CONCEPTUALIZING ETHNOMATHEMATICS AS A BRIDGE BETWEEN PEACE AND CONFLICT: THE CASE OF CULTURAL ARTEFACTS

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Lack of peace and peaceful living is an international concern. Where tranquility abounds (unlike conflicts) there is love, unity, and much is accomplished. Thus the paper discusses how the ethnomathematics program can be used to instill the concept of peace and peaceful living in learners' minds. The paper argues that in most cases conflicts result from ignorance about other nations' culture or ways of knowing, which in most cases, are expressed in artifacts such as painting, basket weaving, etc. Using examples from the Botswana's mathematics syllabus for junior secondary level, the paper shows how ethnomathematics can be used as a bridge between peace and conflict in schools.

Introduction

Like other African people, Batswana[1] treasure peace and tranquility. Living together in harmony is a virtue that every family and/or community strive for simply because "to be human is to belong to the whole" (Mbiti, 1988:2. Children are taught a principle of Botho (humane) which encompasses honesty, respect, tolerance, friendliness, and compassion from childhood. In fact, peaceful living is intrinsically intertwined with the country's principles of democracy, development, unity, self-reliance and Botho; all of which are encapsulated within the ideology of *kagisano* [social harmony] (Botswana, 1977). The Setswana language, for instance, is seen as a cord that binds ethnic groups and cultures together, and thus the country's vision is that:

> By 2016, Botswana will be a united and proud nation, sharing common goals based on a common heritage, national pride and a desire for stability. … The country will still possess a diverse mix of cultures, language, traditions and peoples sharing a common destiny. We will harness all of that diversity. We will have achieved ethnic integration and full partnership to create a nation in harmony with itself" (Botswana, 1997).

[1] The country is Botswana, the people are Batswana, and the language is Setswana

The government believes that religion has a greater part to play in imparting the values of peace and stability to people, and accordingly the country's constitution entitles each citizen to freedom of worship. No wonder Botswana has enjoyed the absence of tribal and ethnic conflicts and is usually characterized as stable and peaceful by observers.

Education is regarded as an indispensable tool through which to transmit the principle of *kagisano* from one generation to the other. Likewise, D'Ambrosio believes that if the ethnomathematics program is infused, mathematics education can instill in students the attitude and value of peace and peaceful living. Following the ideology of social reconstructionism, D'Ambrosio contends that mathematicians and mathematics educators can sensitize their learners about universal problems facing humankind such as wars and conflicts. He believes that it is teachers' obligation to develop students' critical consciousness (McNeil, 1996) so they can act responsibly with the new knowledge acquired. For instance, educators can and should challenge students' beliefs and help them detest all types of unfairness including degrading other cultural groups (D'Ambrosio, 2007). His contention is that through this kind of approach to teaching mathematics, students would develop respect both for self and others, thus developing inner peace, social peace, environment peace and military peace. Thus "ethnomathematics practices in schools favour respect for the other and solidarity and cooperation with the other. It is thus associated with the pursuit of PEACE (D'Ambrosio, 2007:34). This paper explores one way in which ethnomathematics program could be used in the mathematics class to imbue in students' minds, the concept of peace and peaceful living.

Background

By ethnomathematics Ubiran D'Ambrosio meant the mathematics found in identifiable cultural groups from mathematics taught in schools. The identifiable cultural groups included ethnic groups and others who apply mathematics in their various jobs/careers such as engineers, bakers and house wives. Thus ethno-mathematics encompasses all

cultural attributes such as ‘language, codes, values, jargon, beliefs, food and dress, habits, and physical traits” related to quantitative activities including “ciphering, arithmetic, classifying, ordering, inferring, and modeling’ (D’ Ambrosio, 1987: 2-3, cited in D’Ambrosio, 2001:308).

The works of Lave (1988) with women doing grocery and Manyika (2002) with housewives and kombi (public transport) conductors are examples of the search to understand how these groups use mathematics in their cultural corners.

Much of the ethnomathematical research has however focused on ethnic-mathematics. Examples of such research include Africa counts by Zaslavsky (1973) who worked with African societies on quantitative techniques and practices including games and past times; Ascher and Ascher’s (1991) worked with Incas of Peru who stored data on quipu, a mop like ornament with slender, knotted cords tied along a thicker, main cord (Rauff, 2003). Other works include basket weaving in Southern Africa women by Gerdes and the graph theory practiced by the Tshokwe people in Africa, to mention just a few.The abovementioned research has shown without doubt that almost every society has its own intuitive ways of dealing with quantitative needs. For instance, Garegae (2005) explored how Batswana used to measure volume and weight. Onstad, Kasanda and Kapenda (2003) also investigated the mathematical activities of the people of northern Namibia, particularly working with meat sellers, basket weavers, and house and barn makers.

The current debate in the area of ethnomathematics is about its integration/infusion in the curriculum with the aim of contextualising school mathematics (Garegae-Garekwe, 1998) which is believed to be abstract and difficult. Cherinda (2005) has incorporated twill weaving in a mathematics class to help students see relationships between school mathematics and home artefacts. Because the ethnomathematical research has overlooked the cultural messages represented by these artifacts (Garegae, in press), focusing only on the artistic and esthetic manifestations represented by arithmetic/algebraic and geometric patterns embedded in the objects, the integrated indigenous knowledge also become abstract and meaningless, thus failing to fulfill the intended outcomes. But Voltz (1982:

45) accentuates that cultural artefacts have some significance in the group and says that "The language of the shapes, the designs, the myths, and the colors, confirm the community's sense of reality and give it control over its own time and its own space", and that "when masks are used without full knowledge of the code, their articulative power is reduced to a confused stammer" (Voltz, 1982: 41).

The above quotations confirm that cultural artefacts are not made only to "adorn walls, ceilings, baskets, utensils, clothes, jewellery, and even the human body itself, …but … may serve religious purposes as well" (Onstad, Kasanda & Kapenda, 2003:40), in addition to containing cultural messages (quantitative & qualitative) that are of high importance to a cultural group. This paper explores the question: How can teachers use the ethnomathematics program to inculcate an attitude of tolerance and peaceful living in the minds of secondary school learners?

Theoretical framework: Causes of conflict

Conflict between families, local and trans-national societies

Peace is an indispensable commodity. Its absence results in turmoil within, between and among nations. When individuals feel that their rights have been trampled upon, they may show resistance or intend to revenge later. In situations where reconciliation failed, usually separation takes place, especially in families factions are formed and in the case of conflicts among local and trans-national societies, war breaks. One of the examples of family conflict is the Bakgatla tribe which divided into two factions—Bakgatla-ba-ga-Mmanaana and Bakgatla-ba-ga-Kgafela—when settling in Botswana. As a result of misunderstanding between two siblings, these tribes live in different locations—Moshupa/Thamaga and Mochudi, respectively. In local conflicts, ethnic groups may despise each other; hate each other to the extent of wanting the other party to extinct, Rwanda is a case in point. Religion, resources, and border lines may also cause conflicts and disputes, and such are sometimes based on the historical events concerning the tribes/ethnic groups.

Trans-national wars are commonly caused by conflicts over boundaries, resources or religion. For example, the Mfeqane wars fought in Southern Africa in the 19th century were territorial. Some wars are fought over natural minerals (e.g. gold in South Africa; crude oil in the Middle East). Still, others are caused by religion or worship. Watson and Boag (2003:7) in their literature review observed that religion reinforces tribal cohesion; hence inter-tribal marriages are looked upon with contempt and are vehemently discouraged. To underscore the divisiveness of religion among societies, Watson and Boag further say that:

> Where religion matters most in this context is in respect of people's interest in maintaining or defending boundaries between themselves and others. … Typically the social dimensions of religion; the ways in which people use religion as a banner of identity to define themselves versus others, operate with the same force and effect as other factors of ethnic differentiation (such as language) in creating discrete social categories (Watson & Boag, 2000:2).

We cannot divorce religion from cultural beliefs, values and norms. Admittedly, these attributes are expressed through worship for it is through it that people show respect and adoration to their gods. Therefore, religious conflicts are also about protecting cultural beliefs, values and norms.

Discussions above addressed conflict at macro level. But conflict may also exist at a micro level. Micro level conflicts, if nurtured for a long time may change into a macro level status. Because human nature is intertwined with violence and aggression (Hinde & Pulkinnen, 2000), conflicts among school children are not uncommon.

Conflict among school children

Schools do not exist in a vacuum. They are a miniature of the larger society, thus beliefs, values—good or bad—are enacted in schools and classrooms. For instance, if a class composes of one or two students from a minority group, classmates from the dominant groups are likely to despise such students, calling them names, if that is the norm of the larger society. Although teasing and bulling seem to be a natural phenomenon in schools, the victims develop hostility and aggression in the process (Hinde & Pulkinnen, 2000),

suppress it, and yet nurse it until the convenient time for revenge comes. Further still, the abuser's behaviour may be reinforced by signs of pain in the victim and would want to perpetuate the conduct even into adulthood. The childhood conflicts can continue later in life and may trickle down to subsequent generations resulting in a vicious cycle of hatred, jealousy and 'wars'.

Teasing, bullying and conflict among students, can be construed as resulting from misunderstanding between and among groups. The recognition of being different from "them", the '**us-them'** dichotomy, may lead students to despise the "other" regarding themselves as superior and/or deserving better service than the other party. They might think they are better civilized while the other group is backward, despite their lack of knowledge about the other party's ways of knowing, and how such knowledge is expressed and stored. How can the integration of ethnomathematics into the mathematics curriculum help to alleviate or eradicate this detestation between and within the world's societies? That is, how can ethnomathematics entrench in the minds of learners, the attitude of tolerance and learning to live together given that these are future nation leaders? This paper attempts to argue that ethnomathematics can be used to promote good values in schools which would ultimately result in harmonious understanding among learners of mathematics.

Ethnomathematics as a bridge between peace and conflict

> Although multicultural mathematics activities are important, they should not be our final goal. As our students experience multicultural mathematics activities that reflect the knowledge and behaviors of people from diverse cultural environments, they not only may learn to value the mathematics but, just as important, *may develop a greater respect for those who are different from themselves* (D'Ambrosio, 2001, 308) [emphasis mine]

Although ethnomathematics is construed in this paper as inclusive of ethnic-mathematics and application of mathematics in other disciplines, (e.g. engineering), this section restricts itself to multicultural mathematics activities with a focus on cultural

artifacts. As stated elsewhere, decorative patterns displayed on cultural artifacts are an expression of beliefs, values, taboos, and religion of the identifiable people whose culture they represent. A foreigner will only admire artistic patterns without comprehending the messages therein. For instance, in Botswana, an outsider might admire painted window panes (with mixture of cow-dug and soil) without knowing that they signify a mourning house. How [then], can mathematics educators "reaffirm, and in some instances … restore, the cultural identity of children" (D'Ambrosio, 2001:308) who come from different cultural groups?

As observed elsewhere and in the literature, conflicts result from misunderstanding. Misunderstanding means one party does not comprehend or is misinterpreting the other person's message (verbal or non-verbal). Misinterpretation can result from lack of understanding the medium of communication, and since the language and symbols are culturally situated, an outsider is bound to misunderstand the other participant to the extent of despising him/her. As D'Ambrosio has pointed out, teachers can use ethnomathematical knowledge to eliminate ignorance among school age going children. If for instance, students through discussions and activities, are made to realize and appreciate the complexity of codes, symbols, and quantitative activities of people from other cultures, they will be 'tamed' and develop attitudes of inclusiveness knowing that they are living in a global world with people of diverse backgrounds and abilities and that each is contributing meaningfully to development of the same.

Ethnomathematical Teaching approach for imparting peace and peaceful living values

The illustration in this section is based of a Junior Secondary School mathematics curriculum. The objectives for the topic Geometry are in Appendix A. To teach Form 1 (Grade 8), a teacher may use Figures 1, 2, and 3 which are patterns from quilts made by African-Americans as means of communicating secret messages during slavery (http://library.thinkquest.org/J0112604/index.htm).

Form 1 Objectives

1. Name polygons (square, rectangle, right-angled triangle, circle, isosceles triangle, equilateral triangle, kite, parallelogram, rhombus and regular polygons up to 10 sides)
2. draw the image of an object under reflection, rotation, translation and enlargement
3. identify a reflection, rotation, translation and enlargement
4. describe fully a reflection, rotation, translation and enlargement

A teacher may start by asking students to name shapes (**Objective 1, Form 1 syllabus**) in the pattern. After discussing properties of identified (and other shapes), s/he may ask students if they know the utility of the quilt pattern. Most students may not know any uses other than artistic adornment. At this juncture, the teacher would inform students the meaning of the pattern.

This pattern instructed the slaves to travel to the freedom and they always traveled in the northern direction.

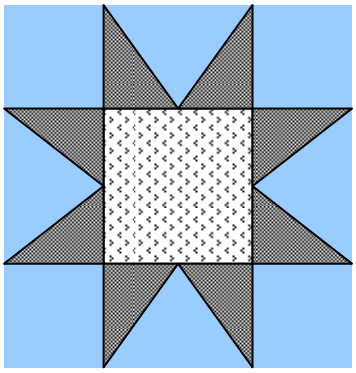


Fig. 1: Northern Star

Then afterwards engage in a discussion on the advantages of using quilts instead of pen/pencil and paper could have been. Students may give the following as reasons why slaves used quilts to transfer secret messages

- letters may not last long (durability of paper)
- paper may get wet during rainy seasons
- letters may be discovered by their masters and then got whipped
- Those who were illiterate could not read the message

The log cabin patterned quilts hang on safe houses on the underground Rail. Lamps were left lit, hence the yellow center

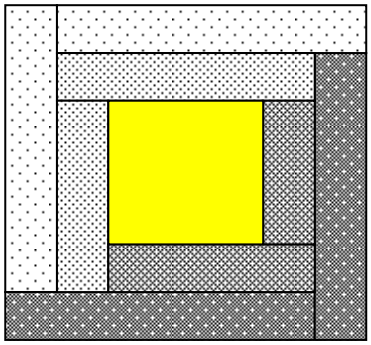


Fig. 2: Log Cabin

In this exercise students will appreciate the intellectual capability involved in the strategies of sending secret messages, and hence realize that the slaves were smart. The teacher may also ask students to speculate how knowledge of secret messages was transmitted from one generation to the other; a discussion that might enlighten learners on the importance of education in their lives and the role the teacher plays in the system.

The teacher would then ask students to use polygons learnt to make a pattern to improve the one shown to them. (**Objective 2, Form 1 syllabus**)

Still in Form 1, when addressing transformation, students will be asked to produce similar patterns using a combination of reflection, rotation, translation and enlargement (**Objectives 2, 3 & 4, Form 1 syllabus; Objectives 3, 4, 5, & 6, Form 2 syllabus).** Below is an example of questions/activities that can be given:

- Find out how the slaves came about with this pattern
    a) Don't use a ruler
    b) Use a ruler to measure

The teacher then should emphasize the importance of estimation (or making sketches) before the answer can be calculated.

Figure 2 also can be used in learning translation, rotation and enlargement.

Form 2 Objectives

1. sketch and draw the net of a 3-dimensional figure
2. find a point's position using direction (bearing), distances, and/or angles
3. describe fully a reflection, rotation, translation, and enlargement
4. recognize the differences between the transformations
5. estimate the size of an object in an enlargement or reduction using a known measure or scale factor
6. measure the real size of an object in an enlargement or reduction using a known measure or scale factor

Figure 3 can be used to meet most of the objectives—Form 1, objectives 3 &4; Form 2 objective 3 & 4—that of identifying transformations used to draw the arrows. Furthermore, Form 2's can be asked to make a frieze of triangles at the top and bottom of a cylinder net through a combination of reflection, translation, and reflection in that order. The same exercise can be repeated in Form 3 but using the concept of parallel and perpendicular line.

The flying geese told slaves to follow the migrating geese towards freedom. It also told them the best season to leave and the differently colored arrows indicated the direction in which they had to follow.

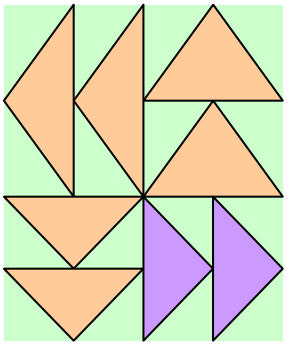


Fig. 3: Flying Geese

Form 3 Objectives:

1. Construct parallel & perpendicular lines
2. Construct triangles, quadrilaterals & regular polygons

Some of the questions that students could explore include the following:

- Using the concept of reflection/parallel lines, construct a flying geese pattern.
- Discuss how these women could have constructed this pattern without having measurement tools.

When using Figure 3 to meet objectives in the Form 3 syllabus, the teacher may first remind students that cultural artifacts makers depended on their skill of estimations, and underscore the importance of making rough sketches before doing the actual drawing. In the process of acquiring skills for constructing polygons, students can be asked to reproduce artistic patterns found in their respective homes/cultures through accurate drawings of polygons. They may also be asked to investigate if non-regular polygons can produce any systematic pattern.

Benefits of ethnomathematics teaching approach

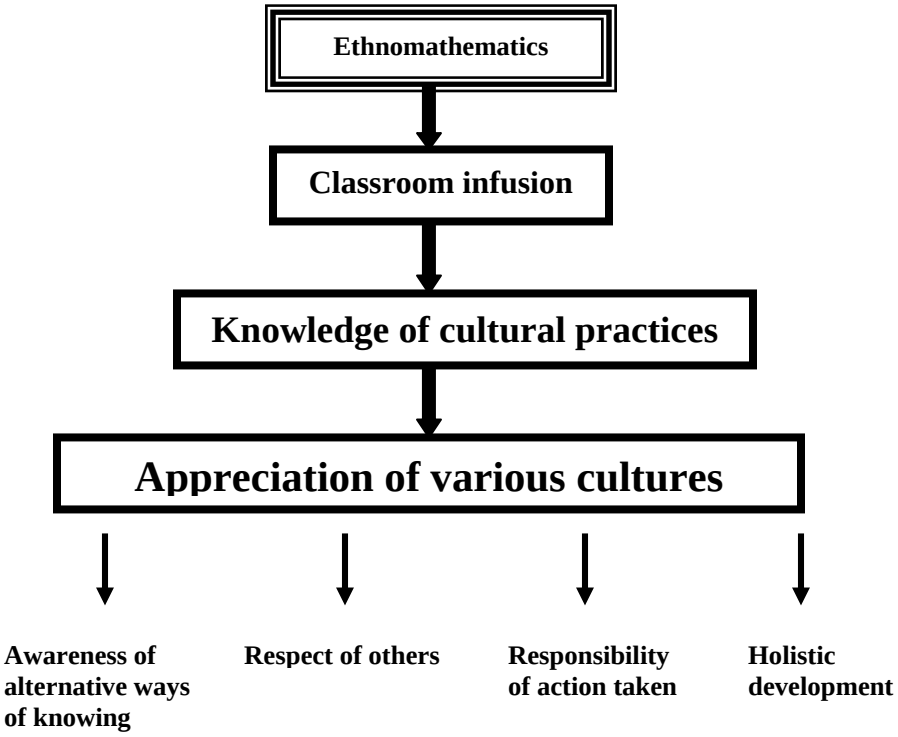
> Traditionally in mathematics classrooms, the relevance of culture has been strangely absent from the content and instruction. The result is that many students and teachers unquestioningly believe that no connection exists between mathematics and culture. Failing to consider other possibilities, they believe that mathematics is acultural, a discipline without cultural significance (D'Ambrosio, 2001:309)

In the process, students learn mathematics concepts and appreciate the works of other cultures, especially when they find the material challenging. They will realize that people in diverse cultures think differently, and that it would be unreasonable to despise them, making violence and hatred less likely to happen in schools. For instance, considering that the voluminous information/data in cultural ornaments are stored in a succinct manner, one cannot help it but admire the minds of those who first created them. Also, students will discover that mathematical knowledge is value-laden, and thus refuting the traditional approach of mathematics as observed by D'Ambrosio in the above quotation.

The ethnomathematics program, therefore, is an approach to teaching mathematics (and other subjects) with the aim of making students appreciate mathematics as a meaningful subject as opposed to an abstract, acultural subject, and at the same time building them into good citizenry by imparting values such as respect, peace, tolerance, equality, responsibility—considering others as human beings who think differently but not potential killers or 'objects' to be massacred by sophisticated weapons. Figure 4 below

summarizes the potential benefits of integrating/infusing ethnomathematics in the teaching and learning of school mathematics.

Figure 4: Potential Benefits of ethnomathematics in the school curriculum



Conclusion

The paper discussed ethnomathematics as a potential tool to end war and conflict among world cultures and nations. It showed how ethnomathematical knowledge can be used to imbue peace and peaceful living values to learners of mathematics. The paper argued that lack of knowledge about the other cultures is a source of misunderstandings that usually spark wars and conflicts, resulting in massive killings such as the one witnessed in Rwanda. Ethnomathematics is seen as having the potential to enlighten students about the quantitative indigenous knowledge of other cultures thus instilling in them invaluable values such as respect, tolerance and responsibility. Ethnomathematics, therefore, was regarded in this paper, as a bridge between peace and war.

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Appendix 1: **Excerpts of Junior Secondary School Mathematics Curriculum**

Level	Topic	General objective	Specific objective
Form 1	▪ Properties of polygons, symmetries, angles of polygons	a. Acquire knowledge on polygons and their properties	i. Name polygons (square, rectangle, right-angled triangle, circle, isosceles triangle, equilateral triangle, kite, parallelogram, rhombus and regular polygons up to 10 sides) ii. describe both line and rotational symmetries of polygons iii. calculate the sum of interior angles of a polygon iv. calculate the sum of exterior angles of a polygon v. calculate the missing angles in a polygon
		b. Acquire knowledge on angles and understand relationships between them	vi. identify acute, obtuse, right, straight and reflex angles vii. calculate angles using concepts of supplementary & complementary viii. identify vertically opposite, corresponding, alternate, interior angles ix. calculate the missing angles using the concepts of vertically opposite, corresponding, alternate, interior angles
	▪ Column vectors	c. acquire knowledge on vectors	x. add/subtract column vectors xi. multiply a column vector by scalar
	▪ Transformations (reflection, rotation, translation, & enlargement)	d. Acquire knowledge on transformation	xii. draw the image of an object under reflection, rotation, translation and enlargement xiii. identify a reflection, rotation, translation and enlargement xiv. describe fully a reflection, rotation, translation and enlargement
Form 2	▪ perpendicular and angle bisectors	a. Acquire skills in constructing perpendicular and angle bisectors	i. Construct an angle bisector, ii. Construct perpendicular bisector
	▪ 3-dimensional figures & drawing of nets	b. Acquire knowledge in 3-dimensional figures and their properties	iii. name cube, cuboid, cylinder, triangular prism iv. sketch cube, cuboid, cylinder, triangular prism v. use paper, wood, wire to make -3-dimensional objects vi. describe 3-dimensional figure when net is

			given vii. draw the net of a 3-dimensional figure
	▪ Elevation & bearing	b. Acquire knowledge on plans and elevations	viii. Acquire knowledge on plans and elevations
	▪ Transformations (reflection, rotation, translation, enlargement & application)	d. Acquire knowledge on transformation	ix. describe fully a reflection, rotation, translation, and enlargement x. recognize the differences between the transformations xi. mention real life examples of transformations xii. estimate the size of an object in an enlargement or reduction using a known measure or scale factor xiii. measure the real size of an object in an enlargement or reduction using a known measure or scale factor
Form 3	▪ Parallel & perpendicular lines	a. Acquire skills in constructing triangles, quadrilaterals & regular polygons	i. Construct parallel & perpendicular lines
	▪ Triangles, quadrilaterals & regular polygons		ii. Construct triangles, quadrilaterals & regular polygons

Source: *Junior secondary school mathematics curriculum. Ministry of Education, pages 5, 12, and 17*