RLE
Revista Latinoamericana de Etnomatemática

Revista Latinoamericana de Etnomatemática
E-ISSN: 2011-5474
revista@etnomatematica.org
Red Latinoamericana de Etnomatemática
Colombia

Madusise, Sylvia
Cultural villages as contexts for mediating culture and mathematics education in the South African curriculum
Revista Latinoamericana de Etnomatemática, vol. 8, núm. 2, junio-septiembre, 2015, pp. 11-31
Red Latinoamericana de Etnomatemática
San Juan de Pasto, Colombia

Available in: http://www.redalyc.org/articulo.oa?id=274041586002

Madusise, S. (2015). Cultural villages as contexts for mediating culture and mathematics education in the South African curriculum. *Revista Latinoamericana de Etnomatemática*, 8(2), 11-31.

Artículo recibido el 17 de septiembre de 2014; Aceptado para publicación el 26 de abril de 2015

Cultural villages as contexts for mediating culture and mathematics education in the South African curriculum

Aldeas culturales como contextos para la mediación de la cultura y la educación matemática en el currículo de Sudáfrica

Sylvia Madusise[1]

Abstract

Some mathematics educational reform policies indicate that mathematics education should be connected to learners' cultures. However, teaching in schools rarely brings the interconnection between mathematics and culture in pedagogically informed ways. Connections are often done superficially; the curriculum in schools lacks content and specific strategies that enable the making of the connections explicit in the context of teaching. The qualitative study from which this paper emerges worked with three mathematics teachers in an attempt to teach mathematics in ways that connect key concepts with culture. Through mathematizing culturally-based activities performed at a cultural village[2], two Grade 9 mathematics topics in the South African curriculum were indigenised. A teaching unit on the indigenised topics was designed and implemented in five Grade 9 classes at the same school. The paper demonstrates that the experience of designing, implementing, and reflecting on the intervention study had some positive contribution to the participating teachers' pedagogical repertoire. Teachers saw the possibility of using cultural villages as instructional resources for connecting mathematics education to learners' cultures in the South African curriculum. I argue that cultural villages can be used as contexts for mediating culture and mathematics education.

Keywords: Indigenisation; Mathematisation; Cultural villages; Culturally-relevant pedagogy.

Resumen

Algunas políticas de reforma educativa de matemáticas indican que la educación matemática debe estar conectada a las culturas de los alumnos. Sin embargo, la enseñanza en las escuelas rara vez hace la conexión entre las matemáticas y la cultura de manera pedagógicamente informadas. Las conexiones se hacen a menudo superficialmente; el plan de estudios en las escuelas carece de estrategias de contenido y estrategias específicas que permitan la realización de las conexiones explícitas en la enseñanza. El estudio cualitativo del cual este trabajo surge trabajó con tres profesores de matemáticas en un intento de enseñar esta disciplina en formas que conectan los conceptos clave de la cultura. A través de las actividades culturales realizadas en una aldea cultural[3], dos cursos del noveno grado del currículo sudafricano fueron indigenizados. Una unidad didáctica sobre los temas indigenizados fue diseñada e implementada en cinco clases de noveno grado en la misma escuela. El trabajo demuestra que la experiencia en el diseño, implementación, y reflexión sobre el estudio de intervención tuvo alguna contribución positiva al repertorio pedagógico de los profesores

[1] Great Zimbabwe University, Department of Teacher Development, Faculty of Education, Masvingo, Zimbabwe. Email: madusise@gmail.com

[2] A cultural village is a tourist establishment where tourists can view aspects such as the homestead, traditional clothing, food and food-related practices, history and societal structures as well as song and dance routines of one or more of South Africa's cultures (Mearns & du Toit, 2008).

[3] Un pueblo cultural es un establecimiento turístico, donde los turistas pueden ver aspectos como el hogar, la ropa tradicional, los alimentos y las prácticas relacionadas con la alimentación, la historia y las estructuras sociales, así como de rutinas de canto y danza de una o más de las culturas de Sudáfrica (Mearns y du Toit, 2008).

participantes. Los maestros vieron la posibilidad de utilizar las aldeas culturales como recursos didácticos para la conexión de la educación matemática a las culturas de los alumnos en el plan de estudios de Sudáfrica. Sostengo que las aldeas culturales pueden ser utilizadas como contextos para la mediación de la cultura y la educación matemática.

Palabras clave: Indigenización; Matematización; Aldeas culturales; Pedagogía culturalmente relevante

INTRODUCTION

Some education reform policies indicate that education needs to be relevant to the learners' cultures. Many researchers have agreed that teaching must be related to its cultural and geographical contexts (Bishop, 1988; Kroma, 1996; Ascher & Ascher, 1994; Gerdes, 1999; Mosimege, 2003; Madusise, 2010). Seah and Bishop (2003) argued that mathematics and culture are often interconnected, making school mathematics intimately linked to the society in which it is taught. There is consensus amongst these researchers that mathematics is being perceived as dry, uninteresting and irrelevant. Familiar subject matter and experiences that could be used to lay the foundations of the discipline, arouse learners' interests, and challenge their intellect early in life have been largely neglected (Kroma, 1996).

South Africa has embarked upon a curriculum that strives to enable all learners to achieve their maximum potential (Revised National Curriculum Policy, 2002). Policy statements for Grades R-9 Mathematics envisage learners who will "be culturally and aesthetically sensitive across a range of social contexts" (Department of Education, 2002: 2). Interestingly, some assessment standards expect learners to be able to solve problems in contexts that may be used to build awareness of social, cultural and environmental issues. The South African National Curriculum Statement (NCS) challenges educators to find new and innovative ways to reach learners from diverse cultures in their mathematics classrooms. Valuing indigenous knowledge systems is one of the principles upon which the NCS is based. Part of the teacher's work involves using ethnomathematics as a cultural way of doing mathematics. The NCS calls for radical teaching practice changes on the part of some teachers in order to see mathematics incorporated in the real world as a starting point for mathematical activities in the classroom. For there to be a real possibility of implementing such kind of classroom activity, there is need to investigate the mathematical ideas and practices of the cultural, ethnic, and linguistic communities of the learners.

Khisty, (1995) argues that learners of all background would benefit from the opportunity to learn about and identify with their rich mathematics heritage and on-going cultural practices.

IMPLEMENTATION PROBLEMS

Although these new understandings of mathematics teaching and learning may sound very appropriate, the implementation and impact of explicit instructional strategy may not be widespread and may be problematic. In South Africa, teaching in schools rarely brings the interconnection between mathematics and culture in pedagogically informed ways (Mosimege, 2012). In his plenary address on 'Mathematical connections and contexts' at the Institute for Science and Technology Education (ISTE) 2012 International Conference at Kruger National Park in South Africa, Professor Mosimege reiterated that mathematics teachers lack the ability to make connections in their mathematics classrooms; their indigenous (local) content knowledge is shallow. Also, an evaluation of the implementation of the NCS carried out in 2009 by the Task Team for the Review of the implementation of the National Curriculum Statement revealed that some teachers had problems of converting the NCS vision of mathematics teaching from the written into the taught curriculum. Some teachers face challenges when using social and/or cultural contexts to reveal the underlying mathematics while simultaneously using the mathematics to make sense of the contexts themselves. In so doing they are hindered from developing in their learners the ability to read and understand their world mathematically. This stagnancy in classroom pedagogy, I argue, may be in part related to the failure of educational research to adequately investigate and promote the relationship between teacher professional development and enhanced understanding of the espoused pedagogical shifts. There is widespread agreement that improving teaching and learning requires that teachers participate in high-quality professional development (Elliot, & Kazemi, 2007). Such professional learning communities are largely linked to teacher learning in and from practice. Effective teacher professional development has been characterised as being long-term, collaborative, school-based and focused on student learning (Hiebert, Gallimore, & Stigler, 2002). Little (1993) describes professional development as an activity that is intended partly or primarily to

prepare teachers for improved performance in present or future roles in their schools (Desimone, 2009:182).

STUDY FOCUS

Driven by the proposal of the South African National Curriculum Statement (NCS) Grade R-9 Mathematics, to incorporate indigenous knowledge in mathematics education, the study sought to assist teachers in terms of where to access the indigenous mathematical content knowledge and how to integrate the extracted indigenous mathematical ideas in their mathematics lessons. The aim was to explore the context of a cultural village as a vehicle for mediating culture and mathematics education, interrogating connections between mathematics and indigenous knowledge systems. Mathematics teachers were then engaged in a school-based professional learning community, basing the teaching of mathematics on the cultural background of the learners, using out-of-school, culturally-based activities. The major aim was to extract mathematical ideas from the environment and embed them within mathematical instruction.

Through mathematising culturally-based activities performed at the cultural village, the research team indigenised (i.e. adapted to local culture) two Grade 9 mathematics topics in the South African curriculum. A teaching and learning unit on the indigenised topics was designed and implemented in five Grade 9 classes at the same school. This paper traces the journey of extracting mathematical ideas from cultural activities at the cultural village, designing and implementing an intervention teaching and learning unit at Grade 9 based on the extracted mathematical ideas, and discusses the impact of this intervention study on the participating teachers. It addresses the following central research question: *What is the potential of mathematical ideas associated with activities at a cultural village for informing teachers' pedagogical repertoire?*

THEORETICAL FRAMEWORK

The study was guided by Ladson-Billings' (1995) culturally-relevant pedagogy theory; a pedagogy that builds on the premise that how people are expected to go about learning may differ across cultures. Ladson Billings (1995) asserts that culturally-relevant teaching is designed not only to fit the school culture to the students' culture but also to use students'

cultures as the basis for helping students understand themselves and conceptualize knowledge. Culturally relevant pedagogy has been defined as a means to use students' cultures to bridge school knowledge and cultural knowledge (Boutte & Hill, 2006), to validate students' life experiences by utilizing their cultures and histories as teaching resources (Boyle-Baise, 2005), and to recognize students' home cultures, promote collaboration among peers, and connect home life with school experiences (Neuman, 1999). Culturally relevant pedagogy is a teaching style that validates and incorporates learners' cultural background, ethnic history, and current societal interests into teachers' daily instruction. Many mathematicians, mathematics teachers and students possess "only a limited understanding of what and how [cultural] values are being transmitted" through the discipline (Bishop, 2001, p.234). Culturally relevant mathematics lessons work against this ignorance by reversing the trend in traditional mathematics curricula to divorce mathematics from its cultural roots (Troutman &McCoy, 2008).

Ladson-Billings (1995) documented the success of innovative lessons that appeal to diverse cultures in improving students' attitudes towards classroom subject matter. Teachers who participated in her study developed lessons that incorporated the knowledge students gained from their lives outside of class and demonstrating the value of students' home cultures and languages. By so doing the participating teachers positively influenced student test scores, engagement in the classroom community, and overall attitude towards school and learning (Ladson-Billings, 1995).

METHODOLOGY

Samples and sampling procedures

The sample in this qualitative case study consisted of three mathematics teachers from one rural school in the North West Province of South Africa and their Grade 9 learners. Purposive sampling was used to select the research sites. According to Cohen and Manion (1994, p. 89):

> 'In purposive sampling, researchers handpick the cases to be included in the sample on the basis of their judgment of their typicality. In this way they build up a sample that is satisfactory to their specific needs'.

Merriam (2009) identifies purposive sampling as one appropriate sampling strategy in a case-study design. Merriam (2009) further adds that purposeful sampling is based on the assumption that one wants to discover, understand, gain sight; therefore one needs to select a sample from which one can learn the most. In this case, a cultural village was identified as the research site and mathematics teachers who teach at a school very close to the selected cultural village were chosen. A cultural village was selected with the belief that it is where the community's indigenous knowledge is preserved. It was further considered that activities at a cultural village could assist teachers and learners in understanding condensed cultural ways of living. The intention was to make the cultural village a context for mediating culture and mathematics education. There is tremendous potential for cultural villages to act as custodians of indigenous knowledge (Mearns, 2006). Visitors and workers at cultural villages interviewed by Mearns (2006) expressed that cultural villages conserve the respective cultures they are representing. A school close to the cultural village was conveniently chosen with an assumption that its members (including learners) could be quite familiar with the activities taking place at the cultural village since the chosen village was a multi-cultural village representing the traditional village life of the Basotho, Ndebele, Zulu, Venda, Tswana and Xhosa. The traditional life styles of the above mentioned cultures were showcased in each separate village dedicated to these cultures. This assumption was supported by the school principal's comment that they were using the cultural village in Arts and Culture activities and that some learners were participants at the cultural village.

Nature of data

The data collected in the study on which this paper is premised included seventeen video-recorded culturally-based lessons from five Grade 9 classes (these lessons were co-taught by the researcher and the class teachers). Also used were data from: learners' pre and post questionnaires, journal entries, post lesson interviews and teachers' pre and post interviews, and reflective meetings. These data served as corroborating evidence to enrich the picture of teaching practices presented in the study. The multiple sources of data provided convergent lines of evidence to enhance credibility of assertions (Yin, 2003). Lessons were collaboratively planned by the researcher and the class teachers. However, for the purpose

of this paper only data from participating teachers are used by triangulating data from transcribed pre and post interviews and reflections.

Data analysis

In analysing teachers' data, I found Cohen, et al.'s (2000) steps of analysing interview data very useful, their steps start from the establishment of units of analysis of the data (in my case, the subject issues). The analytic induction involved reading and re-reading interview transcripts and notes from reflective meetings to unveil different subject issues. Responses were then classified on the basis of the formed subject issues (categories).

Data presentation

The three participating teachers are coded TR A, TR B, and TR C for confidentiality reasons (TR A = Teacher A, TR B = Teacher B and TR = Teacher C). All the teachers had a minimum of seventeen years teaching middle school (Grades 7 to 9) mathematics, which means they should have gained substantial experience teaching mathematics up to Grade 9.

F issues emerged in the analysis of the interview data relating to teachers' existing practices. They were linked to: Coverage of indigenous mathematical knowledge in the textbooks; Improvising teaching materials on indigenous knowledge; Classroom practices: Lesson planning; Instructional strategies, and Learners' roles in mathematics lessons. These issues are exemplified below.

With respect to coverage of indigenous mathematical knowledge in the textbooks, the teachers made the following remarks in the interviews:

> TR A: There is not much really.
> TR B: There isn't much.
> TR C: It is confusing because the children come from different cultures.

It can be seen from the above remarks that TR A and TR B believe the textbooks they are using are not covering much of indigenous mathematical knowledge. TR C thinks what is in the textbooks confuses her; it is not representing all the learners' cultures.

None of the teachers were improvising teaching materials on indigenous mathematical knowledge. They said they used textbooks recommended by the Department of Education, which from above, they had evaluated as not covering much on indigenous mathematical knowledge. This is illuminated by the following:

> Researcher: Do you sometimes improvise teaching materials on indigenous mathematical knowledge?
> TR A: To improvise! No I find it difficult. I find it difficult really. I always refer to what is in the textbooks.
> TR B: I can improvise materials for other aspects. For cultural mathematical knowledge, we use recommended textbooks and other textbooks as references.
> TR C: No, I don't improvise.

If the textbooks the teachers and learners are using do not cover much on indigenous mathematical knowledge and the teachers are not improvising teaching materials, the conclusion one can draw is, there is limited link of mathematics education to learners' cultures. When asked how they make decisions on what to teach and how to teach it, planning of teaching work, the following remarks were made.

> TR A: I just prepare starting from what they did before. I refer to what they did before which is related to the same topic I would like to teach. I refer to their previous textbook.
> TR B: By following the curriculum. From the Department of Education they give us what to do for the whole year. We have schedules which come from the department.
> TR C: Checking the level of learners, assessing the level of learners and their knowledge.
> Researcher: How do you determine that level?
> TR C: I refer to the previous covered work to check the related content and level which was covered.

TR B checks the curriculum demands when planning to teach. She uses the work schedule which is provided by the Department of Education. TR A and TR C use the traditional way of planning where the previous covered work should guide the planning. None of them indicated reference to learners' out of school experiences. This indicates that the mathematical knowledge which learners' may develop out of school is not taken into consideration when planning.

The teachers were also asked to describe the different instructional strategies they employed in the teaching/learning process in their mathematics classrooms. They were also asked to describe the usual activities they undertook in their mathematics lessons. The teachers gave the following remarks

> TR A: I start by explaining using the chalkboard, chalkboard explanations. Using what they know then I can introduce new work using examples from the textbook.
> TR B: I mainly use question and answer method. I give instructions; tell them what they should do. What the topic is all about and then ask them and they give me answers. I also show them how to get to the answer using chalkboard demonstrations.

> TR C: I usually use question and answer, explanatory, chalkboard demonstrations. Learners must know the formula where it is required. I sometimes use practical work like drawings depending on the topic.

TR B uses question and answer to check if learners got the instructions, checking learners' understanding on the topic. She uses demonstration to show learners what they are expected to do. TR A uses chalkboard explanations and textbook examples to facilitate understanding and to illustrate an idea. TR C uses question and answer to check if learners are following the formula. She uses explanations maybe to emphasise and summarise important ideas. From the above remarks it can be observed that the case teachers' roles in the classroom can be classified into helping learners to remember what was learnt previously, checking if learners are following the lesson, helping learners to check misconceptions and conveying information. Teachers were not connecting mathematics education to learners' cultures. When the teachers were asked to describe the usual activities their learners engaged as they learnt mathematics in their mathematics classrooms, they gave the following statements:

> TR A: Individual classwork, copying homework, oral work just to check how much they understand. In fact I believe if they all participate, they must be involved.
> TR B: Oral work, written work and I sometimes allow them to ask questions and work in groups. The activities I give them are guided by the teacher's guide.
> TR C: Writing corrections, explanations and asking questions.

TR A gives individual work to make sure all learners participate in his lessons. To him active participation means engaging in individual classwork, oral work and copying homework. TR B allows learners to ask questions to help them to identify misconceptions and misunderstandings. In TR C's classes learners write corrections to identify misconceptions. This observation indicates that the case teachers were not basing their teaching on learner thinking. It was also observed that their instructional strategies were not based on a clear theoretical framework as they could not clearly explain the learning theories which they were engaging.

> Researcher: Is your teaching based on any learning theory or generalised ideas on how mathematics can be taught or learnt?
> TR A: Hmm…m theories? No…In fact I believe when they all participate they must be involved. Yeah they must be involved so that they can understand. If you are quiet we never know whether you are with us or not.

> TR B: Yes I try by all means to make my learners understand; I do not base my teaching on one method, but use different approaches.
> TR C: We follow given policies.

It seems the teachers did not quite answer the question on teaching/learning theories they were engaging.

INTERVENTION TEACHING

Two Grade 9 topics were co-taught by the researcher and the participating class teachers using culturally-based activities in five Grade 9 classes. The lessons were collaboratively planned by the researcher and the class teachers. A group of Grade 9 learners (these learners had previously participated in the cultural dances at the cultural village) demonstrated a Setswana step dance, a cultural dance practiced at a cultural village near the school. It was observed that the dancers were following a certain dancing style where each dancer was making five footsteps forward, backward and sideways. The modeling of the dancing style through class discussions produced a number pattern involving the number of dancers and the number of cumulative foot-steps made in one direction before change of direction (see Table 1 below).

Number of dancers	1	2	3	4 - - - -	n
Number of foot-steps	5	10	15	20 - - - -	nx5

Table 1. A number pattern derived from the dancing style.

The second row was used to introduce a sequence. Through deductive reasoning the rule connecting the terms of the sequence was generalised. Learners managed to explain their understanding of a sequence leading to its definition. However, there was a heated argument on whether 'n' could take any value. Realistic considerations were recruited. Making 'n' = 0 meant no dancer, therefore no dance and making 'n' too large meant too many dancers dancing at the same time making it difficult to follow the dance. At higher levels the depicted scenario can be used to introduce bounded sequences. Given the periodic nature of the cultural dance – going forward, backward and sideways, the implied mathematics involved is periodic in motion since the steps were repeated over time. This led to another sequence - a constant sequence: 5, 5, 5, 5, … whose n^{th} term is 5.

In Teacher B's observed lessons, the same dancing context was used to introduce plotting of linear graphs. The number of dancers represented the independent variable *x* and the number of footsteps represented the dependent variable *y*. In her other lesson on 'input' and 'output', the number of dancers represented the input and the footsteps represented the output.

In another topic, artefacts from the Ndebele paintings and beadings, collected from the cultural village (see Figures 1and 2 below) were used to teach properties of shapes and transformations.

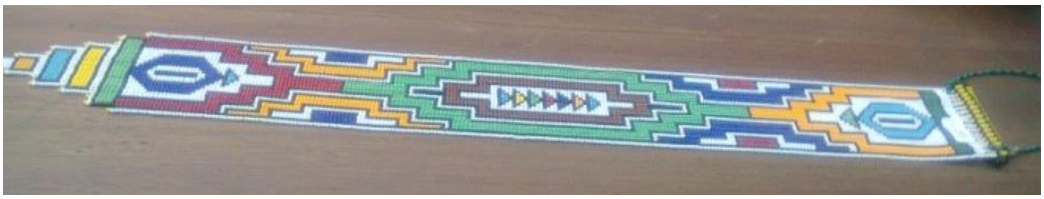

Figure 1. Zulu beadings

Through applying their school mathematical knowledge on translation, reflection and enlargement, learners had constructive group discussions on how the beads were sown. This led to a deeper understanding of the beading activities as well as the involved mathematics. Through measuring (in some cases counting beads in a line) the real artefacts learners came up with the used enlargement scale factors, the translation vectors and reflection mirror lines (axis of symmetry). Some learners reiterated that they were going to use their school mathematical knowledge in coming up with their own different beading designs.

Figure 2. Ndebele paintings

Learners managed to describe the patterns and transformations on pictures of the Ndebele huts used during the lessons. This led to an understanding of the mathematics involved.

Perceived benefits of the intervention study on the teachers' practices

For the purpose of this paper I chose to focus on TR B. I chose to focus on this particular teacher because of her commitment and participation in the activities of the intervention study. Also her espoused claims of how her participation changed her thinking about connecting the teaching of mathematics to learners' cultures led me to focus my analysis on her practices.

Four issues emerged in the analysis of TR B's perspectives of the intervention teaching. The issues were categorised into:

- Cultural village as a mathematics instructional resource.
- Use of connections in mathematics education.
- Effects of the intervention on teachers' pedagogical repertoire.
- Indigenisation as an entry point to mathematics education.

Cultural village as a mathematics instruction resource:

> TR B: What I have gained is that I can use resources like culture….from cultural villages, like dancers (pause) to create, plan a lesson.
> Researcher: Do you think the way you are thinking about setting homework, class exercises, tests, is different form the way you were thinking before the project?
> TR B: We have all the tasks included in the assessment programme. The problem is when we research learners go to ……maybe the library, but there is no library which is nearer for the learners to use. They have to go to town for the library. And also if they want to research using the computers it is a problem as we do not have computers at our school. But we will now think of ….the cultural village….of using the cultural village and ask the learners to go to the cultural village as it is nearer to them.
> TR B: Yeah….you can give the learners a task which needs them to go to the cultural village so that they can research more.
> TR B: Or to take them to some places, like to take them to a museum or a cultural village where they can see all these things.

From the above comments, TR B approves the possibility of using the cultural village as a context for mediating culture and mathematics. She contends that in the project all the required resources were available but all the used materials were designed using the cultural village as a resource. To her the cultural village can play the role of a library. She believes learners can use the cultural village as a research centre to assist them to answer

given mathematics tasks. She now sees the richness of the cultural village in terms of mathematical knowledge. According to TR B, one advantage of using the cultural village when doing research is visualisation. "…take them to the museum or cultural village where they can see all these things".

According to TR B, before the intervention the educational value of the cultural village was only attached to Arts and Culture.

> TR B: During Arts and Culture festive we use dancers from the cultural village and these dancers are our learners who practise there during their own time. Therefore that means they are important but they were only important for Arts and Culture.
>
> Researcher: But not for mathematics?
>
> TR B: We haven't linked them to mathematics at all. This is the first time that the cultural dancers or cultural activities were linked to mathematics teaching and learning.

Now that in the intervention cultural activities were linked to mathematics education, TR B sees the need to consider the educational value of the cultural village across all the subjects in the curriculum.

> TR B: I think there is need to consider the educational value of the cultural village across all the school subjects. Also the school should work hand in hand with the community.

Use of connections in mathematics education

> Researcher: What do you think about the preparation required?
> TR B: Just to link the mathematics and the culture so that the children can see where these two topics, the culture and….how their culture integrates with mathematics.
> Researcher: You mean they need something like an educational tour.
> TR B: Yeah …..that is also important because I realised that most of them learn better when they see something and they can make connections.
> Researcher: What advice would you give to other mathematics teachers in general?
> TR B: I think we need to look at our environment and identify the places where learners can learn on their own using the environment, where they can gain more using our own environment, places like the cultural village and they may also be some other resources here in their community which they can use and can benefit them in their learning. But then this can only be effective if the community and the school work hand in hand that will be effective.

TR B now sees the value of connecting mathematics to learners' cultures in her lesson preparations. To her, use of environment can assist learners to learn on their own, they can gain more using their own environment. By conducting educational tours which take learners to places where mathematics is being used, TR B believes learners can make

connections. She now sees the need to link mathematics and culture in mathematics education. Teaching and learning resources can also come from learners' communities; she believes mathematical knowledge learnt from outside school can be transferred to the classroom. TR B now wants mathematical content in the textbooks they use to reflect the everyday. She wants textbook writers when coming up with Learning Outcomes (LOs) to give more information that refer to cultural activities.

> TR B: About topics in the textbooks, I think their content must be in relation to the learners' cultures. That will be the most important thing for our learners. These authors should give us more information on the LOs that refer to cultural activities. This information is awash at cultural villages.

Effects of the intervention on teachers' pedagogical repertoire

> Researcher: Do you think the way we used activities at the cultural village will shift the way you will see these activities when you visit the cultural village today or say in future?
> TR B: Yes now we are going to can see activities differently, because we are now going to see different kinds of shapes, number patterns, different colours used and all these are included into mathematics.
> Researcher: Do you think the way you are thinking about assessment is now different from the way you were thinking about assessment before?
> TR B: Before the project yes, it is different because we didn't prepare our lessons like we usually did in the project. For this project we had all the resources we needed. Learners were actively involved and were able to answer tasks on their own.
> Researcher: Do you think the way you are thinking about setting homework, class exercises, tests, is different form the way you were thinking before the project?
> TR B: Yeah….you can give the learners a task which needs them to go to the cultural village so that they can research more.

Despite her comment in the first meeting that she was familiar with activities at the cultural village, TR B contends that the way she is going to see these activities is completely different now. She is now going to look for the mathematics being used - a perceived change. Another perceived change is on her lesson preparation. She now has to design resources similar to those designed in the study. She now knows where to search for the cultural mathematics content - at the cultural village. She is also thinking of setting tasks which can be answered using the mathematical content to be extracted at the cultural village. TR B also reiterated that for mathematics to be interesting to teach and learn there is need for adequate resources, resources that learners can visualise. Learners must be interested in the learning and to her learners enjoy use of cultural examples.

> TR B: I think by using the dancers this made the lesson funny for them and they enjoyed the lesson. The more they enjoy the more they learn. Then it has more impact on them than when they just read from the book…… the fun thing is that the learners were able to make their own explanations. (TR B, Final interview, 15\3\2012)
> TR B: In my lessons only three or four learners participate, but in these lessons almost all learners participate. In groups I could see they were sharing ideas. I also observed that almost all the learners submitted the given tasks unlike in my previous lessons. Most learners do not write home work. (TR B, Notes of reflective meetings, 21\2\2012)

It is observed that TR B was ready to critique her own lessons due to the perceived benefits of using culturally-based activities in the mathematics lessons. According to her, learners were involved in mathematical thinking because they could come up with their own explanations.

Indigenisation as an entry point to mathematics education

> Researcher: How has the students' learning of mathematics been affected by the tasks we used?
> TR B: I think by using the dancers this made the lesson funny for them and they enjoyed the lesson. The more they enjoy the more they learn. Then it has more impact on them than when they just read from the book.
> Researcher: What effect do you think this pedagogy has on learners?
> TR B: Yes, the fun thing is that the learners were able to make their own explanations from what they see, they can visualise everything and they can also deduct their explanation from that.

The use of culturally-based activities made learning interesting. TR B claims the more learners enjoy the more they learn. Therefore the use of culturally-based activities positively impacted on the learners' learning. According to TR B, learners were involved in mathematical thinking because they could come up with their own explanations.

DISCUSSION

The presented analysis of the case teachers' existing practices before the intervention revealed that teachers base their teaching on recommended textbooks and other supplied curriculum materials. Their pedagogical strategies are influenced by instructional approaches of the materials (Rey, et al., 2003). Research has suggested that, mathematical topics/ideas not included in textbooks are most likely not presented by the teachers (Freeman, & Porter, 1989; Rey et al., 2003). Learners' out of school mathematical experiences were not taken into consideration when planning to teach. Teachers were not

connecting mathematics education to learners' cultures as they reiterated that the textbooks they were using were not covering much on local cultures and they were not improvising teaching materials on cultural knowledge. The curriculum in schools lacks content and specific strategies that enable the making of the connections explicit in the context of teaching. Studies based on the concept of cultural differences make an assumption that learners coming from culturally diverse backgrounds will achieve academic excellence if classroom instruction is conducted in a manner responsive to the learners' home culture (de Beer, 2010).

Contrary to her contention in the first interview that she could not improvise teaching materials on indigenous mathematical knowledge, but used recommended textbooks, TR B, now affirms the cultural village as an instructional resource. She contends that in the project all the required resources were available and all the used materials were designed using the cultural village as a resource. She believes learners can use the cultural village as a research centre to assist them to answer given mathematical tasks. Going through the learning outcomes in the materials supplied by the Department of Education, TR B cannot see the link between mathematics and culture but in the study the used teaching materials clearly linked the two. She now sees the richness of the cultural village in terms of mediating culture and mathematics education. The statements by TR B indicate some possible shifts in her perceived instructional practices. This sends a message that her engagement in the study positively impacted her teaching practices. This is in line with Vescio et al.'s (2008) argument that well-developed professional learning communities can positively improve teachers' teaching practices.

In her remarks TR B notes that by using resources from the cultural village learners were actively involved and were able to answer tasks on their own. Her exemplification provides important insights into the authentic activities of the members of the cultural village which learners need. When such authentic activities are transmitted to the classroom, their context is inevitably transmuted; they become classroom tasks. Resnick (1988) proposes bridging of the gap between the theoretical learning in the formal instruction of the classroom and the real-life application of that knowledge.

It now seems clear that TR B now wants classroom mathematics to be connected to mathematics in the learners' communities. This view embraces the practice of mathematics, its history and applications, and the place of mathematics in human culture. Lerman (1990) sees mathematical knowledge as a library of accumulated experiences, to be drawn upon and used by those who have access to it. According to the study findings these accumulated community experiences can be studied at cultural villages. Teaching and learning resources can also come from learners' communities; TR B believes mathematical knowledge learnt from outside school can be **transferred** to the classroom. To her, linking or connecting constitutes the quality of mathematics content. However, transfer can occur when the transformed situation contains similar constraints and affordances to the initial context that are perceived as such by the learner (Bracke, 1998; Corte, 1999 cited in Bossard et al, 2008).

When describing the effects of the intervention study on her learners, TR B emphasised that she had noticed a change in her learners' attitude towards mathematics. The use of culturally-based activities made learning interesting. What learners find interesting is relevant to them, and what is interesting to learners is also motivating to them and therefore relevant to teaching and learning (Kazima, 2013). TR B claims the more learners enjoy the more they learn. It is observed that TR B was ready to critique her own lessons due to the perceived benefits of using culturally-based activities performed at the cultural village in the mathematics lessons. According to her, learners were involved in mathematical thinking because they could come up with their own explanations. Learners also made an effort to complete and submit given tasks, even the tasks given in her observed lessons. Shannon (2007) posits that a realistic context will facilitate student success by intrinsically motivating students and thus increasing the likelihood that they will make a serious effort to complete given problems.

In addition TR B contends that before the project she could not see the mathematical educational value of the cultural village since it was never linked to mathematics education. The educational value of cultural villages was only attached to Arts and Culture, but not to other subjects. Mosimege (2004) argues that cultural villages could serve more educational purposes than being merely tourist centres. Teaching maybe informed not only by the

content of the discipline but also by the lives of the learners. An ethnomathematical or cultural view of mathematics argues that mathematics is an intrinsic part of most people's cultural activities (Ernest, 2001). By attending to ethnomathematics, one can identify the broad and living informal cultural presence of mathematics. Teachers themselves need to be professionally empowered to have the confidence to work in such ways. In one of her observed lessons, TR B used the cultural dance context to introduce linear graphs (an extension of number patterns). The number of dances represented the independent variable *x* and the number of steps represented the dependent variable *y*.

However it can be observed that the final result was based on the comments of TR B. I chose to focus on this teacher because of her commitment and participation in the activities of the intervention teaching. To the other teachers, the pedagogical practices had some practical challenges. They cited time consuming and lack of content that enables the making of the connections explicit in the context of teaching as some of the draw-backs. Teachers may therefore face great difficulty with pedagogic competences espoused in the study.

CONCLUSION

The focus on culturally relevant pedagogy brought with it sound pedagogical practices which the participating teachers perceived as bringing some changes in their usual teaching practices. Teachers saw the possibility of improvising teaching materials on indigenous mathematical knowledge through using cultural villages as resource centres. Instead of focusing on the fact that textbooks are unrepresentative of many of the cultural backgrounds of learners in the classrooms, teachers can also bring in articles and resources that represent the knowledge, which supplements that which is presented in the textbook(s). The need for connecting mathematics to the environment is emphasised. A new value is attached to the cultural village – it is rich in mathematical knowledge and can play the role of a library as a research centre. The use of culturally-based activities can make mathematics more interesting to learn and to teach. Based on the above analysis I argue that cultural villages are highly-useful yet underutilised contexts for mediating culture and mathematics education in the South African curriculum.

REFERENCES

Ascher, M. and Ascher, R. (1994). "Ethnomathematics." In I. Grattan-Guiness, (Ed.), *Companion Encyclopedia of the History and Philosophy of the Mathematical Sciences*, (pp. 1545-1554). Volume 2. New York: Routledge.

Bishop, A. J. (1988). Mathematics Education and Culture. *Educational Studies in Mathematics, 2*(2), 179-190.

Bishop, A. J. (2001). Educating student teachers about values in mathematics education. In F. L. Lin & T. Cooney, (Eds.), *Making sense of Mathematics Teacher Education* (pp. 233-246). Holland: Kluwer Academic Publishers.

Bossard, C, Kermearrec, G, Buche, C, & Tisseau, J. (2008). Transfer of learning in virtual environments: a new challenge? *Virtual Reality*, 12, 151-161.

Boutte, G. S., & Hill, E. L. (2006). African American communities: Implications for culturally relevant teaching. *New Education,* 2(4), 311-329.

Boyle-Baise, M. (2005). Preparing community-oriented teachers: Reflections from a multicultural service-learning project. *Journal of Teacher Education,* 56(5), 446-458.

Cohen, L. & Mannion, L. (1994). *Research Methods in Education (4th Ed).* USA, Routledge

Cohen, L., Manion, L., & Morrison, K. (2000). *Research Methods in Education* (5th Ed). London: Routledge Falmer.

D'Ambrosio, U. (1979). Adequate Mathematics for Third World Countries: Considerations and Strategies. In M. E. A. El Tom (Ed.), *Developing Mathematics in Third World Countries* (pp. 33-46). North Holland: Amsterdam.

Ce Beer, M. (2010). Recommendations for collaboration for culturally-relevant teaching and development in Higher Education. In South African Qualifications Authority-SAQA (Comp.) *Towards a map of NQF-related research: Abstracts and summaries for the NQF Research Conference* (pp. 30), South Africa: SAQA

Desmone, L. M. (2009). Improving Impact Studies of Teachers' Professional Development: Toward a better conceptualisation and measures. *Educational Researcher,* 58(3), 181-199.

Education, D. O. (2002). *Revised National Curriculum Statement Grades R-9 (Schools) Policy, Mathematics*. Pretoria, South Africa.

Elliot, R., & Kazemi, E. (2007). Research Mathematics Leader Learning: Investigating the mediation of math knowledge needed for teaching on leaders' collective work in mathematics. In T. Lamberg, & L. R. Wiest (Eds.), *Proceedings of the annual meeting of the North American Chapter of the International Group for Psychology of Mathematics Education,* (pp. 819-826). University of Nevada, Reno: Stateline (Lake Tahoe), NV.

Ernest, P. (2001).*Mathematics, Education and Philosophy: An International Perspective.* London: Falmer Press.

Freeman, D. J., & Porter, A. C. (1989). Do textbooks dictate content of mathematics instruction in elementary schools?. *American Educational Research Journal,* 26(3), 403-421.

Gerdes, P. (1999). *Geometry from Africa: Mathematical and Educational Explorations*. USA: The Mathematical Association of America.

Hiebert, J., Gallimore, R., & Stigler, J. (2002). A knowledge base for the teaching profession: what would it look and how can we get one?. *Educational Researcher*, 31(5), 3–15.

Kazima, M. (2013). Relevance and school mathematics. In S. K. Kwofie, M. B. Ogunniyi, O. Amosun, K. R. Langenhoven, & S. Dinie (Eds.), *Proceedings of the 21st annual meeting of the Southern African association for research in Mathematics, Science and Technology Education* (pp. 14-28). Cape Town, South Africa: University of Western Cape.

Khisty, L. L. (1995). Making inequality: Issues of language and meanings in mathematics teaching with Hispanic students. In W. G. Secada, E. Fennema, & L. B. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 279-297). Cambridge: Cambridge University Press.

Kroma, S. (1996). Polarizing Science Education in developing countries through Indigenous Knowledge. Retrieved May 10, 2005,from http://www.3(3) Kroma.htm

Ladson-Billings, G. (1994). *The dreamkeepers: Successful teaching for African-Americanstudents.* San Francisco : Jossey-Bass.

Ladson-Billings, G. (1995). But that's Just Good Teaching! The case for culturally relevant pedagogy. *Theory into Practice*, 34(3), 159-165.

Lerman, S. (1990). Alternative Perspectives of the Nature of Mathematics and their influence on the Teaching of Mathematics. *British Educational Research Journal*, 16(1), 53-61.

Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis*, 15(2), 129-151.

Madusise, S. (2010). *Exploring the potential of using basket and mat weaving in the teaching and learning of mathematics*. Occasional Paper No. 64. Cape Town, Sudáfrica: CASAS.

Mearns, M. A. (2006). Conservation of Indigenous Knowledge. *Unpublished DLitt et Phil thesis*. South Africa: University of Johannesburg.

Mearns, M. A., & du Toit, A. S. A. (2008). Knowledge audit: Tools of the trade transmitted to tools for tradition. *International Journal of Management*, 28(3), 161-167.

Merriam, S. B. (2009). *Qualitative Research: A guide to design and implementation*. San Francisco: Jossey-Bass Publishers.

Mosimege, M. (2003). Mathematics and its use in daily activities of workers at South African cultural villages. Retrieved May 10, 2005, from http://www.icme-organisers.dk/tsg07/Mosimege.pdf

Mosimege, M. (2004). *Mathematical knowledge and its use in daily activities of workers at South African cultural villages*. Paper presented at the 10th International Congress on Mathematical Education, Copenhagen, Denmark.

Mosimege, M. (2012). Mathematical connections and contexts. In D. Mogari, A. Mji & U. I. Ogbonnaya (Eds.), *Proceedings of the ISTE International Conference: Mathematics, Science and Technology Education* (pp. 22-28).

Neuman, S. B. (1999). Creating continuity in early literacy: Linking home and school with a Culturally responsive approach. In L.B.Gambrell, L.M. Morrows, S.B. Neuman, & M. Pressley (Eds.), *Best practices in literacy instruction*, (pp. 258-270). New York: Guilford.

Resnick, L. (1988). Learning in school and out. *Educational Researcher,* 16(9), 13-20.

Reys, R., Reys, B., & Lapman, R. (2003). Assessing the impact of standards-based middle grades mathematics curriculum materials on student achievement. *Journal for Research in Mathematics Education, 34*(1), 74-95.

Seah, W. T., & Bishop, A. J. (2003). Values, mathematics and society: making the connections. *Prime Number, 18*(3), 4-9.

Shannon, A. (2007). Task, Context and Assessment. In A. H. Schoenfeld (Ed.), *Assessing Mathematical Proficiency* (pp. 177-191). New York: Mathematical Sciences Research Institute Publications.

Troutman, J., & McCoy, L. (2008). Re-membering Mathematics: The Effects of Culturally Relevant Lessons in Math History on Students' Attitudes. *The Journal of Mathematics and Culture,* 1(3), 14-51.

Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education, 24*, 80-91.

Yin, R. K. (2003). *Case Study Research*. London, England: Sage Publications.