning process or even mistake a natural response for unwillingness to learn. Hence, as spelled out in the "teaching standards" (NCTM 1991, p. 25), a key to successful instruction is the teacher's "knowledge of students' understandings, interests, and experiences" and "knowledge of the range of ways that diverse students learn mathematics."

Two of the key processes of mathematics described in the NCTM *Standards* (NCTM 1989, NCTM 2000), are "communication" and "connection". Both of these relate to ethnomathematics:

Communication means students expressing their thinking and exchanging their ideas amongst themselves. The *Principles and Standards* (NCTM 2000) document says instructional programs should enable students to "communicate their mathematical thinking coherently and clearly to peers, teachers, and others". The teacher must encourage the participation of all and emphasize the value of everyone's contribution to the learning process. Students learn by trying out their ideas, so there must be an atmosphere of trust where "students will feel free to express their ideas" (NCTM 2000, p.60). These student ideas may be challenged and defended without criticizing, and the concepts can be molded until all agree and understand. More direct to the multicultural experience, student should become able to "analyze and evaluate the mathematical thinking and strategies of others". Thus, students are learning from each other and recognizing the contributions everyone can make. Also, they are assessing each other's ideas and gaining from multiple perspectives on a mathematical situation. This is really just good instruction, but in a diverse classroom, it requires cross-cultural communication and multicultural values.

Another "process standard" from NCTM, *Connections*, is even more closely tied to ethnomathematics. "Connections" means finding links within mathematics, between mathematics and other subject areas, and for mathematics as a part of the learners' everyday experience. As suggested in Shirley (1995) and Masingila (1995), ethnomathematics is a key to finding those connections – within mathematics as cultural groups blend two or more mathematical areas to meet their needs; to other subject areas such as art, geography, economics, etc., as one looks at other cultures; and to the local culture of the learners by incorporating local mathematics. Students need to be able to "recognize and apply mathematics in contexts outside of mathematics" (NCTM 2000, p. 64). This might include the mathematics involved in their cultural heritage – religion, art, textiles, music, or festivals. It might also relate to mathematical studies of the economics and business of traditional daily life, the statistics of modern social concerns, or the politics of international issues.

With all of these considerations, it becomes clear that ethnomathematics is central to the process of teaching, to the methodology of instruction. It needs to be included throughout pre-service mathematics education programs. Elsewhere (Shirley 1998), I have suggested ways of incorporating ethnomathematics in teacher education. This might be as straightforward as broadening the content of courses to include worldwide history of mathematics and international and multicultural applications of mathematical content. It should also include discussions of multicultural views of the learning process in psychology and methodology courses. If possible, preservice or graduate programs might include specific ethnomathematics courses or modules, such as the course described by Presmeg (1998). These also have

become more common in recent years. As more professors and students become familiar with ethnomathematical ideas, they will be seen as a natural part of any mathematics teacher education program.

That is the important idea: Ethnomathematics is no longer an exotic frill to enrich mathematics classes. Rather, it is central to a broad view of mathematics – to demonstrate that mathematics is not the property of the West and that mathematics values – and even requires – the contributions of all for its continued progress. To make sure this message is carried to the new generations, ethnomathematics is crucial to mathematics teacher preparation. New teachers must be open-minded and ready to show this attitude to their classes. Ethnomathematics has come of age.

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