The Role of Ethnomathematics in Mathematics Education
Cases from the Horn of Africa[1,2]

Jama Musse Jama, Pisa (Italy)

Abstract: The aim of this paper is to highlight the role that ethnomathematics may have in the mathematical curriculum in the Horn of Africa. It is also a first attempt to document some social practices and native procedures that people living in this region use to manage their "daily mathematical problems". Examples from the local culture, which could be used to introduce mathematical arguments in the classroom, are described. The paper finally deals with the possible ways these cultural events may be included in the mathematical syllabi, such as coining new mathematics terms in the local languages, or as preparing mathematics textbooks and classroom activities.

Kurzreferat: *Die Rolle der Ethnomathematik im Mathematikunterricht. Beispiele vom Horn von Afrika.* In diesem Beitrag wird die Rolle, die Ethnomathematik im Mathematikunterricht am Horn von Afrika spielen könnte, beleuchtet. Außerdem wird ein erster Versuch unternommen, einige der sozialen Praktiken und nativen Methoden zu dokumentieren, die die Einheimischen dieser Region zur Bewältigung ihrer "mathematischen Alltagsprobleme" benutzen. Beispiele der lokalen Kultur, die bei der Einführung mathematischer Argumente im Unterricht verwendet werden könnten, werden beschrieben. Schließlich werden mögliche Wege aufgezeigt, wie solche kulturellen Eigenheiten in Mathematiklehrpläne integriert werden können, z. B. durch Einführung neuer mathematischer Begriffe mit Hilfe der regionalen Sprachen, oder durch Entwicklung entsprechender Mathematikschulbücher und Unterrichtsaktivitäten.

ZDM-Classification: C60, D30

1. Introduction

Twenty years ago it was argued that "The cultural placement of an educational system and of scientific structures is, probably, the most relevant fact in modern development of education, mainly in 'undeveloped' countries" (D'Ambrosio 1979). As for mathematics is concerned, in the last two decades many researchers have agreed that teaching must be related to its cultural and geographical context. The rise of ethnomathematics, an emerging field of mathematics and a strong mean of mathematical education, must be considered as a good response to the problems regarding the cultural component of education.

On the other hand, the explosive way of communication media and information technology (Internet, satellites etc.) have created further cultural dependency to the North hemisphere. This dependency is the major cause of the disappearance of traditional knowledge of many societies or identifiable groups of people, especially in the South hemisphere. Musse Ismail Galaal[3], in order to introduce his work on Somali traditional weather expertise and traditional astrology, wrote in 1970: "In trying to set down what I have learned of Somali weather lore I have become aware of many difficulties, and the complexity and uniqueness of the subject is one of them. But more than this, the fact that the beliefs and practices are unwritten, and handed down from generation to generation of scattered group of nomads, and differ somewhat with each group in the oral exposition of them, makes it extremely difficult to offer a comprehensive and consistent statement of what is generally held. It is moreover no easy task to explain this unwritten 'Bush Science' in a manner acceptable both to the culture one writes about and to the modern reader with quite different cultural ideas, and a quite different scientific outlook" (Galaal 1970).

All the difficulties mentioned in these excerpts apply today to ethnomathematics and its use in the Horn of Africa schools' syllabi. They represent the main obstacle to the first steps towards mathematical curricula for the schools, which should embody, or at least take care of, issues from the local culture and daily practices.

Moreover, the East African region, especially the Somali inhabited area, has been suffering political and social instability for the last two decades; this not only further degraded the school system and its value, but also accelerated the disappearance of this unwritten "Bush Science".

Bearing in mind the previous Galaal's statement, this paper aims at:

- making an attempt to document social practices and native procedures that people in the region use to manage their "daily mathematical problems";
- suggesting the schools mathematics curricula curators to include these cultural events in the mathematical syllabi, in other words to "think ethnomathematically".

Some examples from the Somali culture (Jama Musse/ Favilli (to appear)), which can be used to introduce mathematical arguments in the classroom, are presented. Some of these "cultural" examples are compared with the "alien" ones used in the current Somali mathematics school textbooks.

2. Traditional culture and science

Although in the recent years many social professionals and educational researchers have become aware of the so-called indigenous knowledge, many groups of people continue failing to include their own knowledge in their development issues. This fact not only creates further difficulties in the progress of these groups, but also promotes the disappearance of their histories and of last traces of their cultural heritage.

In the Horn of Africa, especially in the Somali inhabited area, very little is known about local traditional knowledge. The main reason is due to the Somalis nomadic

[1] A presentation to the First International Conference on Ethnomathematics, University of Granada, Spain, September 2–5, 1998

[2] The Horn of Africa area I am interested in covers the late Republic of Somalia (funded in 1960, and resulted from a merger between British Somaliland Protectorate and Italian Trust Territory of Somalia), The Republic of Djibouti (ex-French Somaliland), as well as some regions of Ethiopia and Kenya of Somali origins

[3] Musse X. Ismail Galaal was the most prominent Somali educator who dealt with Somali traditional aspects in astronomy. His interest in the relationship between poetry and the traditional lore concerning weather and the movements of the celestial bodies led him to discover important issues on Somali indigenous knowledge (Galaal 1968, Galaal 1970).

life; thus, Somali culture has only been orally transmitted throughout the centuries, with no written records of their history. The Somali became a written language in 1972 only.

However some remarks on traditional knowledge in the Horn of Africa were reported in several fields of science; for instance in astronomy, medicine, animal husbandry and in agriculture (see for example Galaal 1968, Galaal 1970, Ali 1983, Puffer 1997). Some of these development attempts have survived the domination of Western science, which prevented this indigenous knowledge from progress, accumulation and growth.

As far as mathematics is concerned, examples specifically related to the Somali traditional life are shown in Jama Musse/Favilli (to appear). These examples are also classified according to the fundamental activities which are necessary and sufficient to develop mathematical knowledge: counting, locating, measuring, designing, playing and explaining (Bishop 1988).

This paper attempts to contribute to the revival and development of this cultural heritage and to its full incorporation into the school syllabi.

3. Background of Somali schools (before the war)

Until recently the Somali educational system was totally centralised and the schools were run by the State. According to the Somali Educational Code, enacted on July 31, 1972, the school system was subdivided as follows: primary school (elementary and intermediate school, four years each); secondary school (four years); university and higher education institutions (four years). Primary school education was compulsory. There were also vocational and technical training schools. The elementary schools entrance age was at 6 years; students less than 15 years old could join the intermediate school provided they pass an evaluation examination (MING 1975). The school year lasted 9 months, in two terms: from December to May, and from July to September.

Only in the early 1970's a unified curriculum and syllabi were introduced and imposed in all regions; since then, each region used its own educational system coming from the colonial domination.

Somali became the official instruction language in 1972. The Somali language was introduced in the first four years of primary education. Within the following three years Somali became the official language of instruction in all pre-university stages of education. A slow process of somalization in the university was on the way; in some departments – in the faculties of law, economics and the Lafole College of Education – the lectures were already given in Somali.

The only textbooks available for schools were produced in Somali language and distributed free of charge by the Ministry of Education. In the early 1970's, all private schools and printing presses were nationalised (MING 1975). Therefore, single schools had neither freedom of choosing nor availability of alternative textbooks to use.

Students wishing to enrol at the university had to pass the General Certificate Exam: a national examination prepared by the Ministry of Education and administered at the end of each school year. A student had to undertake a two years national service (military duties). The formation of schoolteachers was taken at Lafole National Teacher Training Centre (later it became the Lafole College of Education after it joined the National University in 1972). Throughout the period 1963–1972 all teacher-training facilities were being centralised at Lafole Centre, and primary teacher training programmes at Hargeisa and Amoud were phased out.

4. Problems regarding mathematical education in Somalia (before the war)

As the secondary school curriculum has never been reviewed, most of Somali students followed a program completely outdated. Moreover, the overloaded program in the school curriculum caused the textbooks to contain excessive mathematical syllabi, which were appropriate neither to the students' level of attainment nor to the teachers' ability to handle them.

The total absence of review to the initial attempt of drafting maths textbooks, the poor preparation of the school teachers, and the shortage of the Somali mathematical terminology resulted in a decrease of educational quality in the secondary schools. This fact also increased the gap on mathematical knowledge between the school and the university. A specific difficulty in geometry for Somali students attending the university was observed (Favilli/Jama Musse 1996b).

Another matter which caused a serious problem for students was the Italian language, imposed as the instruction language at the Somali National University. The Italian language was not learned in the secondary schools. Intensive pre-university courses of Italian language were organised, however, the textbooks were published in Italy and written for native Italian speakers, thus for students with a different educational background. Moreover all the examples taken in these books were culturally specific.

5. Education in Somalia (current situation)

Somalia today no longer functions as a state. The civil war broke out in 1988 in the north region of the country and spread to the capital in 1990; it resulted in a division of Somalia into regions ruled by different political and clan groups. This protracted civil war left much of Somalia in ruins. Although in some regions clan conflicts continue, others have reached a post-conflict status where the transition from international relief to development is taking place.

In these latter regions schools are re-opening with great difficulty in terms of organisation, means, infrastructure and teaching staff. The time is, therefore, appropriate to review the educational system. In particular, mathematics educators should review the school program: the curricula, syllabi, mathematical terminology, the textbooks and teacher education.

6. Ethnomathematical program

As pointed out in Vithal/Skovsmose 1997, "within the research and writing in ethnomathematics, it is possible to identify at least four strands": a first strand deals with historical aspects in non-western mathematics; a second

strand analyses the mathematics of traditional cultures; a third one explores the connections, from the mathematical point of view, between cognition, culture and context; the last strand focuses on the relationship between ethnomathematics and mathematics education.

The term "ethnomathematical program", includes a study on all strands, with a particular stress to the last one, in order to identify, publish and promote new teaching methods, which try to incorporate issues from the local culture.

7. A place of an ethnomathematical program in the curricula

As stated in Cockcroft 1982 , "Mathematics provides a means of communication which is powerful, concise and unambiguous", therefore mathematics textbooks, which represent an (the most) important medium to express mathematical concepts, must be written in "a special language" which avoids the use of vague expressions, metaphoric statements and implied sentences. This "special language" cannot be taken as "a simple translation" from another language (usually coming from a very different cultural heritage).

An ethnomathematical program should be expressed in the three main strands a curriculum is usually organised: objectives, contents and methods. More specifically an ethnomathematical program should apply in the following and related points:

- mathematical terminology
- mathematics textbooks
- teachers' preparation courses
- activities in the classroom.

If, on one side, we agree that mathematics education must deal with cultural and social issues, on the other side there is the risk for a new curriculum to contain as more indigenous mathematics as possible. If taken as a folkloristic element, it may scorn both the value of mathematics education and the value of the culture. This concept must instead be seen as a powerful mean to help students understand the value of mathematics.

8. Some examples

In Jama Musse/Favilli (to appear) examples from the Somali culture to be used to introduce mathematical notions in the classroom, as well as the examples taken in the textbooks, are reported. The following are some of them.

Example A

Trading in a livestock market: the inhabitants of the coastal area in the Horn of Africa developed the art to bargain under a cloth. Both parties sit one in front of the other, holding their right hands. The price of the article to be sold is communicated by clasping fingers (Jama Musse/Favilli (to appear)). A similar way of communicating numbers, used in East Africa, is reported in Zaslavsky 1973. The first Europeans who explored the Horn of Africa region also wrote on this trading method. See for example Sir Richard Burton (1821-1890) in his "First Footsteps in East Africa" (Burton 1987).

Example B

A classical Somali fable known as "Qayb Dacawo (fox apportionment)": this fable, which interests Somalis has nothing to do with school mathematics, can be fit as a good example to introduce important mathematical notions, such as the sum of series, infinity and limit (Jama Musse/Favilli (to appear)).

Finally, many unappropriate examples are still used to introduce mathematical notions. A good example is probability. In fact, reading the textbooks in Somali language, a well-known exercise by playing cards is often used to introduce the concept of probability: "Extract one card from a 52 box playing-cards; calculate the probability that the extracted card is of a particular symbol". However, in some families playing cards is considered morally incorrect! Another example is to play dice. If the student has never heard about the die, the teacher must first describe what a die is and how to play the game; only after that he will be able to explain the concept of probability. Wouldn't it be better if examples from the local culture and traditional games were collected to introduce these notions?

9. Conclusions

The decision-makers on mathematical education in many regions, like the Horn of Africa, are faced with a double challenge. On one hand they have to endorse the changes of information technology to prepare students for tomorrow's jobs and to proceed to further education. On the other hand they should include cultural issues which could help students in learning mathematics.

There is, however, no doubt that every culture has its own "science", which is part of its inheritance and the result of the struggle for its survival. This "science" must not only be preserved in the museums, but it must also be used to achieve better results in the development and education, thus by incorporating it into the school curricula. This may also be the role an ethnomathematics program can play in mathematical education.

The goals of such a program are also addressed to those students belonging to specific populations, whether they are in a mono- or a multicultural society.

The suggestion is to cover the gap between the past and the future by collecting examples from the traditional culture on one hand, and examples from information technology and software on the other. In doing so, a student may enrich his experience and enlarge his vision, both resulting in a better understanding and learning of mathematics.

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Author
Jama Musse Jama, (c/o) Dipartimento di Matematica, Via Buonarroti, 2, I-56100 Pisa, Italy.
E-mail: jama@dm.unipi.it

Vorschau auf Analysethemen der nächsten Hefte

Für die Analysen der Jahrgänge 31 (1999) bis 32 (2000) sind folgende Themen geplant:
– TIMSS
– Computergestütztes Lösen offener Probleme im Mathematikunterricht
– Mathematikdidaktische Forschung im Primarbereich
– Mathematik an Hochschulen lehren und lernen
– Analysis an Hochschulen
– Mathematik in der Ingenieurausbildung
– Theoretische Betrachtungen zu Schulbuchanalysen.

Vorschläge für Beiträge zu o.g. Themen erbitten wir an die Schriftleitung.

Outlook on Future Topics

The following subjects are intended for the analysis sections of Vol. 31 (1999) to Vol. 32 (2000):
– TIMSS
– Computer-aided solution of open problems in mathematics teaching
– Research in primary mathematics education
– Teaching and learning mathematics at university level
– Calculus at universities
– Mathematics and engineering education
– Concepts and issues in textbook analyses.

Suggestions for contributions to these subjects are welcome and should be addressed to the editor.