Indigenous Mathematical Knowledge at South African Cultural Villages: Opportunities for Integration in Mathematics Classrooms

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Abstract
Since 1998, South Africa has embarked upon a program on Indigenous Knowledge Systems (IKS), a program which calls upon Curriculum Planners and Implementers to incorporate IKS aspects within the various learning areas. In the context of mathematics, possibilities for this incorporation exist in various settings outside the classrooms. This paper discusses the extent to which mathematical knowledge is exhibited in cultural villages in both the workers and the artefacts made. The paper reflects on research that has been conducted at Lesedi Cultural Village and Basotho Cultural village and shows some mathematical concepts and uses found at such villages and how these can be used in mathematics classrooms, especially in the context of the new curriculum in South Africa.

Introduction

Cultural villages have been part of the cultural landscape of South Africa over many years. Before 1994, they predominantly served the purpose of showing the divide between the different cultural groups and in a sense helped to perpetuate the stereotypes and differences between the different groups. After the birth of democracy in 1994 most of these villages were turned around and used to showcase the cultural diversity that populates South Africa. The number of cultural villages have increased and their status as tourists centres enhanced even more to attract tourists from other parts of the world to a country that had for many been riddled with political differences and policies of segregation and apartheid.

Cultural villages still serve almost exclusively as tourist centres. Whilst this is an important development, especially for the economy of the country, questions have been raised about the purposes of the establishment of such villages and whether they really empower the predominantly black population of the country economically. Another argument that can be raised, which forms the major focus of the discussion of this paper, is that these villages can serve more educational purposes than just tourist centres. A mathematical analysis of the various artefacts and activities at the villages provides an opportunity to explore the mathematical concepts that are used regularly by inhabitants (workers) at such villages.

Mathematical Knowledge as manifested in the work at Cultural Villages

Each Cultural Village employs a number of people who are knowledgeable about cultural activities and can be able to enact them appropriately for the visitors. It is interesting to note that most of the villages (at least those I have visited) employ a number of the elderly in the community to be able to showcase various indigenous activities appropriately in their historical and socio-cultural background. The employees get involved in actively making the artefacts that are showcased and sold at the courier shops found at the villages. They also take an active part in the decoration of the villages, like the mural decorations at the Lesedi cultural village explained below. A brief analysis of most of the artefacts and activities at these villages exhibits a number of mathematical concepts that are associated with the different activities.

Gerdes (1999) indicates that the people of Africa south of the Sahara desert constitute a vibrant cultural mosaic, extremely rich in its diversity. Among these people are a variety of geometrical ideas as manifested in the work of wood and ivory carvers, potters, painters, weavers, mat and basket makers, and many other laborious and creative African men and women alike. Both men and women contribute creatively to these geometrical shapes. In fact Gerdes (1995) had earlier alluded to the work that women do in artefacts like decorated handbags, coiled baskets, string figures, decorated pottery, grass brooms, tattooing and body painting, bead ornaments, and mural decorations. Almost all the activities that Gerdes is referring to are found at the different cultural villages.

In her book 'Africa Counts', Zaslavsky (1999) argues that Africans have made significant contributions to the development of counting and numbers and deserve a place in studies dealing with the subject. She then continues to write about the construction of the numerations system as experienced and practised in various countries in the African continent. A look at the Ndebele culture, especially at places like the Lesedi Cultural Village and the Botshabelo Historical Town expose the extent to which counting and numeration are used. They also show how members of such communities who have not been privileged to attend school are able to do most of the cultural activities and artefacts that are embedded with a lot of mathematical concepts and processes. Beadwork and artefacts covered in beads are found in many cultural villages. Dabula (2000) has gone on to explore and identify mathematical concepts associated with beadwork like number patterns, geometrical shapes, tessellation, and various types of symmetry. The same is exhibited and can be investigated further in the Ndebele culture. Examples of these are discussed below in the excerpt of the Ndebele culture at the Lesedi Cultural Village.

Use of Mathematical Knowledge and Concepts at Basotho Cultural Village and Lesedi Cultural Village

(i) Basotho Cultural Village

The Basotho Cultural Village is situated in the Eastern part of the Free State Province of South Africa. It lies in the scenic Qwa-Qwa National Park which is found next to the Golden Gate National Park and the Drankesburg Mountain range is within easy reach. The village houses a traditional Sotho Museum, a sandstone amphitheatre, a restaurant and a curio shop. The museum introduces visitors to the Basotho nation, from its inception through its history till their present existence.

In an ethnographic study of mathematical concepts in the cultural activities at the Basotho Cultural Village, Mosimege and Lebeta (2000:336 – 341) reported on the indigenous mathematical knowledge as used by the inhabitants of the village. They found extensive use of a variety of mathematical concepts in the following grass artefacts: (i) Traditional baskets (ii) Traditional hats and (iii) Miscellaneous items (*Motlhotlho (strainer)*, Plaited rope used for binding, etc.). This study revealed that even though the average level of formal education for most of the inhabitants of the village was Grade 4, the villagers were dealing with mathematical concepts like estimation, patterns, geometry, symmetry, etc. This illustration of use of mathematical concepts in various cultural activities showed that most indigenous people are knowledgeable about a variety of artefacts and activities in which mathematical concepts are used extensively. It is clear that such mathematical knowledge and concepts are used regularly in their work, even though they do not necessarily know the mathematical terms as described in mathematics literature. Yet they are able to use such concepts with ease and can actually describe

them extensively. The same has been found in a study on indigenous games and related mathematical concepts (Mosimege 2000).

Interview on how to make '*Sesiu*'

The excerpt reported below is part of the interview that was conducted with Mr Mothibi, one of the members of the village, actually the most important member as he plays the role of the Chief of the village. The excerpt explores how a container made of grass (Sesiu) is constructed. It also reveals the extent of the use of mathematical concepts in this particular activity as done by the male inhabitants of the Basotho Cultural Village. The study was conducted by two researchers, labelled R1 and R2. M is for Mr Mothibi. The interview was conducted in the Sesotho language which is the main language used at the village. Using this language also enabled Mr Mothibi to express himself freely without going through the difficulties of trying to cope with a foreign language which is not spoken daily at the village nor as part of the home language of the Basotho nation.

R1: Ooh Ntate, o ka qala joale o re bolelle hore ha ke qala ke etsa jwang, re ke re kgone ho ho latella. O hle o re rute joale Ntate [Father, you can start now, tell us how we begin and what we do, so that we can follow you. You may proceed to teach us].

M: Ke tla le ruta hee hore le ke le tsebe, le be le ye ho ruta ba bang. Joale ha ke qala sesiu sena, ke qala ka ho nka hlotswana se se kana, joale ke se finye lefuto. Lefuto lena ke la ho etsa hore ho na le ntho e ke tla hlaba mona e tlabe e se e tla tshwara. E tlabe e be e se e tshwara hobane ke tla nka thapo e se e kene mono. Lehlabo leno ke hlaba ka lona. [I am now teaching you so that you can know, and then you can go and teach others. When I start 'sesiu', I start by taking this amount and make a knot. I make this knot so that when I use something to put through, it will hold because I will take a string. This needle I use to thread through].

R2: Ntate, o re le nka joang bo bo kana. He ke a bona o bo bala, fela wena o tseba hore bo lokile. O tseba jwang hore bo lokile?O tseba jwang hore O tsee selekanyo se se kae?O tseba jwang hore o tshwanetse ho tsaa ngatana tse lesome kgotsa tse masome a mabedi, hoba tse nne, ho ba tse kae?[Chief, you say you take so much grass. I notice that you have not counted it. How do you know which amount to take? How do you know which amount to take, whether it be ten grasses, or twenty, or four, or how many?]

M: Ooh, ha ke etse joalo. Ke tsipa fela sehlopa. Ha ke batla ho etsa lefito le leholo ke tsipa haholo fela. Ha ke batla ho...[I do not do that. I ,merely take a certain amount. When I want to make a big knot, I take a big amount. When I want…]

R2: So, ho tsipa hoono, ha se hore o a dibala. [So taking an amount, it does not mean you count them]

M: Ha ke di bale. [I don't count them].

R2: Ha o dibale. O di lebella ka mahlo, wa fetsa ka hore tse di ka etsa sena, tse di ka etsa sena.[You don't count them. You just estimate by mere looking at them and decide that this amount will give this and this].

M: Eke. Ha ke batla ho etsa ho ho holo, ke tla sheba ka mahlo fela hore ha e le mona ke nkile ha kana, bo tla etsa boholo bo bo kana. Ha ke nkile ha kana, bo tla etsa bonnyane bo bo kana. [Yes. When I want to make a big thing. I just use my eyes to estimate any size I want to make. If I have taken this much, it will give me this small amount].

R1: Joale ha le nke le kgathatseha hore ha le sa di bale, joang bona ba lona bo tla fela ka pele, pele le qeta sesiu sena?.. Ke dumela hore le tswhwanetse le di bale.[Now don't you get worried that when you don't count, the grass will get finished before you complete the 'sesiu'?..I believe that you should count them].
M: Hee. Ha re di bale hoo hang hobane le joang bona ha re bo reke, re bo hela fela le he bo ka fela. Re ntse re ya. Ebile o tseba hore o tlile ho etsa sesiu se se boholo bo bokae se se tla nkang joang bo bo kae. [No, we don't count at all. After all, even this grass we don't buy, we merely pick it up].

In this excerpt from the interview with Mr Mothibi, a number of mathematical concepts are referred to or used throughout the interview. Prominent among these is the **estimation** about how much grass is needed for which step in the making of this container. He explains the accuracy of his estimation from the experience which he gained from many years of working with the grass. He does not go on to **count** the number of grasses that he uses for the different sizes of the container, although this does not mean that he does not know how to count. Another part of this interview which is not reflected in the excerpt above is the **size of the container** (*sesiu*). The size is determined by what the container will be used for, so that the sizes of the containers vary. So the amount of grasses used for the different sizes of the containers are estimated.

(ii) Lesedi Cultural Village

Lesedi Cultural Village is situated approximately 50km to the north of Johannesburg and about 40km west of Pretoria, the two major cities in the Gauteng Province. It is a multicultural village comprising of 5 traditional homesteads: the Zulus with their fighting sticks and cozy beehive huts; the Xhosa with their perfectly thatched rondawels and distinctive white blankets; the rhythmic drums and whistles of the Pedi tribe; the conical straw hats and the thick coloured blankets of the Basotho; and the art and craft market and the mural decorations of the Ndebele.

The first phase of a study on Indigenous Mathematical Knowledge in South African Communities has focussed on the Lesedi Cultural Village. Thus far, four Ndebele ladies have been interviewed about their work and the extent to which they use mathematical concepts and principles in their work. Some of the findings that have been revealed in the study with respect to the ladies are:

They had never attended school

The learned how to make various artefacts (necklaces, ties, toys, etc) from their grandmothers and their sisters i.e. they learned the skills in beadwork from watching their grandmothers and in some cases their sisters when they made such.

They learned most of the skills when they were very young, between the ages of 10 and 14 years

They have also taken part in teaching their children the skills that they had learned from their grandmothers

Some of the mathematical concepts that the four ladies referred to in various artefacts that they make regularly are:

(i) Counting: This they clearly illustrated when they explained how they had to count the number of layers or turns to make before making a particular design in their beadwork

(ii) Repetitive Cycles: There are instances in the designs when they have to repeat a specific part for purposes of adding similar designs or creating a similar pattern

(iii) Similarity in Figures: These show themselves in most of the mural decorations that the Ndebele communities are well known for. Repetition of a specific geometric figure leads to specific types of patterns and the creation of a particular mural decoration

(iv) Symmetry: This is also shown in a variety of artefacts. The knowledge they have gained has made them to be aware that there are mirror images and these mirror images tend to create a different effect than in the artefacts where it has not been used.

Possible use of Mathematical Knowledge and Concepts used at Cultural Villages in Mathematics Classroom Settings

South Africa has recently embarked upon a curriculum that strives to enable all learners to achieve to their maximum ability (Revised National Curriculum Policy, 2002). This is done through setting outcomes to be achieved at the end of a process. These outcomes encourage a learner-centred and activity-based approach. One of the developmental outcomes in the Revised National Curriculum Statement Grades R-9 Policy for Mathematics envisages learners who will be culturally and aesthetically sensitive across a range of social contexts (2002:2). Exposure to activities that take place at various cultural villages goes a long towards ensuring that this developmental outcome is attained. Actually the activities that take place at cultural villages and the artefacts that are found therein are a representation of what takes place in various communities in the different provinces of South Africa. It is therefore possible that some of the artefacts that are found at the cultural villages may be brought to classroom and analysed by the educators and learners together to reveal related mathematical concepts embedded in such artefacts. As they do so they will also be more about the communities in which they live. In fact, the use of various artefacts provides an opportunity for the community members knowledgeable in various artefacts and cultural activities to interact with the educators and learners. Such community members may be invited to schools to share their expertise and knowledge.

In the interview with the Ndebele ladies, they indicated that knowledge of working with beads is passed on by grandmothers and mothers to their daughters. This is one way of ensuring that indigenous knowledge in the communities does not become extinct but is used appropriately to link what happens within mathematics classroom and activities outside the classrooms.

The examples from the two cultural villages used in this paper reveal a use of various mathematical concepts activities. The mathematical concepts that have been identified in the making of a grass container and the beadwork as shown in the interviews above are: Counting; Estimation; Straightness of Lines; Shapes and Patterns; Angles; etc. Many other mathematical concepts may be found when an analysis of the various activities and processes is done. This calls upon the educators to play an important role of linking what happens at the cultural villages to various mathematics curriculum requirements. As Graven (2000:159) correctly points out, current curriculum change demand that teachers (educators) use a learner centred approach and understand mathematics as a learning area which includes the following identity of mathematics as a school subject: Maths as a useful subject for everyone, it is both relevant and practical and is applicable to everyday life. Teachers are appropriately placed (Mosimege, 2000:283) due to their mathematical knowledge to create linkages between various activities embedded with mathematical concepts to ensure that learners' experiences are enriched through daily experiences of what they encounter outside the classroom.

Educators can therefore help to close the gap that seems to be always there between classroom activities and activities outside the classroom, ensuring that mathematical concepts learned in classrooms is not done in isolation but takes into account daily experiences of workers in various settings, including cultural villages as known and established in countries like South Africa.

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