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Does Importing of Everyday Mathematics to the Classroom Guarantee better Mathematics Learning? Lessons from a Study of Ngoni/ Tumbuka Learners in Zambia

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Abstract

The present research paper comprises of two parts. Part I discusses the difference between the epistemic basis of everyday practices of Ngoni/Tumbuka children and the school mathematics practices in Zambia and the embedded nature of everyday and school mathematics concepts in the respective discursive practices. The second part looks at the mathematics pedagogy of Grade I and VI. The analyses show that the teachers in Grade I brought in a lot of everyday examples, materials and ideas to teach the young children the number concept, place value, concept of zero etc. In contrast, the teachers in Grade VI used very few examples of everyday experiences for children in the mathematics class. They emphasise the use of routines, templates and the procedures for teaching mathematics in school. Most children excepting a few in Grade VI had not developed any theoretical understanding well. They could, sometimes, solve the problems because the teacher presented the problems in familiar templates but not because they understood the problem. Some teachers tried to link everyday experiences to the school mathematics concepts like ratios and factors. Yet, they failed to exhibit any understanding of how to help these children shift from everyday discourse to school mathematics discourse. Most of the teachers in Government schools emphasised specific use of mathematical signs, symbols and registers, standards of accuracy, language etc. without working sufficiently on how to help these children mathematize everyday experiences using this representational and semiotic system of school mathematics. The paper concludes with some suggested activities to bridge this gap.

Introduction

The research report I share comprises two parts. The first part highlights the Ngoni/Tumbuka children's mathematical practices and the embedded nature of their everyday and school mathematics. The second part looks at the pedagogical practices of Grade I and Grade VI learners. I end with a proposed way forward.

The low levels of numeracy in Zambian schools have been well documented. Tabakamulamu (1998) found that approximately 50% of students had difficulties understanding concepts in mathematics. Other researches and National assessments for school-age learners of 5 – 7 years indicate that learners have numerous and varied difficulties (e.g. Kalima, 2006; Ministry of Education, 2008; Ndhlovu, Tambulukani, Sampa, 2004).

The difficulties learners face have been attributed to traditional teaching and learning approaches, the way learners are introduced to basic concepts and ideas in primary school (Ministry of Education, 1996, 2006) and teachers not considering children's experiences worthy of including in the classroom discourse. Meanwhile children enter school possessing much mathematical ideas and knowledge, however, little was known about the qualitative nature of their experience prior to school (Anderson, Anderson, & Shapiro, 2004). As pointed out by Resnick, "the accumulated body of research on the development of children's mathematical knowledge indicates that certain fundamental concepts are normally constructed by children and are, therefore, available as the basis for further mathematical development. Also of significance are the social practices and activities that embody these mathematical ideas.

The studies dealing with everyday and school mathematics indicate that there is mathematical knowledge (concepts that are used outside and in school), but that there are differences in the ways in which the knowledge/practices of this mathematical knowledge is treated in the two areas. Also little is known about how this informal knowledge interplays with school knowledge. There are few studies that have extensively theorised everyday and school mathematics knowledge and discourse (Panda, 2007; Sfard, 2000).

Methodology

The study I did examined mathematical practices by children while they participated with other people in cultural activities and sought to find out if the knowledge established in such contexts was helpful in school.

The broad objective of the study was to examine the treatment of mathematical knowledge from the community by teachers while teaching school mathematics.

In order to focus on the discursive practices of school mathematics, focused ethnographic approaches were utilized which allowed an examination of the community interactions through the socially constructed learning activities both in the community and the classroom. The study targeted one school along with the community where the school was located in Lundazi District of the Eastern Province of Zambia. School-going children at Grade I (age range 6 – 7 years) and Grade VI levels (age range of 12 – 13 years) were selected. The study utilised observations, unstructured interviews and analyses of discourses and activities in the community and school to collect data.

I immersed myself in the community life, observing, interviewing and note-taking the activities such as, numeration system, buying and selling activities etc. Classroom observations included the whole class both for the first grade and the sixth grade. Apart from lesson observations, mathematical tasks were given to the class.

The data obtained using focused ethnographic methods were analysed through a process of inductive data analysis (Berg, 1995), while data from classroom observations, were analysed using discourse analysis techniques. The research questions that guided the study were:

What mathematics was practiced in the community?

What pedagogical practices did teachers exhibit in the class room?

How did teachers treat the mathematics knowledge from the community in the classroom?

Results

Before I present some mathematical practices in the community I will briefly outline the context: The Ngoni/Tumbuka people.

The Ngoni/Tumbuka people are located in the Eastern Province of Zambia, in a district called Lundazi. The estimated population of the area is 50 000 people. The social life is organised around the cycle of maize growing. The Ngoni/Tumbuka people did not have a currency as a medium of exchange for commodities – rather the barter system was used. The Ngoni/Tumbuka did not have a written alphabet, but they utilised sticks, stones and strings to keep records. The barter system in the community continued and existed alongside the currency introduced by the settlers/missionaries. The missionaries introduced basic literacy, new crafts (carpentry, building) and generally helped people to participate in the modern exchange economy. Thus, men and women engaged in agricultural farming and, buying and selling of these products.

The Ngoni/Tumbuka people had a centralised and hierarchical social structure, which was also patriarchal in nature. The elderly and many who had not been to school still preferred the barter system to obtain their requirements in the community. The surplus food items were traded for clothes, soap and salt. Otherwise the most common way of buying and selling was through money. Below I present an excerpt of the kind of buying and selling practices in the community

I found an eight year old girl selling bananas sent by her mother. An excerpt below exemplifies a buying and selling practice in the community

"R: How much is one banana?
Girl: Tugulisa imoza imoza yayi, kweni folu in 300 Kwacha (We are not selling one by one, we sell four for K300)
R: If I were to buy one, how much would it cost?
Girl: Ngeti ninga gulisa yayi! (I would not sell!) [At this point the girl wanted to leave and continue her business]
R: Okay, give us these, 5 heaps… how much?
Girl: [She remained quiet for sometime, then she counted on her fingers and said] 'One five' [The exchange rate between the US dollar and the Zambian Kwacha at the time of research was K3,500 per $US1. When dealing with the local currency, people usually ignore the last two zeros and refer only to the figures in front. "One five" means, One Thousand Five Hundred Kwacha K1500/-]

R: [She was given K2000/-] How much is my change?
Girl: [after a short while she said] Five ngeti? (Five is it?? meaning K500 is it?)"

The girl knew how to sell only the 'packed' items. She was matching the four bananas against the K300. She had not thought about how much one banana would cost. She did not entertain the idea that she could sell one, it was not in her mind. She handled the transaction well, by counting on. Thus, instead of multiplying 5 by 300, she added up the K300 to find 'one-five', that is, K1,500. The girl was not eager to attend to an as-if situation. She ignored the request/question and she tried to move away.

In the school arena the situation was different but before I talk about these I will briefly give the school context in terms of facilities and a profile of learners and teachers.

Many classrooms were not adequately equipped. There were not enough desks to go round; three and sometimes four learners shared a desk meant for two. The classroom for the Grade VI class was bare in terms of wall charts and other learning aids. The Grade I class however, had charts on the walls and many other teaching and learning aids.

Learner Profile:

The average age of the Grade VI learners under study was between 12 and 13 years with girls being younger compared to boys. The ages varied more in the case of boys. The average age for Grade I learners was 7 years.

Teacher Profile:

In this research site (school), out of ten teaching staff, only three (3) were females. The teachers who handled the research classes had High Secondary Education academic qualifications. They went through a two year pre-service teacher preparation course. This was the trend for the teachers of primary school learners.

Classroom Practices:

The class was observed during the second term of the school calendar (May –July term). The learners had already spent one term in school. In Grade I ten lessons were observed and during this time the class dealt with writing of 1 up to 20, counting, addition and subtraction. The starting points for introducing concepts were learners' everyday experiences or were situations that could be related to concrete objects, especially in Grade I.

An excerpt from a Grade I class highlights the teacher's treatment of learners knowledge from the community.

[T: stands for teacher, Ls: Stands for learner(s)]
1. T: Nthoci na Papaya lutani kumalo yinu (Nthoci and Papaya go back to your seats) [Teacher asked two groups; Nthoci and Papaya to go back to their seats/groups]
2. [Two groups remain at Teaching Corner, while Nthoci and Papaya work on writing of numbers 15,16,17,18,19, 20, repeated on each line, the remaining group, dealt with how to add. The teacher wrote 6 + 4 and advised learners to use the sticks which they had!]
3. T: Pendani tumi tengo wuto muli nato – penda Iwe! Sazyani 6 na 4 musyazye! Penda '6' nibo neko!(Count the sticks that you have – you count, add 6 and 4, first count 6, I want to see) [Some learners do not have sticks that reach 10, teacher advises them to pick more sticks]
4. Ls: A ticha, a ticha! A ticha! Ine napenda! (Teacher, teacher, me I have counted!)
5. T: Tapenda '7' (Have we counted seven?)
6. Ls: eeh! Eeh! (Yes! Yes!) [Many respond accordingly]
7. T: Para walemba kuniphalira yayi! Walemba! [Teacher cautions those that mention the answer when they find it, as they were giving their answers away to others]
8. T: Sono pendaso '5' sono sazya! Lembani mu box! Sono mupendeso '7' (count 5 again then add, then write in the box. Then again 7.) [Teacher wrote 7 + 5 =]
9. [Teacher writes 7 + 8 = and guides the learners, taking step by step in counting on as a strategy for addi-

tion!]
10. T: Sazyako na '8' , mbwenu vose pamoza niwuli? Pendani '8' (Add with 8, then together it comes to what? 'count 8') [Teacher is referring to 7 + 8, that is adding 7 and 8]
11. T: Another exercise 9 + 4 =
12. Sono penda '9', sono pendaniso '4', sazya . Sono vose pamoza ni vichi (Now count 9, count again 4 and add. Together what have you found?)

The teacher gave work to two groups as they prepared to leave the front of the classroom. One group worked on writing numbers; that is, repeating the same figures on each line in their exercise books. To the group that remained in front of the class, the teacher introduced addition through counting on. The group used sticks to aid their counting. The group went through a process of physically counting six sticks, putting them aside and counting another four sticks, putting them aside. They were then advised to put the two heaps together and to count the whole lot. The answer they obtained after counting was written down in the box (Turns 3, 4, 5, 6).

In the first grade the lessons were characterized by statements that were ground in local practices/knowledge. The teacher advised learners to use objects or materials that they were familiar with, such as, sticks, stones etc.

In the Grade VI class, however, the teaching and learning practices were predominantly on content and procedures without much link to everyday mathematics knowledge. The teacher focused on giving instructions and examples of the procedures to be followed. On the basis of instruction and example(s) learners were expected to pick up ideas of what to do when given particular types of questions or problems. On occasions that everyday situations/examples were brought in, learners were provided with a useful platform upon which to engage with school mathematics. When introducing ratios, the teacher brought in concrete materials to re-enforce the concepts. Some diagrams were also used as shown in Figure 1.

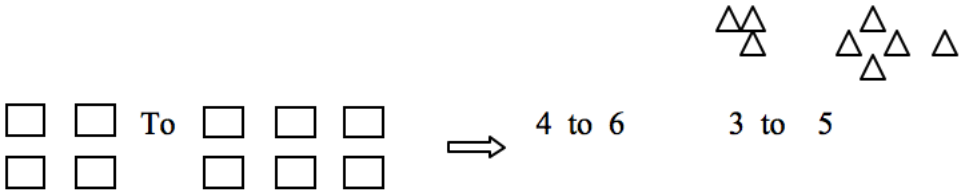

Figure 1: Objects showing ratios

The learners indicated the ratios correctly which appeared to suggest grasping of the concept. At the outset the use of concrete materials facilitated the limited idea of ratio, but many learners were just able to indicate the ratio of 4 : 6 , and 3 : 5 as these tallied directly with the concrete shapes. However, learners did not pay attention to the relationship between the numbers (numerals). As a result, when learners were asked to put or express the ratio in its lowest terms, many learners failed to proceed with the task. Basically, the concept of ratio and its related prepositional reasoning concepts i.e. as an arrangement of objects according to set proportion was not grasped by the learners. The learners, on their part, focused on the empirical visual features, while the teacher desired them to see the abstract 'relations' between the concrete objects.

Pedagogical Aspects:

In order to highlight pedagogical aspects in the classroom an excerpt below might exemplify the practices. In the excerpt the teacher introduced some concepts through pattern recognition, from which a given pattern or behaviour of numbers, learners deduced a pattern. The excerpt below also shows the teacher guiding the learners along a pattern of generating multiples of numbers.

1. T: Sono bekani apa! (Now look here!)

Teacher wrote 1 x 3 = 3, 2 x 3 = 6, 3 x 3 = 9, 4 x 3 = 12, 5 x 3 =15, 6 x 3 = 18
2. T: Sono apa mwaona (So here you have seen) these are called multiples of 3 Sono (now) what are the first six multiples of 4? What do we begin with? We began with one So (teacher begins to write 1 x 4 = 4, as learners respond giving the multiples following the pattern of 3 previous examples.
3. Ls: 2 x 4 = 8, 3 x 4 = 12, 4 x 4 =16, 5 x 4 = 20, 6 x 4 = 24 (teacher wrote as learners gave the answers. Teacher asks, 3 times 4 = ? , then next ni vichi (is what)? Ok 4 times 4 = ? and so on). These were the first six multiples of 4 which are 4, 8, 12, 16, 20, 24. sono para tachita divide by 4 agha ma number tikusanga vichi? (Now when you divide by 4 these numbers, what do we find?) 4 into 4? Ans 1! 4 into 8? Ans 2 4 into 12? Ans …till 24.
4. T: sono tiyeni tisange (Now lets find the) multiples of 5, what are the first multiples of five?
5. Ls: [The teacher directed learners as they produced] 1 x 5 = 5, 2 x 5 = 10, 3 x 5 = 15, 4 x 5 = 20, 5 x 5 = 25, 6 x 5 = 30
6. T: you are supposed to know the tables by heart! Mose mukwenela kumanya! (All of you should know) Sono tiyeni tisanga ma (Now lets find the …) multiples of 6 – the first six multiples of 6 (learners generated the following; 1 x 6 = 6, 2 x 6 = 12, 3 x 6 = 18, 4 x 6 = 24, 5 x 6 =30, 6 x 6 = 36)

The teacher introduced the concept of multiples through pattern recognition by learners. The first pattern –multiples of three – was the basis for development of the other sets of multiples of numbers. The teacher did not explain what multiples were or link them to known knowledge in the community but hoped that learners would see the pattern and deduce for themselves. The teacher presented the procedure to be used when dealing with the tasks.

Discussion of Results

The profiles and pedagogic practices in the two grades provide the circumstances and learning context at the school. The main thrust of the study, however, was on how the everyday experiences and activities of learners were utilized in the classroom and whether these facilitated or made learning of mathematics better.

The discourse in the Grade I class focused on everyday practices. The teacher introduced school mathematics alongside the learners' community ways. The discourse focused on the mathematical practices that learners already had and the teacher formalised the learners' knowledge. The teacher utilized aids, such as sticks and stones, as he introduced the school terms. The teacher worked within the epistemic practices of the learners. The learners physically counted the objects; either counting on or removing some. There was a direct extension of the learners' orientation as the learning of number in the community involved or was accompanied by finger gestures.

In the Grade VI class some lessons began with exemplifiers or situations from everyday mathematics but this was not sufficiently explored to facilitate meaningful learning. The transition was rushed such that there was a sudden jump into school (academic) mathematics. Learners had difficulties as they remained in the frame of their everyday knowledge relating empirical phenomena to particular numerals step by step, without thinking about the relationship among numerals. In the ratio lesson, for example, many learners missed the school ratio concept. The learners not grasping the concept of ratio arose out of teachers not taking care of the step or rupture in the epistemological bases of the learners' knowledge from their community practice into school practice.

In Grade I teachers themselves brought in a lot of everyday examples, materials and ideas to teach the young children the concepts of number, place value etc. In contrast, the teachers in Grade VI allowed some everyday experiences and activities to inform the classroom teaching, but emphasised the routines, templates and the procedures for learning and production of classroom knowledge. Most children, except a few, had not developed any theoretical understanding well.

The teachers, nonetheless, tried in their own ways to link everyday ways of knowing and doing mathematics to the school mathematics concepts and methods but they failed to exhibit any understanding of how to help children shift from everyday discourse to school or scientific discourse. Teachers tended to focus on accuracy

of terms/language and use of appropriate symbols/signs of school mathematics.

The initial focus should have been development of a strong mathematical foundation which is rooted in the learners' everyday mathematical practices.

Conclusion

The use of everyday mathematical knowledge/practices in school enhances classroom learning. It allows learners to utilise their knowledge and experiences and thus cherish their heritage and culture. It has the potential to build a strong mathematical foundation rooted in the learners' culture.

In the study, however, in Grade VI the transition from everyday mathematical practices to school mathematics was rushed. The pedagogy adopted did not foster understanding of concepts by learners; instead, the teacher provided routines, procedures and templates for learners to follow.

Suggestion

In order for teachers to critically and consciously engage learners in transforming everyday knowledge to academic knowledge, the study proposes that:

- Teachers, in consultation with stakeholders in the community (supervisors, Non Governmental Organisations, other teachers etc), identify mathematical knowledge practices, strategies and experiences that relate to school mathematics.
- From the identified/surveyed practices, lessons should be developed.
- The ideas/activities identified should be used as pedagogical tools for teaching in the classroom (Vygotsky, 1987)
- Teachers should encourage discourse in learners' language in the development of concepts.

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