Number in the Tolai Culture

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Abstract

This paper contributes to the field of ethno-mathematics and how Tolai people use number in their lives. The Tolai people live in the Gazelle Peninsular of the East New Britain Province of Papua New Guinea. Indigenous people throughout the world have mathematical knowledge in their cultures which is expressed through their languages and everyday activities. In this paper the author discusses past and current views on indigenous knowledge. She explains how number in used in the lives of Tolai people and makes links with the value of cultural mathematics in the school curriculum. The Tolai mathematical knowledge presented in this article is only one of the areas of mathematical knowledge that exists in the Tolai culture.

Keywords: indigenous knowledge, cultural mathematics, oral history

Indigenous knowledge

The Tolai people have an oral history therefore the author relates to Battiste's (2002) view that difficulty exists in reviewing indigenous knowledge because such knowledge is built up of complex sets of technologies that have been developed and sustained by indigenous civilisations. People within a particular culture understand the complexity of practises as they are passed on orally through the generations. As Battiste (2002:2) stated:

> [Knowledge] is transmitted through the structure of indigenous languages passed on to the next generation through modelling, practice and animation, rather than through the written word.

Indigenous knowledge is embedded in the cumulative experiences and teaching of indigenous people. Much of this knowledge is not written and cannot be found in a library as in the western world and other cultures with written histories. The limitation of some explanations of research findings is that a western interpretation may not reveal a true understanding of indigenous knowledge because it 'does not mirror classic Eurocentric orders of life' (Battiste 2002:2). Battiste further stated:

> It [indigenous knowledge] is a knowledge system in its own right with its own internal consistency and ways of knowing, and there are limits to how far it can be comprehended from a Eurocentric point of view.

During colonial times, indigenous knowledge was usually classified as primitive and was considered a hindrance to western progress and development (Smith, 1975; Nakata, 2002). However, in recent times, the utilisation of indigenous knowledge and skills has been encouraged in many fields of study, as well as being promoted through the formal school curriculum. Indigenous knowledge is a growing field of inquiry, both nationally and internationally, particularly for those interested in educational innovation (Battiste 2002:2).

Nakata (2002) in his discussion on indigenous knowledge claims that westerners now view indigenous knowledge as valuable but only because it serves their own self interests. They do not necessarily view it in the same way as indigenous people do. He refers to the work of Warren, von Liebenstein and Silkkerveer (1993) who point out that indigenous knowledge encompasses fields such as ecology, soil science, veterinary medicine, forestry, human health, aquatic resource management, botany, zoology, agronomy, agricultural economics, rural sociology, mathematics, management science, agricultural education and extension, fisheries, information science, wildlife management and water resource management.

As Nakata (2002) and Myer (1998) point out, although westerners are now interested in indigenous knowledge which contributes to the elevation of its status, their interest is largely driven by research into sustainable development practices in developing countries, the scientific community's concern about the loss of biodiversity of species and ecosystems and the future implications of that for planet earth. Nakata (2002) stressed that the human sciences' elevation of indigenous knowledge is driven by the academic interrogation of dominant discourses and the recognition and valuing of social and cultural diversity.

Nakata further points out that, in the humanitarian and scientific areas, scientists recognise that indigenous knowledge needs to be recorded and validated if it is to be incorporated into scientific bodies of knowledge and applied. Also agencies who are working in developing countries show an interest because they realise the importance of local knowledge in solving problems at the local level. Interested parties in indigenous knowledge are endless. As Nakata (2002) stressed, these people are not always interested in indigenous knowledge because it is unique, valuable and practical to the indigenous people but because of their own self interests.

Battiste (2002) adds another dimension to the viewpoints of Nakata by pointing out the contribution that can be made by indigenous academics. She states:

> The recognition and intellectual activation of indigenous knowledge today is an act of empowerment for indigenous people. The task for indigenous academics has been to affirm and activate the holistic paradigm of indigenous knowledge to reveal the wealth and richness of indigenous languages, worldviews, teaching and experiences, all of which have been systematically excluded from contemporary institutions and from Euorocentric knowledge systems (Battiste, 2002:4).

Battiste stated that westerners generally think that only they 'can progress and that indigenous peoples are frozen in time, guided by knowledge systems that reinforce the past and do not look towards the future' (Battiste, 2002:4). She argues that westerners frequently ignore the fact the western knowledge consists partly of knowledge that is of non European origin. For example the Greek alphabet is largely of Syrian/Lebanese origin and some western mathematical knowledge is of Mayan, Hindu and Arabic origin.

Battiste, Nakata and other indigenous academics support the preservation of indigenous knowledge because of its intrinsic value to indigenous people. Negative attitudes to indigenous knowledge in the past have often resulted in the non-use and loss of valuable knowledge. This is especially so in cultures with oral histories like Papua New Guinea.

Battiste suggests that one way of preserving culture in her homeland of Canada and elsewhere is through the school curriculum. This is evident in the current elementary years of schooling in Papua New Guinea where there is a syllabus for 'cultural mathematics' (Department of Education, 2003). Mathematics at this level of schooling is based on the everyday mathematics used in the community. The subject covers measurement, space, chance, pattern and number. The language of instruction is the students' vernacular which enables teachers to enhance students' understanding of mathematical concepts.

The recognition and acceptance of the value of indigenous knowledge and practices, and their inclusion in the Papua New Guinea school curriculum are positive steps towards the validation of the various bodies of indigenous knowledge. Students may then be able to relate their indigenous knowledge to that of other cultures. 'Cultural mathematics provides a sound foundation for future mathematical studies and the mathematical literacy necessary to do other studies' (Department of Education, 2003:iv).

Battiste (2002) stresses that caution should prevail when incorporating indigenous and western knowledge. While there are similarities that can be easily accommodated for educational purposes, there are also differences that are unique to each culture. These differences cannot be separated or compared with western cultures, but should be recognised as unique components of their particular cultures.

Ascher (2002) stated in her studies that mathematical knowledge had been used by many people around the world for centuries and is reflected in the work of artisans, craftsman, farmers, fishermen, healers, storytellers and traders. It manifested itself in beadwork, games, hairstyle, maps, painted designs and woven goods.

From an indigenous perspective, I will add that not only is mathematical knowledge expressed in these areas but is manifested in all activities that each group of people participates in, in their everyday lives. Mathematical knowledge is a dominant feature in the lives of indigenous people and is applied in virtually all practical activities. Number is one the areas of mathematical knowledge that is used extensively by my people, the Tolais.

Tolai indigenous number knowledge

The following section presents the Tolais' indigenous number system and how it is used in their everyday life. The indigenous number knowledge is discussed here in order to place such knowledge and its teaching strategies in the same position as the number knowledge prescribed in the current elementary and lower primary curriculum. It is an example of indigenous knowledge embedded in a particular language.

Ray (1891), Codrington (1885:225) and Schee (1901:247) recorded six lists of the Tolai counting. Lean (1994) discussed some of those counting systems in his study of the Tolai counting systems. He made visible the Tolai counting systems and how they are organized. His discussions on Tolai counting were presented from the perspective of a mathematics specialist. I will present this information from a language cultural perspective and in greater detail.

There are various ways of counting items in the Tolai society. Items can be counted individually from one to indefinite large numbers. For example, *tikai* (one), *a urua* (two), *a utulu* (three), *a ivati* (four), *a ilima* (five), *a lapikai* (six), *a lavurua* (seven), *a lavutulu* (eight), *a lavuvati* (nine), *a vinunu* (ten).

The Tolais can also count more than ten, for example, *a ura vinunu* (twenty), *a utula vinunu* (thirty), *a ivati na vinunu* (forty), *a ilima na vinunu* (fifty), *a lapikai na vununu* (sixty), *a lavurua na vununu* (seventy), *a lavutulu na vinunu* (eighty), *a lavuvati na vinunu* (ninety), *tikana mari* (one hundred).

They also can count more than one hundred. For example, tikana mari, (one hundred), *a ura mari* (two hundred), a utula mari (three hundred), *a ivati na mari (*four hundred), *a ilima na mari* (five hundred), *a lapikai na mari* (six hundred), a *lavurua na mari*, (seven hundred) *a lavutulu na mari* (eight hundred), *a lavuvati na mari* (nine hundred), *tikana arivu* (one thousand).

They can count beyond one thousand to large indefinite numbers. Individual numbers were either recorded using marks cut into wood called *kukutu* or bits of broken off fern leaves to represent numbers called *kikiniti*. A particular fern variety which has an even pair of leaves on each side of the fern stock was used for *kikiniti*.

Contributing to a feast is a form of investment so therefore items were counted in sets for easy recording, given our oral history. The recipients of the goods are expected to contribute in return the same quantity or more to the givers' future feasts whether they are marriage or death ceremonies. This counting is becoming invisible as it is now rarely used and individual item counting is now dominant.

Number in counting taro

Specific items available in the Tolai communities are counted in sets. For example; sets of fours, sixes, tens and twelves are used for counting. Taro used to be counted in sixes and tied together for trading purposes although this is not common anymore. Taro were counted as *tikana kurene* (one set of six), *a ura kurene* (two sets of six = twelve), and *a utula kurene* (three sets of six = eighteen). Now any number of taros are tied together and sold at the local markets for western currency.

Number in counting bananas

As well, whole bunches of bananas are grouped in fours for recording purposes primarily for contribution to feasts and for recording purposes. For example, *a inangava* (one set of four), *aura inangava* (two sets of four = eight), and *a utula inangava* (three sets of four = twelve).

Number in counting wild fowl eggs

Wild fowl eggs are still counted in fours for recording purposes in commercial activities. For example, *tikana kevai* (one set of four), *a ura kevai* (two sets of four = eight), and *a utula kevai* (three sets of four = twelve). Currently these are paid for with *tabu* (shell money) and western/modern currency. The seller determines the currency to be used in such cases. One wild fowl egg is worth *a tura malimalikunu* or one kina fifty toea (K1.50, Papua New Guinea currency). Like the counting of bananas, this way of counting of wild fowl eggs is also beginning to become invisible and is now rarely used. Individual item counting is now dominant and people can now record items in print.

Number in counting peanuts

Peanuts are tied in small bundles and recorded in sets of ten for commercial purposes. So they can be counted; *tikai*, (one), *a urua* (two), *a utulu* (three), *a ivati* (four), *a ilima* (five*), a lapikai* (six), *a lavurua* (seven), *a lavutulu* (eight) *a lavuvati* (nine) and *tikana pakaruati* (ten). They can also be counted in twos. For example, *a evutu* (one set of two), *a varivi* (two sets of twos), a *niraiti* (three sets of twos), *a niraiti ma evutu* (four sets of twos), *a pakaruati* (five sets of twos). Ten bundles of peanuts then becomes *tikana pakaruati* (one set of ten), *a ura pakaruati* (two sets of ten), *a utula pakaruati* (three sets of ten).

Number in counting fish, *pitiu*, beans and greens

Small fish with no fixed number are stringed together and also recorded in tens. They are counted in the same way as peanuts. *Pitiu* (same family as sugar cane, where the flower is cooked and eaten), beans and greens (no set number) are also tied together in bundles and recorded in tens for commercial purposes. These are also counted the same way as peanuts. Like the counting of bananas, and eggs this way of counting is also becoming invisible and is now rarely used as individual item counting is now dominant.

Number in counting coconuts

Coconuts on the other hand are always tied together in twos (*a evevutu*), then grouped in fours (*a varivarivi*), then in sixes (*a kurakurene*), then the sixes are grouped in twelves (*a tangutanguvani*), and then the coconuts are counted in sets of twelves and then again grouped in sets of ten. This counting is done simultaneously. The coconuts are counted in sets of twelve and then tens for commercial and recording purposes.

For example, *A evutu* (one set of two) is two, *a ura evutu* (two sets of twos) is four which becomes *a varivi* (one set of four), *a utula evutu* (three sets of twos) is six which becomes *a kurene* (three sets of two which then becomes one set of six), *a kurene ma evutu* is eight (one set of six plus two), *a kurene ma varivi* is ten (one set of six plus one set of four), *a ura kurene* is twelve (twelve sets of twos, which becomes two sets of six), and the two sets of six becomes *a tanguwani* (one set of twelve).

Coconuts are grouped in twelves and if there are a lot of coconuts the sets of twelves are again grouped in tens for easy recording purposes and to measure quantity for barter trading in the past, and currently for copra production. Ten sets of twelves (coconuts) are called *a pakaruati na tanguvani*. This method of counting coconuts is still very strong in many Tolai communities.

Picture 1: *a evutu* (two)

Picture 2: *a varivi* (four)

Picture 3: *a kurene* (six)

Picture 4: *a kurene ma evutu* (eight)

Picture 5: *a kurene ma varivi* (ten)

Picture 6: *a ura kurene* or *a tanguvani* (twelve)

When counting coconuts in *Tinatatuna*, the Tolai language, coconuts are always tied in twos, then grouped in fours, then grouped in sixes, and then the sixes are again grouped in twelves, and finally grouped in sets of ten for recording purposes. These groupings are not isolated from each other when counting the coconuts. The groupings are done simultaneously. In the event that three people are gathering coconuts for commercial purposes, and if a lot of coconuts are gathered, the groups of twelves are grouped in groups of ten and called *a pakaruati* (one lot of ten) and counted. Because of our oral history it is easier to remember *tikana pakaruat* (10 x 12 x 10) or *aura pakaruat* (10 x 12 x 20). This recording activity also minimises cheating.

I will add here that the Tolai complex counting is very much related to how the people lived for generations and used it for their particular needs such as recording, transporting and commercial purposes. The essence of how this counting systems works cannot be comprehended easily from a Eurocentric point of view. Therefore I have used pictures in this writing to illustrate how coconuts are counted, organised and recorded to enhance a visual understanding of this type of counting.

Picture 7: *a tanguvani/nanguvani* (twelve)

When the coconuts are tied together like in picture seven, a larger quantity can be carried in ropes usually made from tall ginger plant variety. The stems are beaten into soft pulps and tied into one-metre loops. The coconuts tied in sets of sixes or twelves are hung from these loops. When carried on the head these coconuts hang on female carriers' back. Four sets of twelve can be carried by women from the coconut plantation to the copra drier or home using this method of transportation.

The male carriers carried theirs on the shoulder so some coconuts hang in front and some at the back. The men carried the coconuts or any load in this way as it was easier to throw the coconuts off to fight off enemies should they be encountered. Their loads were usually lighter than the females for the same reason.

Conclusion

This description of number in Tolai culture contributes to the work of others (Lean, 1994; Bishop, 1995; Zavlavsky, 1998; D`Ambrosio, 2001; Ascher 2002; Lara-Alecio, 2002; Rauff, 2003), who have reported how indigenous mathematics is unique to particular cultures which have developed outside the western culture. Some of the mathematical concepts in these indigenous cultures are similar to the western mathematical knowledge. In Battiste's (2002) discussions on indigenous knowledge, she cautioned that some indigenous knowledge may be similar to the western knowledge but cannot be related to the western way of thinking. I will stress that caution further regarding the Tolai counting system of coconuts. The concept of counting coconuts can be converted to the western multiplication of the x2, x4, x6, x12 and x10 operations; however, it cannot be related well to any of the western number systems as Ascher cautioned when discussing the interpretation and relation of indigenous knowledge to western ways of thinking.

This complex way of Tolai counting cannot be translated well into the western way of multiplication or division understanding or taught well using western teaching methods. I should also stress here that this counting is not as neat as counting in base four, six, twelve and ten or counting in twos as non-Tolais may view it. As Ascher (2002) stated, indigenous mathematics cannot be separated from the people's cultures and the way particular mathematical concepts are used in those particular cultures. Lean's thesis (1994) emphasized that counting systems did not spread around the world from the Middle East but that the indigenous counting systems belong to cultures that are much older than those of the Middle East.

There is now an increasing recognition that indigenous knowledge is as valuable as western knowledge. There are now efforts being made to validate indigenous knowledge for use in sustainable developments around the world. With the increasing focus on maintenance of indigenous knowledge through school curriculum, curriculum developers have now begun to encourage the integration of indigenous and western knowledge in formal learning environments to assist students to build on from what they already have and understand the practical application of indigenous knowledge especially in mathematics. The number knowledge is presented here to make visible its value and how it is embedded in the *Tinatatuna* language. This knowledge has superficial similarities to western number (multiplication and division) knowledge. Therefore caution must prevail during the integration of indigenous and western number knowledge because the way they are applied in this particular indigenous people's lives and activities are different. However, these similarities can be used as a basis when introducing similar or new number knowledge in formal learning environments.

References

Ascher, Marcia 2002, 'Mathematics elsewhere: an exploration of ideas across cultures', *Natural History,* Vol:112, No. 7. pp. 2-9, American Museum of Natural History.

Battiste, Marie 2002, 'Indigenous knowledge and pedagogy in first nations education: a literature review with recommendations', Working paper, Apamuwek Institute, Ottawa.

Bishop, A. J. 1995, 'What do we learn from the counting systems research of Dr Glendon Lean', keynote address to the History and Pedagogy of Mathematics Conference, Cairns, Australia.

D`Ambrosio, Ubiratan 2001, 'What is ethno-mathematics, and how can it help children in school?' *Teaching Children Mathematics*, Vol. 7, No. 6, pp. 308-310, National Council of Teachers of Mathematics, United States.

Department of Education 2003, *Cultural Mathematics Elementary Syllabus,* Papua New Guinea.

Lara-Alecio, R. (ed.) 2002, 'Naturalistic language assessment of LEP students in classroom interaction', *Bilingual Research Journal,* Vol.20, No.1. (www.nclela.gwa.edu.pubs/nabe/brj/v20/)

Lean, G. 1994, 'Counting systems in Papua New Guinea', in Glendon Lean PhD Thesis, Papua New Guinea University of Technology, Lae.

Myer, L. 1998, 'Biodiversity conservation and indigenous knowledge: rethinking the role of anthropology'. *Indigenous Knowledge and Development Monitor,* [online journal], 6(1), 1-6.

Nakata, Martin, 2002. 'Indigenous Knowledge and Cultural Interface: Underlying Issues at the Intersection of Knowledge and Information Systems', conference paper, University of South Australia, Adelaide.

Rauff, James V, 2003. 'The Varieties of mathematical Experience' Natural History, Vol.112, No.7 September 2003:2-9, American Museoum of Natural History.

Shea J, 1978, 'The Study of Cognitive Development in PNG', Papua New Guinea Journal of Education Vol 14, Special Issue< pp85-110.

Smith, Geoffrey 1975, *Education in Papua New Guinea,* Melbourne University Press, Carlton.

Zavlavsky, Claudia 1998, 'Ethnomathematics and multicultural mathematics education', *Teaching Children Mathematics,* May 1998 Vol.4 No. 9 pp. 502-504, National Council of Teachers of Mathematics, United States.

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