STORYTELLING AS A METHOD FOR ACQUIRING MATHEMATICAL UNDERSTANDING AND SKILL

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ABSTRACT

According to historical accounts of old Africa, mathematics got divorced from the heritage arena. It was subsequently perceived incongruent with locally produced knowledge. Zaslavsky (1999) affirms that the manner in which Africa is portrayed in reference to the history of mathematics and the history of numbers, one would conclude that Africans barely knew how to count. Notwithstanding this, storytelling as an aspect of African indigenous knowledge systems and of a genre of oral tradition constitutes various socio-cosmic codes. Narrative being a social phenomenon and rhythm being symbolic to innate ability to count assume storytelling and numbering affinity. The article aims to explore employment of storytelling for the purpose of assisting basic education learners to acquire mathematical understanding and skills.

Keywords: storytelling, oral history, mathematics, methodology, indigenous knowledge systems, identity

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METHODOLOGY

Due to some constraints that included financial resources and time, an attempt to carry out an empirical research on the subject of storytelling and mathematics was suspended. The aim was to establish an influence of storytelling in emotionally connecting African learners with mathematics. Informed by observation and my historical knowledge, I hypothesise that mathematics is an intrinsic part of people's internal make-up. However, the research was not completely suspended; instead, a literature review conducted and presented here is the first part of the same research.

Since the research relates to oral history in storytelling, three methods were used to collect data: firstly, it was collected from a series of storytelling performances presented by storytellers in various live performances; secondly, additional material was obtained from organisations such as Freedom Park Heritage where digital storytellers have been recorded relating their personal experiences of apartheid. Kuhn (cited in Richie 2012) affirms that oral history has permeated museums. At Freedom Park museum interactive monitors and digital storytellers have presented to the public knowledge gathered through oral history. Taken into account in the discussion is that oral historians of all kinds have had to learn skills required for the creation and documentation of recorded interviews. We have drawn upon different intellectual disciplines, including sociology, anthropology, psychology and linguistics, to better understand the narratives of memory (Perks and Thomson 2006: viii); thirdly, some of the live and digital storytellers were interviewed face to face for the purpose of understanding personal meanings they attach to the stories they tell. Two benefits arose from this process: one was that this oral history methodology enabled the researcher to acquire stories from the interviewer's personal experiences of events. The stories are to be crafted into types of stories suitable for performances by learners. The second benefit was gained through understanding that, in the majority of cases, folktales, myths or history stories, storytellers narrate for audiences. Although at face value they appear removed from the tellers, these stories are in fact subtly their personal understandings or experiences or how their view a phenomenon.

It is therefore not surprising that the word storytelling was first introduced by a historian, Herodotus, around 5th century BC, after being on a mission into investigating the past of Europe, Asia and Africa. He consequently wrote down the results of his investigations as stories ranging from fables and travellers' tales. African traditional stories in particular are embedded with historical information. According to Finnegan (cited in Perks and Thomson 2006), our memories are built up through myths and images. This is to say the story of whom we are, where we have been, what experiences we carry are framed around a narrative model. One of the storytellers interviewed says that a storyteller's performance is a story of his or her experiences philosophically designed for audiences to learn, and, at the same time, to be entertained.

Apart from politics, stories inform us about past knowledges of the people or the history of what, how what came about. For example, there is an oral narrative about the historical origin of the saying, 'sibambe elentulo' – 'we have already accepted the rock rabbit's message'. To a great extent, these are stories or information that storytellers collected orally from communities. One storyteller says that, in different ways, learners will be engaging in the telling of history, while being taught to love numbers and counting. Such stories should help in improving concentration, listening and communication skills of the learners. All these skills are necessary to inspire interest in mathematics.

Storytelling genres that came out of the research ranged from politics, legends, and historical events to myths, folklore, how in the past people built positive characters or originality of phenomenon.

AIM

Apart from striving to motivate mathematical understanding using the art of storytelling, this article should also be read and understood as an attempt to contribute to endeavours that seek to disseminate and popularise history among ordinary South Africans.

Portellic (1997: 25) says:

> Poetry, Aristotle argued, is situated somewhere between the discursive practice representing specific events in the past, through which our sense of history is generated, and what might be in the further, as an always and as yet unrealized utopian (and universal) potentiality. This means that the work of art, and in particular the theatre, is situated between the past and the future, representing a "now" which in its fluidity reflects the ontological instability as well as the ephemerality the theatre.

Not only would African traditional folktales or myths provide access to historical information archived in these oral tales, but the manner in which they are delivered to audiences highlights their critical functional value for modern society, the same way it did for previous generations. Finnegan (cited in Perks and Thomson 2006: 178) points out that 'tales do more than just express a particular sense of history and of one's place in it; they also help shape that experience'.

As in other forms of African epistemologies, through folktales, knowledge and wisdom of an oral society are unveiled. Scheub (1996) refers to such pieces of evidence from traditional stories as *cultural imprints*. He says that traditional tales are culturally defined and adapted to local situations; and that they reveal some community work and thought, while reflecting acquired habits.

EFFECT OF MATHEMATICS IN THE SOCIETY

Mathematics, an integral part of science, is considered a spearhead of development. Mathematics and development have therefore gone hand in hand in bringing about innovations and improvement in societies. For better or worse, mathematics affects people's lives on all levels, such as in highly technologised or computerised cars, biometrics systems in organisations and enclosed residential places, home automation systems where one can switch on and off radio while one is away from home. A recent advancement in the area of science worth mentioning is the Square Kilometer Array (SKA) project, which is taking root in South Africa. The SKA project requires mathematics knowledge and skill. This long-term government project will go on for many decades. Despite these foreseen possible future opportunities related to knowledge and skill in mathematics, it is not clear what is being done to prepare people of South Africa, African youth in particular, to take on this challenge and so meaningfully contribute to the success of this one of its kind projects in Africa, as well as other innovative programmes that require mathematics.

MATHEMATICS IN TOWNSHIP SCHOOLS

In the research conducted and produced by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), about 80% of South African grade 6 learners in the study reached the lower half of eight levels of competence in mathematics. The lowest levels of competency were observed in learners in rural schools. Among factors that contributed to the low achievement in mathematics, SACMEQ's research points out a lack of resources, inadequate infrastructure, incompetent teachers and that local textbooks of mathematics presented a disconnection between what texts presented and what the official curriculum requires. The paper considers the disconnection as serious because schools in rural schools have only textbooks to rely on in their mathematics learning. Case learners are running a risk of learning from a textbook that does not bear information needed to pass exams. It is also clear that if teachers are not competent in their subject, they will produce incompetent learners, who, in turn, will produce incompetent members of the society. The situation becomes a vicious cycle.

While not disregarding the importance of resources and infrastructure, it is, however, notable that the research makes no mention of a connection between the learner and the subject or the subject and the learner's environment, which will take into consideration the learner's history and cultural dynamics. Instead, the research goes on to say that although textbooks may not be the sole cause of poor learner performance, the relevance of learner support materials is a matter that needs to be prioritised. Based on this research, an African learner comes to class as a clean slate, unaffected by his or her own cultural make-up. Such education breaks a thread that serves as a link between a learner's natural and academic life. Mchunguzi (2006)

affirms that there is little continuity between the school and the African child's social environment; the subject matter had little relevance to the child's life, he or she is not motivated to learn. Mchunguzi says that 'this accounted for the stress on rote memory which characterised the education of African children. No paradigm shift has occurred in the modern kind of education system' Mchunguzi (2006: 24).

Resulting from the failure in basic education, the South African Department of Education (2004; 2005) survey finds that only 3 per cent of all the students enrolled in institutions of higher learning in the year 2000 were in mathematical sciences as an area of specialisation, only 9 per cent of employed South Africans aged 15–65 years were in occupations that require some mathematical competence, for example, technicians, IT and associate professionals. From this article's standpoint, this is an unfortunate notion, and maintains that Africans possess invisible knowledge of mathematics, which requires some evocation. Van Sertima (1983) reveals that from antiquity Africans have been mathematicians and scientists. Storytelling, on the other hand, is a natural way of connecting a person with one's environment; that is, a storyteller can tell stories about a land that people occupy and all that comes with it. In this way the storyteller constantly reminds people of what they have and what they need to protect and guard against.

In Africa, the art of storytelling is, according to Boateng (1983), a way of life rather than an event. Like mathematics, storytelling impacts on various levels of people's lives. When engaging in storytelling, one recognises the interconnectedness of things, an intrinsic value of African cultural practises. Here integrated and coordinated processes are realised whereby culture, history, spirituality and the way of knowing of a people can be embodied into one of which modern mathematics or science pedagogy is devoid. The article maintains that if learners, especially those in townships and rural schools of South Africa, were to improve their understanding and keenness in mathematics, then it is important to take into account the concept of interconnectedness. This is so despite the fact that Zaslavsky (1999) says that much of the foundation for the mathematics children learn in elementary and middle grades was first laid in Africa, and yet the school curriculum hardly recognises the multicultural nature of its origin. This makes it critical that the oral history on the knowledge of mathematics be conducted and that stories of African mathematics be developed and told in order that African youth have a claim and pride in this critical skill.

In order to locate this argument within African discourses, the article is grounded on the interconnectedness perspective, and puts forward a discussion based on a connection between an individual's way of knowing his/her inner self and counting. It maintains that the disconnection between cultural practices, inner-self and counting that exists within the mathematical fraternity, contributes to the low mathematics achievement by Africans. It also argues that a disconnection between the self and emotions cannot inspire interest. In order to make an example of mathematical

alignment with cognitive processes, the story of the Nanana Boselesele is presented. Moreover, according to Portellic (1997: 22), 'a work of art "performing history" demonstrates how to construct and retain the balance between the lived moment and the retrospective understanding. Political polemics often lack an understanding of the complexities for those who lived in a certain moment to grasp larger and more comprehensive patterns.'

A woman called Nanana Boselesele lives with her two children and their older cousin. One day she leaves them with the cousin while she goes to fetch wood from the forest. The three children go to play outside, they go to play where animals go past to drink water. Still playing a leopard comes by and praises the beauty of the children. An antelope also comes, looks at the children playing, admires them and goes past. All this time the cousin brags to animals that these are Nanana's children. The third animal that comes by is an elephant with only one tusk, he asks about the children and comments that they are beautiful but immediately complains that they are playing in his path. He swallows the two children, the cousin escapes and runs back home.

When Nanana comes back she learns that her children have been taken by a one tusk elephant. She goes out looking for them, she first meets the antelope then the leopard and they both direct her to under a tall tree that is surrounded by white stones. The one tusk elephant stays there, they said. Nanana finds the elephant there; the elephant got angry of being accused of stealing the children, so swallowed Nanana too. Inside the stomach she finds her children and other animals which have been swallowed by the elephant. She tells everyone inside the stomach to tickle and scratch the elephant, some start dancing and singing until the elephant decides to throw them all up. According to the story, that is why the elephant does not eat meat, from that day he became a vegetarian.

Here a learner engages with the story, thinking critically and analytically. The learner engages in listening and concentration skills. In order to ascertain understanding of the connection of points that make a whole, questions asked: what enabled Nanana to find her children, what role does the tree play in the story or why did the mother build her house along the path of animals? The idea here is not to engage a learner in numbers as such, but to lay a foundation for any problem-solving context, and that it is accepted without fear. This is enabled by the fact that storytelling is not a threatening phenomenon, it comes naturally to humans and learning through it is instead enjoyable. By means of storytelling one inspires coordinated thinking actions and a skill of critical observation, an exercise and a skill paramount to mathematics.

Levelling storytelling with mathematics is not intended to suggest that all mathematics lessons be conducted in a storytelling form, but that mathematics forms part of the story of the people, that it is located in the pulse of the society in the same manner that a story is. Mathematics should be made natural to African learners.

According to Frucht (1999: 26), 'Using mathematics to tell stories and using stories to explain mathematics are two sides of the same coin. They join what never should have been separated: the scientist's and the artist's ways of uncovering truths about the world.' Bell and Cornelius add that 'it is interesting to observe that pupils would carry out some quite complex analyses when given tasks which were based on a game but that they would be less willing and less interested to carry out the tasks in isolation' (in Zaslavsky 1999: 284). All that the scholars say here is that despite substantial evidence of mathematical knowledge in Africa, mathematics is still made foreign to the people.

Mathematics is not supposed to be foreign to Africans considering their dealings with crafts, whether a tangible kind of craft as in basket- and bead-making or intangible as in physical or oral arts, dance, singing, chanting. Unfortunately, a Western frame of reference hardly associates artistic undertakings with mathematics. Nevertheless, Zaslavsky (1999) observes historical progression of mathematics in Africa and says:

- Knowledge of the days of the week or year, as presented by Diop (2000) shows awareness of counting. Farmers and cattle herders observed the passage of the days and the seasons, which enabled them to predict behaviours of seasons and appearances of unfamiliar occurrences such as earthquakes, locusts, and the like.
- The making of carved bone presumably used in writing or engraving in Zaire, (Republic of Congo), dates back to the period between 23 000 and 18 000 B.C.
- Africans exhibit mathematics skill in their basket making, in artworks, home designs, children's games and other places.
- In modern Africa, mental calculation methods of market women have been observed in Mozambique, most of these women solved multiplication problems mentally by doubling, similar to the method of the ancient Egyptians, and Zaslavsky suggests that women are actually better mathematicians than men.
- Herodotus (1996) expresses that African women invented weaving, and for three thousand years women in ancient Egypt have been weaving linen on horizontal looms.

It is therefore of utmost importance that within the African context mathematics is explained and understood in conjunction with indigenous cultures and traditions as there are practised by the people. Indigenous systems contribute to self-confidence, thus providing a basis for self-determination and suitability; they also provide a rich material for development (Odora Hopper 2002). Performance, on the other hand, adds value by introducing alternative ways of looking at a matter in question; identifies and finds a connection in binary elements, for example, love or hate towards certain characters – since the dramatic nature of performance makes material easy to listen and is memorable. A crucial point in this discussion is the ability to equate mathematical figures and symbols with narrative characters. Perks and Thomson (2006) point out that they have worked alongside museum curators, artists or media professionals to create public histories that combine sound, image and text.

Characters in stories enable learners to establish meaning in a story; the meaning often impacts on the listener's emotions and often emotions are influenced by experiences. Understandably storying is about transformation and movement of processes from one point to another, resulting in something new. This should find resonance in mathematics as it is also a narrative in its structure, and as such it engages in processes of change, the movement of x's and y's into xy's. Another example that brings to the discussion opportunities from which to learn about mathematics within narration is a problem-solving story in the 'Story of a Traveller.'

Story of a traveller

Once a man travelled from one village to another, he was with his dog, his goat and carried some wheat so the animals could eat on the way. Now he had to cross a very big river and could not carry all these three things at the same time. He could not leave the wheat with any of the animals because they would eat it, he could not leave the dog and the goat because they would fight or the dog could hurt the goat. He heard a problem.

Such stories provide leaners with opportunities to exercise their problem-solving skills, because they help accelerate a dynamic way to understand and facilitate problem solving by inspiring interest, excitement, mystery, surprise and motivation to think out a problem. At the same time, analytical and critical thinking skills automatically come to the fore. Furthermore, popularising similar kinds of stories can minimise the fear of numbers or counting that the learners experience. Egan (cited in Zaskis and Liljedahl 1999) states that what is important is not that the students hear a story that contains mathematics, but that they *engage in* the mathematics inspired by the story. Numerous stories exist that convey messages relating to money or counting. These stories may provide useful material for the school curriculum so that mathematics is made less mythical, and instead more of historical narratives that people willingly embark on.

Rhythm and counting

The article introduces orality as an area endowed with numbering, counting and other basic mathematical elements. Attention is placed specifically on story chanting. Chanting is one of the methods that storytellers employ in their story delivery. It is also known to be one method through which individuals in groups would relate their experiences and feelings about a certain matter. Women in particular would chant about how they view their husbands' other wives wives or even their husbands for that matter; they sometimes brag about themselves in chanting.

During chanting the rhythm of a chant evokes emotional responses and enables a connection between an individual and a listener. In order to improve a number of learners taking mathematics, the language of love is paramount, and here

chanting plays an important role since it is able to heighten a sense of acceptance. Likewise, acceptance goes hand in hand with connection, and therefore chanting is a possible tool to connect persons with numbers and consequently mathematics. In this way the person and his or her environment are interconnected. All this happens subconsciously.

The chant called 'Two Shelen' is an example:

Ngilihambile izwe wema
Two sheleni
Ngazengafik' ezintabeni ezinzulu
Two sheleni
Ngahlangana nezinsizwa ezimbili
Two sheleni
Zangibuz' ukuthi ngiw' ban'
Two sheleni
Two sheleni
Two Sheleni

The chant goes on and on until the teller runs out of ideas. In a chant, the focus is on rhythmic patterns that continuously manifest as the chanting progresses. Herein rhythm is explored in order to highlight and bring out an invisible calculation present in a chant. It is characterised by distinct rhythmic sounds; counting during the process of chanting is subtle and proceeds naturally without the person being aware of it. Different chants possess rhythm variations of unequal length, tempos, pitches and sounds. These variations can be measured in terms of weight, intensity and the distance of a travelling sound may also be determined by exploring sound waves moving from the teller to the listener.

As much as analysing mathematical elements in storytelling is critical, it is equally important to bring to attention that counting and numbering are not only physical and visible but also invisible, innate and subtle. As such, mathematical-related skill is perceived in terms of its existence within a human body, and telling a story in a certain way assists in activating and making one aware of skills that are innate and subconscious. Understanding this interplay will assist in revealing elements on a subconscious level, embedded in one's inner world. Thereby the invisible mathematical skill is uprooted and brought to the surface and finally to the attention of a person. Even in memory and remembering, the potential of calculation and counting can be explored. Portellic (1997: 22) states that 'a work of art "performing history" demonstrates how to construct and retain the balance between the lived moment and the retrospective understanding. Political polemics often lack an understanding of the complexities for those who lived in a certain moment to grasp larger and more comprehensive patterns.'

Lastly, in the words of Zokia and Liljedahl, when teaching mathematics we must bring forward human emotions, ambitions, intentions, fears, and so on, then we can expect to engage our students' imaginations in learning. 'Instead of representing knowledge as a given-telling students the rules for the use of parenthesis or for solving equations and giving them exercises until they get the rules right – we might make the knowledge memorable and meaningful by re-embedding it in the context of its original invention or human uses,' (Zokia and Liljedahl 2001: 16).

According to Zokia and Liljedahl, connecting mathematics to history of real human beings is essential. This will demystify mathematics as the subject of the elite, that deserves special attention or that belongs to a chosen few. The article maintains that a scare and mystery have been deliberately maintained by divorcing mathematics from ordinary life and so making it unattainable by the majority, and has promoted mathematics to be for the 'mentally privileged' individuals. Paradoxically, while mathematics is continuously made indispensable to African people's lives, it continues to alienate them from their environment and the land that produced mathematics intellectuals and other scientific knowledge.

In the same way that stories tell about our heroes and heroines, historical events about mathematics, connecting mathematics to its human context should be considered and narrated in the classrooms and beyond. This is because art provides a space for us to re-evaluate and adjust our perceptions. Stories such as those of the father of science, Imhotep of Egypt, or the story of Tom Fuller are critical in humanising mathematics. Balakrishnam (2000) affirms that the facts and algorithms we teach our students will no longer be viewed as meaningless symbols and abstract ideas, but as the product of human passions, hopes and fears. Egan maintains that science and mathematics were made inhuman and emotionless by separating knowledge from its human origin. Greek mathematics has been limited to formalism and foundationism, creating an ivory tower of knowledge, an absolute Knowledge (Egan 2008). This separation has further divided knowledge into that of commoners and of the elite. In actual fact, through the words of Achebe (1975), there are other forms of power: 'Orature appeals to the mind, and appeals ultimately to generations and generations and generations.'

The history of personalities such as Imhotep, Fuller and others should be collected, recorded and narrated in the classroom and beyond. Fuller was brought into the Americas in bondage at the age of fourteen. Although slaves were not permitted to learn to read and write, he became widely known for his skills in mental arithmetic. In the presence of an antislavery society, he calculated mentally in one and a half minutes the number of seconds in 70 years, 17 days, 12 hours, even taking into account of leap years, according to Fauvel and Gerdes (1990).

For Asante (2000: 2), 'There are several elements in the mind of Africa that govern how humans behave with regard to reality: the practicality of wholism, the prevalence of poly-consciousness, the idea of inclusiveness, the unity of worlds and

the value of personal relationships.' Based on the literature reviewed, an empirical research that will explore a relationship between physical mathematics and internal tools that enable unconscious counting is recommended.

CONCLUSION

The article brings forth the idea that storytelling contains histories of the people, specifically African people, and that these histories are often collected from communities or individuals and are presented orally as stories to audiences. Stories by their nature are loved by people because people who listen to them identify with occurrences in the stories. At times, the storyteller speaks the language of the audience or a language that the audience can understand. Consequently, both narrator and listener are on an equal level of communication. In that way, these narratives or stories integrate with the consciousness of the people.

The article argues that in these narratives, whether myths or obvious facts of history and the manner in which a story is presented, numbers and calculations are embedded. How people gauge themselves in terms of understanding numbering and counting depends on the emphases presented to them by a system that governs a well-being of a community. According to this article, African learners can realise their potential in knowing mathematics and science if these two subjects are presented in ways that learners can identify with their content. That is, in presenting maths and science, learners are made part of the story rather than outsiders peeping inside. If one is able to keep rhythmic patterns one is capable of learning physical counting and calculation, consequently mathematics. It was also said that a 'like' can be developed through telling mathematics stories. Finally, not in obvious terms, in the article it is suggested that interviews on knowledge and understanding a history of numbers and counting be done and taken seriously in order that mathematics is associated with humanity, which will result in different stories of histories being widely spread in public.

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