Chapter 3
Listening to the Voices of the Knowledge Holders: The Role of Language in Ethnomathematical Research

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Abstract Language plays a central role in ethnomathematical research. It allows the researcher to interact with the knowledge holders and research participants at a level and in a context where they can express themselves in a language that they are more comfortable with. The use of indigenous languages in research empowers knowledge holders to be free, expressive and more engaging and willing to share more of their knowledge. It is essential that the researcher familiarises himself with the language of the knowledge holder to derive more benefit and gain access to forms of expressions associated with the aspect of investigation. In cases where there is no knowledge of the language, the researcher needs to explore ways in which this limitation can be reduced for the enhancement of the interaction and collection of data.

Keywords Language · Ethnomathematical research · Culture · Cultural village · Mathematics education

3.1 Ethnomathematical Research

Ethnomathematical research and focus in mathematics education is traced back to the seminal work of Ubiratan D'Ambrosio, followed closely by the work of Paulus Gerdes. Both have contributed extensively to the definitions of ethnomathematics and to the conceptual development of this area in mathematics education. Their definitions and ideas have subsequently been embraced, extended, and critiqued by other mathematics educators working in this area. In one of the earlier references to ethnomathematics D'Ambrosio (1985) argues that cultural groups are important in ethnomathematical discussions.

D'Ambrosio (1985) then goes on to define the cultural groups as national tribal societies, labour groups, children of a certain age bracket in the following way: "we

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will call ethnomathematics the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labour groups, children of a certain age bracket, professional classes and so on" (p. 45).

Gerdes (1994) defines ethnomathematics as "the field of research that tries to study mathematics (or mathematical ideas) in its (their) relationship to the whole of cultural and social life" (p. 20). Gerdes (1996, 1997) goes on to indicate that, as a research field, ethnomathematics may be defined as the cultural anthropology of mathematics and mathematical education.

Although the focus of this chapter is on ethnomathematics and specifically on the role that language plays in ethnomathematical research, the chapter fits broadly in the sociocultural aspects of mathematics education and, in this context, it refers, albeit briefly, on another, but closely related area of critical mathematics education (François and Stathopoulou 2012).

This chapter first looks at the importance of culture in ethnomathematical studies. The major focus and emphasis is on the role of language in ethnomathematical studies, so the discussion then looks at language as a component of culture and how it is used in mathematics education. In order to give context to the challenges of language, the chapter then looks briefly at the languages in South Africa, bringing to the fore the complexity of a number of official languages and how this affects developments in both basic and higher education sectors.

Three episodes from ethnomathematical research in South Africa are included in the chapter for illustration of language challenges: the first episode illustrates the interaction between an ethnomathematics researcher and knowledge holders in the production of an artefact, the second episode illustrates the use of language during an indigenous game whereas the third episode follows along the lines of the first in which elderly knowledge holders are interviewed on beadwork.

3.2 Culture as a Central Component in Ethnomathematical Studies

Mathematics educators who work specifically with culture as it relates to mathematics or mathematical activities define culture in different ways. This may be viewed as an attempt to locate the idea of culture within a particular form of understanding and in the context of that writer.

3.2.1 Definition of Culture in Mathematics Education

For Mellin-Olsen (1985) culture is "a concept which considers the relationships between the formation of a society, the creation and construction of the individual in this society and the way he himself lives according to this" (p. 105).

Shared meanings imply a number of common aspects within members of a particular society, whereas relationships are an indication of the closeness of various aspects within that society. Shared meanings also imply some common understanding in relation to a group of people who engage in a common activity. The common activities could include, among others, engaging in socio-cultural activities like the playing of games which are cultural specific; activities like problem solving which are not necessarily sociocultural, but of interest to the group of people engaging in the activity.

The shared meanings give the same sense of shared experiences as given in the definition of culture by Begg et al. (1996) in which they define culture or sub-culture as a set or subset of people who have a set of shared experiences. Although shared meanings and shared experiences imply a form of closeness between the members of a society being referred to, the meanings suggest common understanding whereas experiences imply something that members of a given group have gone through together, but do not necessarily have the same understanding of or give the same interpretation to.

This definition given by Begg et al. (1996) may be used to explain the experiences that members of a society may have about a game. Although each member may have the same experiences about the game, at the time when the game is played or referred to the same people may not have the same knowledge.

In his earlier work *Evolution of Mathematical Concepts* (EMC), Wilder (1981) defined "culture as a collection of customs, rituals, beliefs, tools, mores, and so on, called cultural elements, possessed by a group of people who are related by some associative factor (or factors) such as common membership in a primitive tribe, geographical contiguity or common occupation" (p. 7).

In reflecting on this definition, Wilder (1981) says that he should have included language among the cultural elements, especially since it forms the cement which binds together the world view of a people. He also identifies some cultural elements, which include language. This cultural element had not been included initially.

All the cultural elements are important, but it is of interest that these cultural elements also include beliefs and language, two of the three important features discussed by Amir and Williams (1994). They do not necessarily exclude experiences as Wilder (1981) indicates that the list is not exhaustive. Language is seen as the basis of communication in a culture, which shows how a culture is constituted.

3.2.2 Language as a Main Feature of Culture

Much of the writing on ethnomathematics uses language as a determining feature of culture and as an important component of mathematical activity (Barton 1996). Emphasising the importance of language in culture and the relations between the two, Prins (1995) expresses the "view that there seems to be no language without culture and no culture without language" (p. 94). She continues with the view that

the language of a people reflects their culture and since cultures differ, they do not use language in the same way.

Fitouri (1983) is more explicit about the relations between language and culture. Developing his argument from the research with young bilingual Tunisian children, Fitouri (1983) categorically states that language and culture are inextricably linked. He continues to state that the acquisition of a second language for a child is not a mere mechanical skill but a psychological understanding and emotional acceptance of the culture to which that language is the key.

3.3 Language in Ethnomathematical Research

Language plays an important role in ethnomathematical studies. Mosimege (2012) identified a number of methodological issues that needs to be addressed when ethnomathematical studies are undertaken. One of the methodological issues that needs to be reflected upon is language. In this respect Mosimege (2012) asks:

- How does language feature in ethnomathematical studies?
- Is it important to share a language with the cultural group?
- What happens if the researcher cannot speak the language of another cultural group? Does it mean that the researcher cannot continue with the research?
- Is it impossible for the researcher to continue with the research because of language problems?

Most of the studies reported at the International Conferences on Ethnomathematics (ICEM) (from ICEM 1, in Granada, Spain, in 1998 to ICEM 5, in Maputo, Mozambique, in 2014) have reflected on the language that has been used throughout the ethnomathematical research activities. These studies have largely reported on the language used during the interaction with knowledge holders and elders in communities who prefer to communicate in their home languages. Although most of these studies have not focussed on language as a central component of the discussion, the use of language has continuously emerged as important for purposes of communication with various community members.

Stathopoulou and Kalabasis (2006) discuss about power relations that come from the use of language, not just in research conducted outside the classroom, but also about the impact that they have on the understanding of learners in mathematics classrooms. They also argue that research that is not conducted in English or recorded in English is largely unseen by the international community. In the context of the argument by Stathopoulou and Kalabasis (2006), how much do the issues of language affect interviews conducted in ethnomathematical studies and how do translations from indigenous language to English and other languages affect the extent of the knowledge provided in ethnomathematical settings?

The language of interaction in ethnomathematical research is very important and central in the advancement of such research. Mosimege (2012) concludes that it is

"given that most elderly members of the various communities are more comfortable to express themselves in their own indigenous and local languages" (p. 70–71). Thus, the challenge for researchers is to either find a way to understand the indigenous language spoken by the research participants (interviewees) in order to facilitate access to their knowledge, or to find a way to translate from the indigenous languages to the language in which the research results are being communicated.

This, therefore, means that the inability to speak the language of the knowledge holders limits access to the kind of information related to the exploration of the artifact or indigenous practice. However, this limitation can be reduced through various ways and approaches and a deeper interest and some form of basic understanding of the language of use in ethnomathematical research.

3.4 Languages in South Africa

South Africa has 11 official languages and a number of unofficial languages. According to the 2011 census (Statistics South Africa 2012), isiZulu is the mother tongue for 22.7% of the South African population, followed by isiXhosa at 16%, then Afrikaans at 13.5%. The next two languages are English at 9.6% and Setswana at 8%. The other official languages range from 7.6% (Sesotho) to 2.1% (IsiNdebele). Although English is ranked fifth as a home language, it is used as the language of business, politics, and media.

IsiZulu, isiXhosa, siSwati and isiNdebele are collectively referred to as Nguni languages and have many similarities in syntax and grammar. Setswana, Sesotho sa Lebowa (referred to as Sepedi in the South African Constitution) and Sesotho are collectively known as the Sesotho languages as they also have a lot in common in terms of syntax and grammar.

This means that a person whose home language is isiZulu would be very familiar with other Nguni languages and finds it easier to communicate in such languages. The same applies to any of the Sesotho languages. A person whose mother tongue is Setswana would find it relatively easy to communicate and follow other Sesotho languages.

Language has been and continues to generate many tensions and debates in South Africa. The linguistic tensions between European languages (English and Afrikaans) and African (referred to as indigenous) languages have manifested themselves at various levels and in a number of ways. The most memorable and demonstrated tension is the Soweto riots of 1976. In fact the riots started in Soweto but also spread to other parts of the country.

The basis of the riots was the enforcement by the government of the day to use Afrikaans as the language of instruction in schools. The black youth revolted against this and resulted in one of the major uprisings in South Africa.

3.5 Episodes Illustrating the Use of Language in Ethnomathematical Research in South Africa

The three episodes reported below are drawn from ethnomathematical studies that have been conducted in South Africa. The first and the third are part of an ongoing study on *Indigenous Mathematical Knowledge at South African Cultural Villages* and the second is part of a study on *Indigenous Games and related Mathematical Knowledge*.

Reports related to these studies (and other episodes not referred to in this article) have been presented at various conferences and published elsewhere, however, the emphasis has been on mathematical analysis of indigenous activities and mathematisation processes. The emphasis in the context of this chapter is on language and how it impacts on ethnomathematical research.

3.5.1 Episode One: The Use of Language During an Interview on How to Make 'Sesiu'

The excerpt reported below is part of the interview that was conducted with Mr X, one of the members at the Basotho Cultural Village in the Free State Province, South Africa (Mosimege 2017). He is actually the most important member in the village 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, named R1 and R2. M represents Mr. X. The interview was conducted in the Sesotho language which is the main language used at the village. Using this language also enabled Mr. X 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 lefitole 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 tshwanetse 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].

3.5.1.1 Mathematical Concepts Related to *Sesiu*

In this excerpt from the interview with Mr. X, 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. Figure 3.1 shows Basotho cultural village male workers showing the *sesiu*.

Mr. X 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 grass used for the different sizes of the containers is estimated.

Fig. 3.1 Basotho cultural village male workers showing the *sesiu*. *Source* Mosimege (2017)

3.5.2 Episode Two: The Use of Language in a String Figure Game

The excerpt reported below was conducted in a mathematics classroom in a school in the Limpopo Province, South Africa. The learners who knew the Malepa Game (String Figure Games) were given an opportunity to give demonstrations to their fellow learners on any Gate that they had the knowledge of. The gate is a final configuration that can be made using a string comprising of triangles and quadrilaterals. Gate Two would therefore comprise of a figure which has two quadrilaterals and four triangles.

Each learner who gave such a demonstration (of the Gate) was given an opportunity to use the language that they were comfortable in and the learner giving the demonstration below decided to use the Sesotho sa Lebowa language which was understood by all the learners.

(1) Tseang wa boseven le tsentsheng mo. Le ka go gongwe diang. [Take the seventh and put it in here. Do the same on the other one] {The presenter already had the string hooked on the thumbs and the small fingers, so she started with the very next step. One of the learners asked her to wait a bit before she continues so that they also hook the string on the four fingers. The learner has not started by numbering the fingers, and by the seventh she refers to the pointing finger on the right hand side. When she says that they must also

do on the other side she points to the side by the pointing finger of the left hand}.

(2) Ntshang wa bo five. [Remove the fifth] {she removes the thumbs at the same time}.

(3) Le thieng ka fatshe. A kere le dirile so, e buseng ka mo, le e gogeng so, e be so. Haaa. Goga wa mo fatshe. Ka mo go o monnyane. [Let it pass underneath. You have done like this, turn it back this side, pull it, it must be like this. No. Pull the one underneath. On the small one.] {By passing underneath she is referring to the thumbs. As she starts to hook the string with thumbs the learners murmur to indicate that they are not following the demonstration very well. At this point the demonstrator reverses the thumbs and starts to explain what they have already done up that point. She then starts the step again. One of the learners then asks her to wait a little bit, and she does. Then she looks at what that learner has done and comments about her method, commenting about what she seems to be doing wrong, particularly as it relates to the string underneath. She illustrates to this learner without starting from the beginning nor moving nearer her for assistance but helps her still standing at the front}.

(4) Go e ya bo seven gogang e enngwe, e, ye, e, e, e be so. [On the seventh, pull the other one, yes, yes, yes, yes, must be like this] {She first spends a few seconds looking at her string and then talks about the seventh. Then a male learner asks her whether it is the seventh she is referring to. She points to the string on the seventh finger to be removed with thumbs, then she uses the thumbs to pull the string from the seventh, without specifying the use of thumbs. Then she keeps saying yes - on about three occasions - as the learners check with her whether they are doing the correct thing}.

(5) Ntshang o monnyane. [Remove the small one] {Although she has actually referred to one small finger she removes both small fingers}.

(6) Le goge e, e be so. Mo e tshwanetse le e dire so, e tshopagane so. E tshopagane so. [Pull it, it must be like this. Here you must do it like this; it must be entangled like this. Entangled like this] {By pulling the demonstrator refers to using small fingers, although does not refer to them explicitly. Another female learner calls her by her name - Sophy - and once more asks her to wait}.

(7) Ntshang so, e, e megolo, e, ntsha e megolo, le sale ka one le seven. [Remove like this, yes, the big one, yes, remove the big one, you must remain with one and seven] {The learners ask her if she is referring to the big ones, and whether she means both big fingers, and she says yes on both occasions. She refers to fingers one and seven without clearly showing them but just looking at the right hand, and the learners do not ask her what she means by one and seven, giving an indication that they either see exactly which fingers she is referring to or that they know what she means by one and seven}.

(8) Tatang ka mo so, le tla dia? Le ka go gongwe dia ka mouwe [Make a twist here like this, are you doing it? Do the same the other side] {She starts to make an anti-clockwise twist with the fourth finger on the right hand side. By doing it on the other side she is not referring to the left hand but to the small finger of

the right hand side, symmetry between the fingers and not necessarily the hands as has been the case thus far. Before she asks them whether they will do it, she looks at them and seems to be getting a feeling that they are either not sure what to do or they are finding it difficult to do it. Unfortunately the video camera did not get focussed on the learners to verify their activities at this point. The presenter laughs a little about the difficulties experienced by the learners in this step}.

(9) Le ka mo left diang. [Also on the left hand side do the same] {She then makes similar twists on the left hand side, although not exactly similar as the twists on the left hand side are actually clockwise twists i.e. the learner does not make a distinction between anticlockwise and clockwise twists, but still knows that the same activity must be done on the right hand side. However, this time she does not mention the twist to be done on the small finger but rather follows that doing on the left hand means doing it for both fingers. A female learner then asks 'and then'? This suggests that she had made this step and was now eager to see what will happen next}.

(10) Tsentsha mo, go e mennyane. E, e be so. [Put it in here, in the small ones. Yes. Must be like this] {In this step the thumbs are used to pull the string on top of the small fingers, however no reference to thumbs but to small fingers, not even indicating which string on the small fingers as there are two. Another learner asks whether the figure must look like the one this learner had made, and the demonstrator says yes. However it is interesting that she does not say that it must be like this learner's figure but refers to her's (the demonstrators) i.e. responds to the learner's question by referring to the model being used upfront}.

(11) Tsea o wa boseven, o e tsentshe mo. Le ka mo go o. [Take the seventh one, and put it here. And also on this one] {The demonstrator starts with the string on the left hand, whereas the twists at step number 8 were started on the right hand. This has important implications as it means that you do not always have to start with the right or the left hand all the time, but in many instance you can start with any hand, and don't have to keep to what you started with throughout the activity all the time. This is also different from the how the hands are used in step 12 below}.

(12) Le ntshe so, le ka mo lentshe. [Remove it like this, also this side remove it]. {The demonstrator first removes the string at the back of the right hand thumb, and then follows with the left hand thumb. At times, especially for beginners, this step is best done through the use of a mouth so that you don't lose the other string that must remain on the thumb. This illustrates how adept the demonstrator is about making the gates and the manipulations involved}.

(13) Tsentsha mo, mo, e, wa boseven [Put it here, here, yes, on the seventh finger] {Female learner asks where, and the demonstrator points again at the triangles underneath the thumbs without mentioning the geometric figure involved}.

(14) Ke ka moka lentshe e mennyane. [Then remove the small ones].

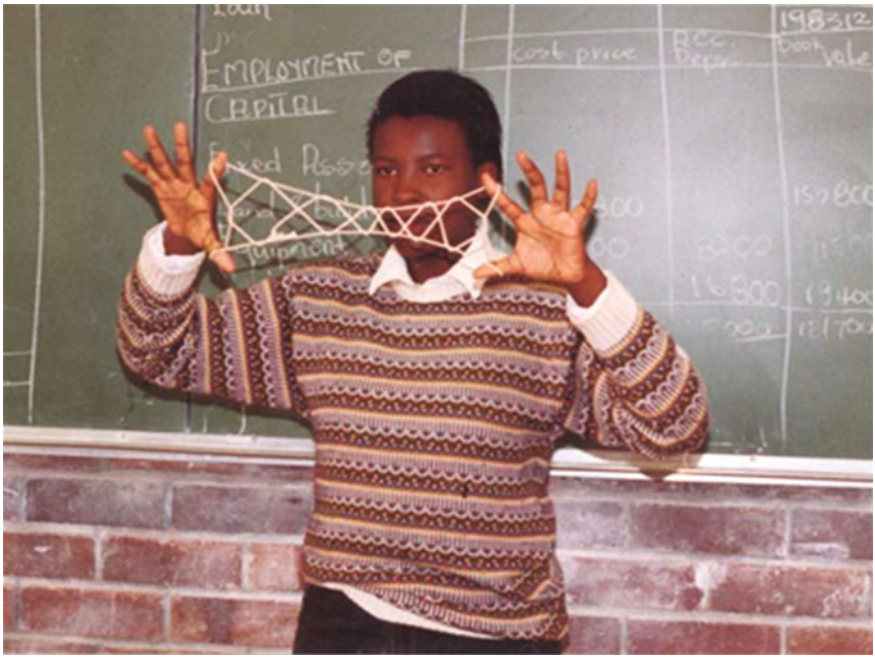

Fig. 3.2 Demonstration of a string figure gate 6 by a learner. *Source* Personal file

(15) Le e goge. [Pull them]. {Pulling here means turning the Gate away from you to face the learners}.
(16) The demonstrator then shows the learners how String Figure Gate 6 looks like (Fig. 3.2). {This is done without an accompanying explanation}.

The researcher then asks the learners if they had managed to do it and finds out that only one learner had managed to make this Gate.

3.5.2.1 Mathematical Concepts in String Figure Games

There are mathematical concepts that can be identified in string figure games.

Variety of Geometric Shapes and Figures

In any string figure gate the following geometric figures may be identified: angles, triangles, quadrilaterals (particularly rectangles and squares). The number of the geometric figures increases as the number of gates increases. The same can be seen from the illustration in Fig. 3.2.

Patterns, Relations, and Functions

An analysis of the String Figure Gates reveals a variety of relationships between the triangles and quadrilaterals, quadrilaterals and intersecting points, and the generalisations that result from these relationships. The generalisations between the different geometric figures are:

- triangles and quadrilaterals: $y = 2x + 2$.
- quadrilaterals and intersecting points: $y = 3x + 1$.
- quadrilaterals and the number of spaces (spaces are given by the combination of triangles and quadrilaterals): $y = 3x + 2$.

Symmetry

Working with gates, a variety of symmetry types may be identified. Most of the gates show bilateral symmetry, particularly even numbered gates. Some of the gates exhibit reflection symmetry, for example Gate 2, while others have rotational symmetry, for example Gate 1. It is also possible to show radial symmetry; translational symmetry; and anti-symmetry.

After making a specific gate, disentangling the string along a specific line of symmetry also ensures that the string does not get entangled. An interesting classroom activity could be to investigate which types of symmetry are associated with which String Gates.

3.5.3 Episode Three: The Use of Language During an Interview on Beadwork

The following excerpt reports on the interview conducted with two Ndebele ladies at the Lesedi Cultural Village, Ms. Y and Ms. Z. The Lesedi Cultural Village is located in the Gauteng Province, South Africa. In the excerpt, the questions focus on how the ladies engage in beadwork activities and explore related mathematical concepts. It focuses specifically on how they use beads to engrave names of people on beadwork activities, but also refers to other beadwork activities.

In the excerpt, R refers to the researcher and SS to Ms. Z and LM to Ms. Y. The ladies speak Isindebele, however, they also understand the Sesotho languages like Setswana and Sesotho, as a result the interviewer used both Isindebele and Sesotho as the latter is mostly understood by the researcher in comparison to Isindebele.

R: Le rutilwe ke mang ho sebetsa ka dibeads? [Who taught you to work with beads?].

SS: Si fundiswe uGogo. [We were taught by our grandmothers].

R: Ni fundiswe nini? Le rutilwe leng ho etsa dibeads? [When were you taught to work with beads?].

LM: Si fundiswe sise bancane. Si ne minyaka e 10. [We were taught when we were very young. We were 10 years old].

R: Nkgono yo a le rutileng, ene o ne a rutwa ke mang? [Who taught the grandmother who taught you to work with beads?].

LM: U fundiswe ngo mama wakhe. [She was taught by her mother].

R: So ho raya hore hangata Gogo o ruta ngwana, ngwana yo ha a setse a hodile o ruta bana ba hae. Jwalo jwalo. [So it means that many a times grandmothers teach their children, and when these children have grown up they also teach their children, and it continues like that].

LM: Njalo njalo [It continues like that].

R: Ho raya hore ha ho hlokahale hore le ye sekolong ho ithuta ho sebetsaka dibeads? [It means you do not need to go to school to learn to work with beads].

SS: A siyanga a skoleni [We have never attended school].

R: Jwale le entse tsohle tse di leng mona [So have you done all beadwork items that are here?] (Researcher asks pointing to all the items displayed around the ladies).

SS: Si enze konke, na nga se stolo. [We have done all the beadwork things here, including all the things in the store] (Sophie says this pointing to the back where the store is and the bead artefacts are sold).

R: Joale mona o etsang? [Now what are you doing here?] (Researcher asks what Lenah is doing, pointing to the artefact she is working on).

LM: Ngi enza igama le Manager wethu. [I am working on a name tag of our Manager].

R: Le etsa joang hore ho be straight? [How do you ensure that this part of the ornament you are making is straight?] (The researcher points to the straight part of the ornament in which LM is writing the name of the Manager at Lesedi Cultural Village. The Manager's name is Xolani).

LM: Indaba ise nhloko. O ya yazi [The matter is here in the head] (Linah says this pointing to her head. Later on, she further explains that they take two beads at a time). O I stopa kabini ngale [You take two beads that side].

SS: Si khetha umqamu o linganayo. [You choose beads of the same size]. (This is an additional explanation from Sophie about how the straight lines are made and maintained. Sophie then continues to explain how various shapes are made, for instance indicating that when you want to start at the centre of any artefact, you start with a big bead to indicate the centre).

R: Le tseba joang hore mona ke bead e kgolo, mona ke e nnyane? [How do you know that here you put a large bead and here you put a small bead?].

LM: Si bona nga mehlo. [We can see with our eyes].

R: Manje, ni bona ka njane ukuthi ni fake esingakhi? [Now, how do you see that you Must put so many beads at a particular point?].

SS: Si ya zi bala. [We count them].

R: Kanti ni yazi kanjani ukubala? Ni the a niyanga esikolweni. [How do you count them? You told me you have not gone to school].

SS: Si ya zibala. [we count them]

R: Hai. Ni zi bala ka njani? Le mpoleletse hore ha le a ya sekolong. [No. How do you count them? You told me that you have anot attended school].

SS: Si ya zi bala. Sithi Kunye, Bili, Thato, Kune, Hlano. Ku hla ngapha ngi ya jika Ngi bheke le [We count them. We say one, two, three, four, five. Then we make a turn to move in the other direction].

R: So, kutsho ukuthi ufuna u ku yenzani. If o batla ho etsa ntho e e riling, o a bala then o jike [So it depends on what you want to do. If you want a specific artefact, you count and then make a turn].

SS & LM: Yebo [yes] (The two ladies respond at the same time. The interview then continues to explore other artefacts and how they were made and what they mean in Ndebele culture).

3.5.3.1 Mathematical Concepts in Beadwork

In this excerpt of the interview with the two ladies, it emerges that they are using a variety of mathematical concepts that are part of the artefacts they are making. Firstly, they refer to *straightness of lines* in making some of the artefacts. Figure 3.3 shows AmaNdebele ladies in their traditional attires at Lesedi Cultural Village, in Johanesburg.

One of the ladies attributes this to their *sense of estimation* and actually mentions that they just watch and get a sense that the line is a straight as they need it to be. She suggests that this is based on the experience they have gained in using this skill many times. However, Sophie further indicates that the straightness is also maintained through the size of beads that are used. In fact, she mentions that *turns (angles)* are made using different sizes of beads. Even though they have not attended school, they clearly demonstrate that they know how to count by *counting*

Fig. 3.3 AmaNdebele ladies in their traditional attires at Lesedi Cultural village, Johanesburg. *Source* Personal file

Fig. 3.4 Beadwork artefacts at Lesedi Cultural village. *Source* Personal file

from one to five. Figure 3.4 shows the Beadwork artefacts at Lesedi Cultural Village.

This counting is crucial in their activities as it determines the *patterns and shapes* they make. In the context of indigenous knowledge which is passed from generation to generation, the ladies indicate that the knowledge of working with beads is generally passed from mother to daughter, and such skills can actually be taught to others, and in this case the young are nurtured into these activities, ensuring that the skills do not die but are kept alive for the benefit of the greater society, in this case, of the Ndebele people.

3.6 Language Issues from the Three Episodes

It can be noted from all the three episodes that the knowledge holders were more at ease and expressed themselves freely in the language that they are familiar and comfortable with. This can be seen in the interaction between the researcher and the knowledge holders.

For instance, in Episode One, the knowledge holders use the following language to illustrate to the researcher the extent of their knowledge:

> 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].

This response by the knowledge holder does not only illustrate free expression and use of language but a demonstration of deeper understanding of the process of language to express depth of knowledge in making this artefact.

The second episode is long due to the fact that it is based on the instruction given by the learner on how to make String Figure Gate Six. Even for the young knowledge holder (student), it is interesting to note that she is more confortable to be using her home language to give the demonstration.

At the beginning of the demonstration the researcher gave the learners an opportunity to use a language of their choice and the learner opted to use her home language. It can be deduced from this illustration that indigenous games are able to be conducted and demonstrated easier in the setting and environment in which they are usually played. This can be seen from the choice of the language by the learner.

3.7 The Implications of the Language and Its Use in Ethnomathematical Research

The three episodes used above illustrate the use of the different languages in ethnomathematical research in the South African context. As indicated earlier, South Africa has 11 official languages and it is expected that these languages will receive equal status in use in official communication. It is also expected that when research is conducted, it will take into account the status of such languages for the purpose of interaction, especially with the elders and knowledge holders in indigenous communities.

In fact acknowledgement and use of these languages is likely to enrich the interactions between researchers and those who hold the knowledge. Even though this situation of official languages may not be exactly the same in other countries, the use of language (in the official and unofficial sense) is equally important.

The episodes (at least one of them) have also shown that the lack of knowledge and basic understanding of the language limits accessibility to the depth of knowledge that is held by the knowledge holders and also limits a deeper interaction between the researcher and the knowledge holders. This is in line with the argument made by Alexander (2005) in the power of language and the language of power.

Alexander (2005) says that "Language is the main instrument of communication at the disposal of human beings; consequently, the specific language (s) in which the production processes take place become(s) the language(s) of power. To put it differently, if one does not command the language(s) of production, one is automatically excluded and disempowered" (p. 2).

In line with Alexander's argument, a researcher is disempowered when he cannot communicate in the language of production i.e. the language of the knowledge holder in this case. He cannot access the deeper meaning, trend of thought, historical meanings and their interpretations as they are held and

understood by the knowledge holder. In this case the language of production is not skewed in favour of the researcher but in favour of the knowledge holder.

This chapter does not argue that it is not possible to conduct research when one is not knowledgeable in a specific language spoken by the holders of the knowledge even though this will surely affect the level of interaction between the researcher and the knowledge holder. It argues for recognition of this limitation and emphasizes efforts that need to be undertaken by those involved in ethnomathematical and other forms of ethnographic research to ensure that the results obtained are as representatives of the views of the knowledge holders as possible

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