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Mechanisms of Ethnomathematical Knowledge Transmission amongst AmaNdebele women: Ways of Transmitting Indigenous Knowledge

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Abstract
Indigenous peoples have their own methods for classifying and transmitting knowledge, just as they have Indigenous ways of deriving a livelihood from their environment. Knowledge and techniques are passed down from one generation to another and they are constantly improved. Guided by the *eZiko Sipheka Sisophula* theory, the study aimed to investigate how AmaNdebele women have passed ethnomathematical knowledge from one generation to another. This study used the Indigenous research methodologies, which are appropriate for Indigenous studies. An ethnographic research designed was used for this study. Making use of focus group interviews, in-depth interviews and observations, ten (10) participants selected through convenient sampling procedure were interviewed on their views and practices on ethnomathematical knowledge transmission. An observation guide was also used to capture activities during data collection. Data was analyzed using thematic analysis and various themes were identified. Triangulation was done through field notes and observations. The results of this study show that ethnomathematical knowledge (in beadwork and mural art) is passed down from mother to daughter using different strategies such as observations, oral knowledge sharing and participation developed by AmaNdebele women. This is to prepare young girls for married life and for the big task of painting their first homes known as *iqathana* in the presence of their in-laws and making beaded attires for their entire family. Such is practiced in order to preserve and protect this knowledge so that it can be accessed by the next generation as supported by the arts and culture policy of 2004. The study also revealed that there are customary laws and protocols, which include restrictions surrounding the transmission of ethnomathematical knowledge among AmaNdebele. As a result, men are restricted from engaging in beadwork or mural painting.

Introduction

The Southern Ndebele people are known for their sophisticated beadwork and mural art, which reflect symmetrical geometry. The expression of this art began before the 16th century but rapidly developed in the 19th century after the AmaNdebele lost the war which is also known as the Mapoch war. This art is used for cultural expression and forms an integral part of Ndebele

identity. It is the duty of women to preserve the Indigenous knowledge of beadwork and mural art then pass it from one generation to another. Mashiyane (2006) agrees that traditionally, it is a duty of women to preserve, protect and disseminate this Indigenous knowledge and pass it from mother to daughter.

There are customary laws and restrictions that are associated with this art as boys are forbidden to take part. AmaNdebele women are believed to carry spiritual powers hence the duty of being custodians of this art was entrusted with them by their ancestors (Mashiyane, 2006). The Ndebele geometric art, which plays a significant role in culture, can be classified as ethnomathematics. Ethnomathematics as stated by Rosa and Orey (2011) is the use of mathematical ideas and concepts by people from a specific culture to deal with quantitative, relational, and spatial aspects of their life. This perspective on mathematics confirms and reinforces all people's experiences with mathematics by demonstrating that mathematical thinking is ingrained in their life (Rosa & Orey, 2011)

Powell (1997) defined ethnomathematics as "the use of mathematical thoughts and ideas by members of a particular culture to manage the quantitative, social, and spatial aspects of their existence." This perspective on mathematics confirms and affirms everyone's involvement in mathematics since it demonstrates that mathematical reasoning is ingrained in their life. Ndebele women can be defined as ethnomathematicians who never attended any formal school yet they understand mathematics.

According to Warren (1991), women, as essential teachers in Indigenous communities, have sustained their structures and associated knowledge systems for centuries, even while experiencing significant social changes because of transformative powers beyond their ability to control. If there is no preservation, acknowledgment and protection of Indigenous knowledge, it will not be passed on (Warren, 1991). Flannery (1995) contended that Indigenous knowledge is gained by children in traditional African communities through their consistent interaction with both the adult world and the physical environment around them. Amongst the AmaNdebele, the socialisation process for girls enables them to consistently engage with adults as they produce artefacts in their ecological environment.

The knowledge includes the understanding of the biological system around communities, the obtaining of skills in the utilization of the different devices and tools in their everyday activities, their acquaintance with the traditions and practices of the relevant society, the understanding of

the societal values and beliefs, and the development of a worldview that reflects the experiences of the society in which they live (Battiste, 2002). Thus, the youngsters dynamically master not only the structural aspects of their language, but also the rich vocabulary that represents the knowledge of society about its physical world, cultural perceptions and practices, and its conceptualization of the universe, through clear contact with the adult individuals from society and the physical environment or nature (Battiste, 2005). In this way, Indigenous knowledge is constantly accumulated and continually transmitted from one generation to the next (Preston, 1975). The objective of the work reported in this study was to investigate the mechanisms used by Ndebele women in transmitting ethnomathematical knowledge. The following question was asked: how is Ndebele ethnomathematical Indigenous knowledge transmitted amongst women?

The importance of Indigenous Knowledge transmission amongst communities

For the purposes of this study, Indigenous knowledge is referred to as traditional or local knowledge rooted in a unique culture, location and society. It is a broad body of knowledge and skills that has been established outside of the formal educational system thus allowing societies to thrive. This is a collective body of knowledge and values, passed down through cultural transmissions over generations (Barnhardt & Kawagley, 2005). According to Ruddle (1993), transmission refers to the process of transferring cultural traits, such as techniques and skills and knowledge, from one individual to another. Cultural attributes are efficiently passed based on the degree of mastery of the skills and frequency of exposure. .

Ruddle (1993) further indicated that knowledge holders are analyzing conditions within Indigenous communities and gathering eyewitness accounts from others so that they can constantly analyze and create their own structural, predictive environmental dynamics models. Pinkerton (1994) emphasized that mechanisms for the transmission of Indigenous knowledge include oral contact, participation, experiments, and observation. History demonstrates that it is the responsibility of the older women in most African Indigenous groups to pass on the knowledge of cultural expression. For this reason, knowledge transmission is a social communication mechanism in which norms of behavior, cosmological principles, creative knowledge of the way of life, and so on, are transmitted and acquired (Ruddle 1993).

Baxter and Wilmot (1985) claimed that this mode of transmission is not simple and depends on various factors, such as age, gender, and other socio-cultural considerations. When it comes to Indigenous knowledge and its preservation, protection, and transmission, various African groups have highly valued cultural restrictions. Cultural restrictions are associated with customary laws, which govern different Indigenous groups' lives, practices and customs.

African people's ways of living, doing and being are bound by customary protocols, which have been put in place to maintain order and stability in different societies (Ayisi, 1992). Their traditional protocols in Zimbabwe that are followed among the Ndebele and Shona with the intention of conservation of, and maintaining of wetlands. The valuable knowledge in the culture of Ndebele is the transferring of the rituals and cultural protocols to the next generation as a way to preserve their natural resources. Gelfand (1973) commenting on Shona Culture, states that knowledge is transmitted from one generation to another , and that this is influenced by age and gender. Elders are responsible for educating the young generation about the protection of wetlands and mechanisms for passing on information from one generation to another (Peters, 1973).

Elsewhere, Aronson (1991) claimed that Ghana's Shai potters restrict and forbid non-Shai women and all men from interfering in their career, in an attempt to be the only ones to profit from that industry. Shai women believe that someone who tries to join their shelter other than themselves will encounter the wrath of gods that causes incurable diseases (Tandoh, Bredwa-Mensah, Dampare, Akaho, and Nyarko, 2009). Those women therefore only teach their female children how to master pottery and how important it is to protect this art from being used by outsiders. Also, in Tanzania, the *Ikombe Kisi* potters who are women do claim sole ownership of pottery production and have complex taboos such as death and madness for outsiders, seeking to capitalize on them (Waane, 1976) and excluding women of other cultures from engaging in pottery. Rather, they pass this information on to their young aspiring pottery girls.

Some interesting work on the sexual division of labour and taboos comes from blacksmithing studies in Nigeria. According to Rasmussen (1995), blacksmiths work in a strict tenet system to maintain control of their operations. Moreover, those guidelines prevail in keeping outsiders, including women, from learning about their profession's insights and secrets. Biological factors are used for the construction of an ideological justification for this rejection. Herbert (1984) notes blacksmiths who are monitoring every single accessible power to ensure safety in their

profession, forbid menstruating women with the fear that their cycle will contaminate the process of purifying iron.

Theoretical framework for the study

eZiko Sipheka Sisophula is a theoretical framework that was postulated by Goduka (2005). According to Goduka (2005), this theory is rooted in African worldviews, without ignoring languages and cultures that draw on the African cosmology's relational/ecological premise that deepens our perception of our interrelatedness. This resonates with the statement of Taleni, Nyoni, and Goduka (2012), that *eZiko Sipheka Sisophula* is derived from an African design of a circle. Based on that design, African life moves in a circular perspective perceived cycle. *eZiko* can also be defined as holistic, feminine, participatory and experiential. The circle in which spiritual, intellectual, and psychological rituals, dialogues, knowledge transmission and intergenerational and intercultural teachings take place.

In this research, this theory was used to explain the process of transmitting the knowledge of ethnomanthematics from elders and to the younger generation. This includes the techniques used, setting for knowledge transmission, purpose, and levels of passing down this knowledge. Furthermore, this theory was essential in explaining the position of women in knowledge transmission for cultural protection and preservation in order for the next generation to have access to ethnomathematical knowledge that serves as cultural identity within the AmaNdebele culture.

Philosophical underpinnings of the study

This study was conducted by an Indigenous researcher using an Indigenous lens in order to understand the processes of ethnomathematical knowledge transmission among the AmaNdebele women, which are an integral part of Indigenous mathematical education. Smith (1999) recommends that Indigenous research be developed and led by Indigenous researchers, analysts, and community members in order to be authentic, and that non-Indigenous researchers, researchers, and community members be involved in improving their understanding of Indigenous knowledge and theories in order to ensure the assurance of Indigenous knowledge and research relevant to Indigenous peoples. Indigenous research has the potential to be a tool for survival, healing, and self-determination through satisfying a need to know and a desire to expand the bounds of current knowledge through the conduct of precise study.

According to Indigenous research, Indigenous societies have shared methods of understanding that are influenced by how people perceive the environment, themselves, and their relationships. As a result, Indigenous understanding comprises a diverse range of thoughts on and resistance against colonialism. Indigenous researchers think about who owns, designs, interprets, reports on, and profits from the research process and goods (Smith, 2012). The study process then becomes one of rewriting history. The center of Indigenous research, then, is a focus on ethics and inter-subjectivity in terms of information access and privilege, the accumulation of methodological tools, and the presenting of viewpoints with physical, psychological, and socio-political ramifications. Indigenous peoples' self-determination is a fundamental goal, both in the research process and in their daily lives, with Indigenous consciousness security serving as a key component in Indigenous methodology (Porsanger, 2004). An Indigenous research agenda includes healing, mobilization, change, and decolonization (Smith, 2012).

This study is underpinned by Indigenous research methodologies based on the reasons that African cultures have unique philosophical beliefs and values, which constitute the way of living and doing. Therefore, use of Indigenous methodologies in Indigenous research protects and advances Indigenous knowledge from being misrepresented, fragmented, mystified, commodified, and simplified (Deloria, 1995; Sue & Sue, 1990; Grenier, 1998; Mihesuah, 1998; Nakata, 1998; Bishop, 1999; Smith, 2000; Fixico, 2003; Mawere, 2014). Furthermore, the use of Indigenous research methodologies for doing research with Indigenous peoples is a decolonizing process (Smith, 2000).

Decolonizing research and employing Indigenous research methodologies are critical in the development of new approaches to reclaiming control over Indigenous ways of knowing and reintroducing lost ancestral teachings, values, and aspirations (Gone, 2019). Indigenous research methodologies are necessary to reframe, redesign and reclaim research processes so that Indigenous people have power of what they see as cultural identities, emancipate the voices concealed in the shadows and recognize Indigenous realities (Steinhauer, 2002).

Indigenous ways of thinking, perceiving, and accessing knowledge have long been condemned by the academic world as belonging to no existing theory (Donald, 2012) or, more often, as nativist or even illogical and contradictory rhetoric (Donald, 2012; Smith 1999). The academic world has frequently understood Indigenous techniques as a political gesture on the side

of Indigenous peoples in their battle for self-determination. Indigenous approaches, on the other hand, must be regarded as part of the body of knowledge about Indigenous peoples and as having theoretical worth.

The research is embedded on Indigenous research methodologies in order to repair and restore dignity and hope to Africans who have experienced historical marginalization and distortion in both research and other scholastic fields (Steinhauer, 2002). In both cases, African ways of perceiving and understanding reality have been questioned or portrayed in spiritualism as strange and exotic. Indigenous scholars such as Chilisa (2012), Kovach (2009), and Smith (2012) began to address Euro-Western scholarship and the concept of reality as universal and a single truth in the late 1990s (Wautischer, 1998).

Policy frameworks underpinning this study

The Arts and Culture Policy of 2002 underpinned this study because it supports the ongoing need for the protection, preservation and promotion of South African Arts, Culture and Heritage. According to Holbrook (2016), the policy states that Indigenous knowledge systems need to be protected, promoted and transmitted and should not be allowed to be eroded and replaced by western dogma hence the need for it to be researched from an insider perspective so as to protect its purity and minimize the infiltration by non-Indigenous ideas. The aims of the Arts and Culture Policy of 2002 are aligned with those of the IKS Act of 2019, which ensures that Indigenous knowledge is protected, promoted, developed, and managed. The IKS Act establishes a National Indigenous Knowledge Systems Office (NIKSO) and an Advisory Panel to advise NIKSO, as well as providing sui generis protection for IK.

The study is further underpinned by the IKS policy of 2004, which supports the participation of women in all aspects of Indigenous Knowledge Systems. Women are encouraged to participate in all aspects of IK promotion and innovation, according to the IKS policy. Participation is defined as a combination of responsibility, trust, and collaboration. Women will be empowered because of this, as they will have more autonomy and decision-making ability over their own lives and circumstances (Mosimege, 2007).

Methodology

The researchers to guide this study used an ethnographic research design. The period that was spent collecting data has enabled the researchers to establish a strong relationship with the participants because the quality of the research findings depended on such relationships (Minkler, 2004). The target population of this study was obtained through the snowball sampling procedure. In brief, after each interview, participants were requested to refer the researchers to the next participants of the study and the person was then approached and recruited to participate. The snowballing proceeded until no new AmaNdebele knowledge holders could be identified (Atkinson, 2001). Fifteen (15) elderly women at villages around the JS moroka municipality were identified who also had years of experience practicing AmaNdebele art and with rich cultural background of this art (Vonk, 2016).

A sample size consisted of ten (10) participants from Ekosini village who were available for the focus group interview. This enabled the researchers to use the convenient sampling procedure. There were three data collection procedures used, namely 1) in-depth interviews, 2) focus group discussions (FGDs) 3) observational field walk-about. The interviews were conducted in a round table sitting. The interviews were conducted in IsiNdebele which is also the language used by one of the researchers. The duration of each interview took three hours. Practices, activities and information were captured during the observation schedule. Information provided by participants during the focus group interviews was captured on a voice recorder. Pictures were also taken using a camera with the consent of participants. Notes taken during interviews were recorded in a diary.

A thematic analysis was used to analyze data and data collected during the interviews was first transcribed from the voice recorders and translated from IsiNdebele language into English. The analysis was manually done on the data. To check the accuracy of the data, the researchers read across data files and themes were identified (Braun & Clarke, 2006). Triangulation was done with field notes and observations and themes were reported as results for this study.

Results

Introduction

Themes that were generated from thematic analysis are as follows: Mechanisms of ethnomathematical knowledge transmission amongst Ndebele women; the setting for ethnomathematical knowledge transmission; Methods of knowledge transmission; purpose for

knowledge transmission; restrictions and protocols in knowledge transmission among AmaNdebele women.

Mechanisms of ethnomathematical knowledge transmission amongst Ndebele women

The AmaNdebele ethnomathematical knowledge is transferred from older women to young girls. Generally, mothers transfer the knowledge to their young girls but also other women with knowledge can transfer it to young girls that they are not related to.

The Setting for ethnomathematical knowledge transmission

A significant place to teach the ethnomathematical knowledge to the younger generation is in *ebaleni* or *erhodlweni*. *Erhodlweni* is where Indigenous mathematical education takes place and women can be taught in groups and individually and that sometimes depends on the level of skills the learner has acquired. This is a revered residence where rituals and cultural activities are carried out. A typical group sitting arrangement is circular, which allows the teacher to circulate about and monitor students without difficulty. The open space in front of the main house is known as Erhodlweni. Cow dung is usually strewn on the floor/ground of the place for décor and to imitate dust. This is referred to as *ukurhuphula*. *Erhodlweni* can also be adorned with a painted tiny wall fencing, as shown in Figure 1. *Ebaleni* is an open space that can be found anywhere in the yard, except in front of the main house. Women identify a collection as an appropriate area in which to carry out their artistic endeavors. As seen in Figure 2, *ebaleni* can be adorned or a structure erected where women can practice their art and share their skills with their children or other women. It's also worth noting that knowledge can be passed on in the *eziko*, which is a part of the yard where cooking by women takes place and where the majority of the fire is burned. Mostly oral knowledge is imparted in this location, where AmaNdebele women tell the history of beadwork and mural art, as well as how they have improved over time.

Figure 1: An *Erhodlweni* setting where ethnomathematical knowledge is transmitted (Bhuda, 2019).

Figure 2: A circular structure built at *ebaleni* setting where women practice and transmit ethnomathematical knowledge (Bhuda, 2019).

Methods of knowledge transmission

Methods of knowledge transmission happen according to certain stages. The authors of this paper have observed the following steps.

1. The beginner stage

Beginners study the methods employed by artists to create art. The artist may observe the student for as long as the artist believes the student is not ready to display their own work. After the artist has determined that a student is ready, an apprenticeship is established. The

apprenticeship program has begun. The artist provides the learner her own material to work with in order to assess her abilities (Figure 3). At this point, the student tries, by trial and error, to incorporate what she has seen from the artist into her own work.

2. Intermediate stage

The artist will next orally give a student guidance on what to do and what not to do during this stage. This supervision will last for days, if not months, until a student has created the best artwork for her level.

3. Advanced stage

A learner's training continues when they are able to do their work on their own (Figure 4) and subsequently demonstrate to their teacher how their skills have progressed. It is up to the artist, according to participant 3, to determine whether a learner is ready to practice her craft without supervision. The education process is never ending. They become more intricate and sophisticated as a learner's experience and practice grows. It takes time, passion, and a lot of devotion for kids to get to this point.

Figure 3: A learner being supervised by an artist (Bhuda, 2019).

Figure 4: Learners independently doing their art after being taught (Bhuda, 2019).

Purpose for knowledge transmission

The primary goal of knowledge transmission is to teach young women who are not married this craft so that when they marry, they can show off their skills to their in-laws. After a newlywed woman has completed all ritual rites, she is supposed to decorate her first home, known as *iqathana*. Her in-laws will assess her abilities to ensure that their son chose a woman with a rich cultural background and who will be able to teach her children the same art. She will also be required to do beadwork for her entire family and her skills will determine how many years she has practiced. Participant 5 backed up this assertion by saying:

> Because they will have to prove to their in-laws that they were taught when they were younger, it is critical for young females to understand this knowledge and perfect these skills. Their mothers-in-law will proudly travel through the villages, praising their daughters-in-law for acquiring the talents. Because these are important days for newlywed brides, the training of beading and mural art is valued by AmaNdebele women.

It is very significant for Ndebele newly married women to be able to paint *iqathana* for the first time in order to please their in-laws and make their parents happy. Furthermore, there is a Ndebele traditional concept that a well-trained woman in painting and mural art is favored with success and fortune by ancestors since she plays an important role in cultural preservation and transmission. Their talents are not restricted to painting and beadwork for their families but women participate in various rituals during celebrations, exhibiting their beaded elegant attires and the magnificently

painted venue that hosts them for the duration of the celebrations. As a result, transmitting this knowledge is vital to preserving their cultural identity.

In support of the above statement, the process of knowledge transmission was observed and confirmed by researchers in table 1.

Table 1: Feminine ethnomathematical knowledge transmission observation overview.

Levels	**Knowledge transmission Setting**	**Knowledge type (common knowledge or secret knowledge)**	**Purposes for knowledge transmission**
Toddlers 1-3	*Erhodlweni/ebaleni*	Knowledge transmitted is common. Teachings become complex according to the level of practice.	1. To prepare women for married life 2. To preserve knowledge so that it can be passed down to the next generation
Teenagers 13-19	*Erhodlweni/ebaleni*	Knowledge transmitted is common. Teachings become complex according to the level of practice	1. To prepare women for married life 2. To preserve knowledge so that it can be passed down to the next generation
Maidens 13-19	*Erhodlweni/ebaleni*	Knowledge transmitted is common. Teachings become complex according to the level of practice.	1. To prepare women for married life 2. To preserve knowledge so that it can be passed down to the next generation

Newly wedded women 20+	*Erhodlweni/ebaleni*	Knowledge transmitted is common. Teachings become complex according to the level of practice.	1. To showcase skills to the new in-laws 2. To preserve knowledge so that it can be passed down to the next generation
Ndebele elderly women 50+	*Erhodlweni/ebaleni*	Knowledge transmitted is common. Teachings become complex according to the level of practice.	1. To preserve knowledge so that it can be passed down to the next generation

The findings in the table above are based on observations that are linked to the data reported in this study. The findings of this table suggest that women are taught the value of information transmission from an early age. They recognize that the talents required to create Ndebele art differ by gender, and they do not attempt to recreate art created by women at a higher level or age group in violation of customary law. Rather, they focus on honing their own craft until they are ready to go to the next level.

Restrictions and protocols in knowledge transmission among AmaNdebele women

Regarding the feminine knowledge transmission, there are restrictions and customary laws involved which have survived for many years in the Ndebele nation. Among other things, these rules succeed in keeping outsiders, including men, from learning the knowledge and secrets of the female profession. Ndebele artists, who act on all available forces to ensure protection in their profession, restrict men from participating in beadwork and mural art. They fear men will disturb the tasks that were given to them by supreme beings which is to preserve and express the Ndebele culture through arts.

According to participants, it has always been a Ndebele belief system that men who associate themselves with art will face the rage of the ancestors such as bad luck or even death. When teaching girls, mothers would dismiss young boys who are spectators during periods when young girls are taught both beadwork and mural art. Girls are separated and taught ways of cultural

expression where boys were taught hard labor and other male duties. This does not mean that what girls were taught by their mothers is sacred. However, in the AmaNdebele culture, boys are not socialized to carry out the same tasks as girls

Discussion

According to the research, AmaNdebele women are ethnomathematical knowledge keepers who have a responsibility to pass on their knowledge to their daughters and other women through various mechanisms and culturally acceptable pedagogies. This information is passed down in an *ebaleni* or erhodlweni, a revered home where ritual and cultural acts take place. Similar studies have been done by Taituha (2014) conducted a masters dissertation at University in Auckland, New Zealand titled: *He kākahu, he korowai, he kaitaka, he aha atu anō? The significance of the transmission of Māori knowledge relating to raranga and whatu muka in the survival of Korowai in Ngati Maniapoto in a contemporary context.* According to Taituha's (2014) statement, knowledge about *raranga* and *whatu muka* has been passed down through generations of *Ngati Maniapoto* women, leaving a legacy for others to continue expressing cultural identity. The transmission of knowledge about *raranga* and *whatu muka* ensures that it lives on through generations. Women are dedicated to the transmission of knowledge about art that has cultural importance in Indigenous Maori culture within contemporary New Zealand.

The study also reveals that Ndebele women rarely conduct other teaching at *eziko*, which is an area where women who cook there share most oral knowledge, myths and legend stories. The transmission of ethnomathemaical knowledge to women takes place in stages and according to age groupings. In most Indigenous nations, age classification is based on the physiological development of the girl child rather than her chronological age. Researchers have claimed that intergenerational knowledge transmission can occur through a variety of techniques, ranging from demonstration and imitation for physical skill transmission to spoken or written communication for idea and concept transmission (Leonti 2011; Schniter et al., 2015).

In an Indigenous context, one witnesses grandmothers, aunties, and women who are called "elders" conveying culture and values from generation to generation (Barrios & Egan, 2002). Women are referred to as "culture carriers," and they are in charge of instilling spiritual and cultural values in their offspring. "Many Native creation stories are female focused, and there are many

stories that speak about the function of women in conveying spirituality to the people," Anderson (2000) says of women's role in carrying culture as the foundation of creation stories.

Similar research was undertaken by Ruddle (1993), who looked into the transmission of traditional ecological knowledge for sites in Venezuela and Polynesia. He discovered that youngsters aged two to five already recognized the names and characteristics of the more prevalent biota. Children were capable of domestic activities, horticulture (plant differentiating, identification, and harvesting), seed choosing, weeding, animal husbandry, fishing, and hunting by the age of fourteen. Overall, he found the training to be age-appropriate, structured, and systematic. During the daily work routine, specific times are set aside for training.

Fafunwa (1974:48) explains how culture is carried down as an intergenerational legacy:

> The child just grows into and within the cultural heritage of his/her people. He/she imbibes it. Culture, in traditional society, is not taught; it is caught. The child observes, imbibes and mimics the action of his elders and siblings. He/she watches the naming ceremonies, religious services, marriage rituals, funeral obsequies. He/she witnesses the coronation of a king or chief, the annual yam festival, the annual dance and acrobatic displays of guilds and age groups or his relations in the activities. The child in a traditional society cannot escape his/her cultural and physical environments.

Ohmagaril and Berkes (1997) carried out investigations on the transmission of Indigenous knowledge and bush skills among the Western James Bay Cree women of Subarctic Canada that were similar to the current research. Bush skills are not taught in formal education, it was revealed. Through apprenticeship and culturally relevant pedagogies, female students from Indigenous communities ‘learn by doing' (Preston, 1975, 1986). The apprenticeship begins when a youngster learns to walk; she is expected to assist and participate in the labor of a bush camp (Long, 1978). In most cases, the child is encouraged to learn skills by playing and mimicking adults through involvement in subsistence generation tasks, rather than being given spoken instructions (Flannery, 1995). Simultaneously, the youngster learns Cree values such as self-reliance, independence, and competence, as well as sharing and cooperation (Sindell, 1997).

Children picked up skills from their parents, grandparents, older siblings, and extended family members with whom they camped. The primary duty for their children's education rested with their parents. Members of extended families, on the other hand, were readily ready to take over teaching tasks when necessary (Preston, 1986). The youngster is allowed to attempt and reproduce the observed skills over a lengthy period of learning by watching and assisting. Depending on the talent's complexity, the apprentice begins by performing one portion of the skill

complex before learning the complete skill complex. Mastery of the skill complex is a long process that can only be accomplished by trial and error (Preston, 1975, 1986). Teachers are patient and encouraging during this trial-and-error process, even if the apprentice fails numerous times as long as she is persistent. The apprentices are instructed to keep trying until they succeed (ibid, 1986).

In addition, the apprentice is expected to learn the skill by following the prescribed recommended ways. When she performs it correctly, the teacher applauds her and says *ekute* (that's how!). Parents in traditional Cree culture educate their children adequate survival skills by the time they reach their mid- to late-adolescent years, allowing them to live in the bush (Flannery, 1995; Rogers & Rogers, 1963; Blythe, Brizinski, & Preston ,1986). The age span of 13-15 years has been identified as a critical stage for mastering most bush skills. Different societies have systems for transmitting knowledge as a tool for maintaining knowledge, according to the studies evaluated in this research. The researchers acknowledge Ohmagaril and Berkes' (1997) study since it details how knowledge is conveyed. The findings of Ohmagaril and Berkes (1997) are consistent with the findings of this study.

The study also demonstrates that information is passed down to other women (such as young women) in order to prepare them for marriage, so that married women can pass it down to their children or children in the community as a way to preserve it for future generations. Orally, through observations, experiments, and participation, women are able to capture knowledge. This kind of knowledge transmission is consistent with Goduka's (2005) theory, *eZiko* Sipheka Sisophula, which argues that Indigenous knowledge is communicated through Indigenous means like practical learning and experiments. The holistic nature of Indigenous knowledge transmission settings, such as intellectual and psychological rituals, dialogues, and intergenerational and intercultural lessons, is also supported by the theory.

Customary laws and protocols prevent the Ndebele and other Indigenous people around the world from sharing their knowledge. Cultural protocols are systems of agreed-upon principles or processes that control behavior and interaction inside a community in order to sustain the cultural norms of the community. They are ingrained in a community's cultural values and highlight the role of communities as keepers of traditional knowledge (Keane et al., 2016). Cultural restrictions, according to Osei (2006), are sources of moral instruction and motivation in African societies for the goal of sustaining social order. Cultural protocols in African communities refer to the fundamental sources of guiding principles and directing and coordinating the conduct of people

and groups toward the Supreme Being, notably gods and ancestors. Osei (2006) did a study that confirmed the findings of this study, namely that customary laws and protocols regulate and influence morals/behavior in Ndebele community.

However, Caillaud et al. (2004) is concerned that cultural restrictions associated with traditions are being replaced by modernization. A study conducted in *Vanuatu* by Caillaud et al. (2004) revealed that in the past, Vanuatu had a diverse spectrum of Indigenous knowledge conservation systems and practices. Direct management and indirect management were the two types of resource management methods in operation. Direct management arose from direct observations (and a perception of a change in resource status or ecological deterioration), leading to decisions to take appropriate remedial action (e.g., imposing a ban or restriction). Conservation measures were developed through ritual and initiation rites, and indirect management had a stronger spiritual and cultural base. The development of taboo places and taboos imposed by customs following specific occurrences such as an epidemic, a murder, or a pig killing ceremony were examples of indirect resource management strategies. Periodic taboos imposed by chiefs or landowners, symbolized by recognized marks, were direct practices.

Anthropologists, non-African Indigenous scholars, and historians who primarily focused on Ndebele history with a historiographical interest in recording the history of personal adornment, rituals, conducted major studies on the Ndebele people near the end of the twentieth century and how the Ndebele Kingdom dispersed using a Western worldview. Most historical documents, such as Weiss (1963), emphasize on beadwork and which Ndebele group it belongs to, rather than the relevance of the knowledge and how it has been passed down through the years. Until recently, no deep study on Ndebelele feminine knowledge transmission have been attempted prior to the twenty-first century. As a result, as the recording of Ndebele history progressed, the study of feminine knowledge transfer was neglected, and therefore lagged behind. As a result, the researchers suggest that Indigenous scholars conduct research on their own cultural backgrounds in order to uncover what has been neglected for a long time. This can only be accomplished when Indigenous scholars do research with Indigenous populations through an Indigenous lens.

Conclusion

The aim of this study was to investigate how women transfer ethnomathematical knowledge from one generation to the next using mechanisms developed by the Ndebele people. The purpose of transmitting this knowledge to the younger generation was provided in detail in

the study. Ndebele women are custodians of beadwork and mural art and it is their responsibility to transfer ethnomathematical knowledge to the next generation. The study provided methods Ndebele women use to share ethnomathematical knowledge and stages of knowledge transmission. Furthermore, the study offered a table on feminine ethnomathematical knowledge transmission, in which the researchers observed women's knowledge transmission age levels, knowledge transmission setting, shared knowledge type, and purpose of knowledge transmission. The study further provided the results, which show that there are customary laws and restrictions associated with the transmitting of the ethnomathematical knowledge. The processes for the transmission of information were also found to be compatible with other cultures around the world. Therefore, Indigenous knowledge is preserved through different types of transmission mechanisms and protected by taboos that have been developed by various cultures. Guided by Indigenous research methodologies, this study has contributed to the bodies of knowledge in Indigenous knowledge systems research.

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