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The extent to which mathematics instructional practices in early childhood education in Zimbabwe relate to or make use of children's experiences

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Abstract

The aim of the study was to establish the extent to which mathematics instructional practices in early childhood education relate to or make use of children's experiences. The major question that guided the study was: In which ways do early childhood teachers use children's out-of-school strategies and everyday experiences in teaching mathematics? The study was conceptualised within a constructivist framework, in which meaningful mathematics instruction for young learners capitalises on their prior knowledge and the ways they solve their daily mathematical problems, and promotes active thinking in the process of making meaning. The study was qualitative, involving classroom observations using videotapes, interviews with teachers and questionnaires with Grade 1 and 2 teachers in a district of Masvingo, Zimbabwe. The major findings of the study were: teachers used children's knowledge minimally when introducing lessons and failed to build on children's knowledge throughout the lessons. There were observably low motivation and low performance by children during lessons. The ramifications of the study for policy and practice are discussed.

Introduction

It would appear that most black students, as they grow up, dread mathematics education, if not mathematics itself. Whitebread (1995) observes that "far too many of our young children find learning mathematics in school difficult, lose their confidence in mathematics, and go on to join that large swathe of the adult population who panic at the first sight of numbers" (p. 11). Socialisation during children's early years, at school and at home, may well instill in them fear of mathematics and/ or reduce their confidence in mathematics education. Children in Grade 1 are rapidly and abruptly socialised into schools, where organisational structures, rules, rituals and languages are remarkably different from those at home. Even so, home and school cultures can support each other. Irvine and Armento (2001) define a culturally responsive pedagogy as one that is "culturally responsible, culturally appropriate, culturally congruent, culturally compatible, culturally relevant ..." (p. 4). A people's culture is an important survival strategy passed down from one generation to another through processes of enculturation and socialisation; a type of roadmap (Skilbeck, 1976) that serves as a sense-making device that guides and shapes behaviour. It is mediated through language/ mother tongue and common practices and experiences. The young child in school mathematics thus faces two culture shifts – one to the culture of the school, a second to the culture of mathematics and the mathematics classroom. African children find themselves in learning situations where the language of learning, the world outlook presented in mathematics lessons, and the whole concept of school is European, and they have to battle to reconcile the two, even as they forge ahead in the new language and new discipline with its new world vision.

In Zimbabwe, Grade 1 is usually a child's first introduction to institutional schooling, when the child is six years old. Thus children come to school with considerable experience in their homes and communities, including experiences with mathematical ideas and processes as part of their daily lives. Education policy in Zimbabwe promotes learner-centered, constructivist

approaches at all levels of schooling, including Early Childhood. Policy requires also that the language of instruction is the home language.

Thus our research was undertaken to see how teachers in Grades 1 and 2 use children's out-of-school strategies and everyday experiences when teaching mathematics. Our interests were three-fold: the ways in which out-of-school experiences were used to assist in learning school mathematics, the ways in which school mathematics was applied to out-of-school situations, and the ways in which home culture and school culture were treated in mathematics classrooms.

Conceptual framework

Whitebread (1995) distinguishes between what he terms 'home' mathematics and 'school' mathematics. According to him home mathematics is learnt (rather than taught) in real world contexts for real purposes. For instance a young boy back from the bush with his thirteen goats knows how many would be remaining if four were lost. Home mathematics invariably involves particular objects and is rarely, if ever, recorded. For young children, mathematical understanding seems to develop easily and naturally at home, and they can become very confident in solving the kinds of mathematical problems they come across, but the story is very different at school. School mathematics is often carried out for its own sake, unrelated to any real or particular context and almost always involves recording using written symbols. Research carried out by Davies (1989) and Greer (1993), quoted by Anghileri (1995), revealed that mathematics learning in school often has nothing to do with the child's real world. Holt (1964) described the bewilderment of young children when faced with school mathematics. Children, he observed, try to apply formal procedures they have been taught in school and in the process get muddled because they do not really understand what they are doing.

Studies of Brazilian street children, for example, have revealed their ability to develop very effective routines for mental calculations in relation to real, everyday practical situations (Whitebread, 1995). They trade at street markets from as young as eight or nine years of age, carrying out arithmetic calculations quickly and accurately. Learning 'pencil' and 'paper' routines to solve exactly the same problems proves to be much more difficult and actually interferes with their abilities to solve problems.

These issues are not only issues for black African children. Whitebread (1995) makes reference to the United Kingdom, Assessment of Performance Unit (APU) whose report of 1980 revealed considerable evidence of children's lack of understanding of formal mathematical symbols. The report identified four key features of school mathematics that made it difficult for young children. First, school mathematics was commonly bereft of any meaningful or supporting context. Second, it commonly involved the use of abstract symbolism. Third, school mathematics often required children to use pen and paper strategies that were not simply written versions of the mental strategies that they had already developed. Fourth, school mathematics was presented as a set of prescribed procedures, not helping children really understand numbers and ways numbers behave. Emphasis was placed on getting the right answer more than on understanding the processes involved.

From a constructivist viewpoint such as Vygotsky's (quoted by Eggen & Kauchak, 1999) young children learn school mathematics much more easily if it is meaningful in their life and culture, if it emerges from their experiences and part of their social life. To this end an 'emergent mathematics' approach (Whitebread, 1995) involves placing tasks in meaningful contexts, helping children to understand the nature and purposes of mathematics. Barnes (1974) mentions that what pupils learn must be closely related to what they do. What they do

includes the interpretations they put upon their actions. Mere 'handing on' is an inadequate metaphor, as pupils interpret what the teacher says through what they already know. Outside the parameters of what they know (whether from school or home), Barnes (1974) emphasises that children have no means of interpretation. Only when mathematics school learning has gone beyond meaningless rote can we take it that a child has made some kind of relationship between what he knows already and what instruction has presented. Alongside this are views such as Whitebread's (1995) that home (informal) mathematics and school (formal) mathematics are different ways of thinking, so that children have to be consciously helped to make the connections between them.

Thus, in our research, we wanted to see how teachers at the Early Childhood level linked home experiences, school experiences, informal and formal mathematical knowledge.

Methodology

Consistent with our research question we chose a qualitative methodology, designed in three stages. First, 20 Grade 1 and 2 teachers completed a questionnaire concerning their beliefs about education and children. From the responses, four teachers were chosen for interviews, used to extend and probe ideas and patterns raised in the questionnaires. The aim of the interviews was to establish: strategies employed by teachers to teach mathematics to young children; teachers' knowledge of mathematical experiences and skills that children bring from home; and methods children usually use to solve mathematical problems. Third, three of these four teachers were observed teaching one lesson each, and their lessons videotaped. The observations provided comparison of what teachers said with what the class did. They also allowed the researchers to relive the classroom situation and identify salient interaction issues, including the possibility of studying aspects that took place at the same time.

Purposeful sampling was adopted to select twenty Grade 1 and 2 teachers from five schools in a particular district of Masvingo, Zimbabwe. The communities in the five schools were similar, and the teachers were all qualified Early Childhood teachers and females. Data were analysed using descriptive statistics (for the questionnaires), content analysis of the interviews and the open-ended section of the questionnaires, and identification of events from the videos. This allowed aspects and themes to emerge from the data, and gave the researchers opportunity to crosscheck and validate data.

Results

From the questionnaires (Table 1), a pattern emerged of the teachers' beliefs about mathematics, children and learning. While most teachers believed that young children brought mathematical knowledge to school they contradicted themselves by disagreeing with the statement that children have their own ways of solving mathematical problems. The respondents strongly believed that children should be taught how to solve mathematical problems in the classroom, and that problem-solving strategies were essentially routine. While generally feeling that teaching should build on children's existing knowledge, the teachers distinguished this from using out-of-school strategies, which they feared would waste time, and result in misconceptions. All the teachers believed that children should be taught how to solve mathematical problems, with most believing that problem-solving involves routine procedures. Teachers were divided as to whether problem-solving approaches to mathematics slow down concept development. The teachers showed mixed beliefs on the statement that formal and informal methods of solving mathematical problems both exist. On the whole their bias was towards formal methods: most teachers agreed that the teacher is the expert and must give children mathematical knowledge; teachers should not allow children to use informal methods in a mathematics lesson; drill and practice help children quickly master mathematics concepts.

Consistent with this, they disagreed with the statement that teachers should use informal methods in their teaching of mathematics.

Table 1: Distribution of responses to teacher questionnaire on using children’s prior experiences and out-of-school strategies statements

Teacher Statements	Frequency (N=20)			
	SA	A	D	SD
Children bring mathematical knowledge to school.	12	2	4	2
Children have their own way of solving mathematical problems.	5	1	5	9
Children should be taught how to solve mathematical problems.	18	2	0	0
Mathematical problem-solving methods are routine procedures.	15	1	3	1
Children have creative ways of solving mathematical problems.	3	3	4	10
There are formal and informal methods of solving mathematical problems	5	5	1	9
Young children can determine their own learning strategies.	2	3	9	6
Using children’s strategies wastes time slowing concept development.	12	4	3	1
Using children’s prior knowledge results in misconceptions.	6	9	4	1
Building on children’s experiences facilitates learning.	8	8	1	3
Children need to be taught in order to learn mathematics	11	8	1	0
Teacher is the expert and must give children mathematical knowledge	12	6	2	0
Teachers should use informal methods in their teaching of mathematics.	0	0	6	14
Teachers should not allow children to use informal methods in a mathematics lesson.	1	13	4	2
Drill and practice make children quickly master mathematics concepts.	14	3	3	0
Problem-solving approach slows down children’s formation of mathematical concepts.	5	6	6	3
Using children’s out-of-school strategies enhances learning.	7	1	3	9
Teacher should encourage children to use their out-of-school strategies to solve mathematical problems.	1	5	7	7

*Responses: SA-strongly agree, A-agree, D-disagree and SD-strongly disagree

The questionnaire included three open-ended questions that were similar to the questions in the interview guide. The first asked for methods used to ‘teach mathematics effectively’ to young children. Teachers might have taken the question to be about methods they actually used, or methods that would be especially effective. Their answers emphasised drill and practice, games, teacher talk, group work, individual work and pen and paper exercises. With the probable exceptions of drill and practice and teacher talk, these methods might have linked to home experiences or might not. However, the interviews and classroom observations suggest they do not.

Asked to list methods children use to solve mathematical problems, teachers could offer only counting fingers, counting stones, saying rhymes and, sometimes, counting toes. Thus, in problem-solving, the teachers’ focus was counting. The statements by one of the interviewees expressed a more widely held belief:

...you know, these children are young, you know, and they have no methods of their own, you see! They are still learning you know. They need to be taught. They need help. (laughing)

...Honestly, how do you expect children to have methods? For God’s sake, they are young...

Another interviewee said:

Of course children have their funny ways of finding answers, like counting stones, counting their fingers and counting their toes ... and so on.

The classroom observations and videos confirm the beliefs and claims from the questionnaires and interviews: the three teachers observed made very little use of children’s knowledge, and provided little opportunity for activity or different ways of learning (Table 2). Even with young

children in Grades 1 and 2, the predominant teaching methods were lecturing, recitation and drill and practice. On occasions when children were counting with stones, the teachers did not use or refer to common African children's games with stones, such as 'nhodo' (which, as Masuku and Ndawi (2001) point out, can be used to teach not only counting, addition and subtraction, but also sets, division and multiplication) or 'tsoro' (which can be used to teach counting, number value, estimation and spatial relations). Neither did children, for example, tell about situations at home where they used mathematical ideas, or recount stories from their experiences. The teachers made little attempt to allow children to learn mathematical structures through induction, examination and manipulation of physical objects, or game-like embodiments of the concepts involved (Barnes, 1974).

Table 2: Summary of lesson observations

Aspect	Lesson One	Lesson Two	Lesson Three
Methods, teaching and learning strategies	Lecture method, low level recall questions, repetition and memorisation	Drill and practice, whole class, group work, demonstration and lecture method.	Drill and practice, lecture and demonstration
Learning tasks and activities	Chorus answers, recitation of jingles and rhymes. Counting fingers, listening and repeating alternative words for subtraction leading to memorisation	Counting stones, individual writing of subtraction exercises on the chalkboard, demonstration, matching numerals with quantities.	Counting stones, recitation and written exercise
Teacher behaviour	Teacher dominance through question and answer. No structured group activities.	Dominating the lesson through teacher activity as well as question and answer. Giving all children similar tasks.	Asking children questions throughout the lesson. Pacing up and down and doing most of the tasks as children observed.
Student behaviour	Passive involvement-children seated throughout the lesson.	Passive involvement-observing teacher demonstrations and activity. Stray attention by children evidenced by gazing at unrelated objects and events.	Watching teacher-counting stones demonstrating subtraction. Individually children writing 3 subtraction sums.

Discussion

The question that guided the study was: In what ways do early childhood teachers use children's out-of-school strategies and everyday experiences in the teaching of mathematics? Results revealed that, while teachers acknowledge that children bring mathematical experiences to school and that teaching should build from their experiences, teachers do not see the mathematical knowledge children have from outside school as especially valid or helpful, and fear that it slows progress and concept development. The teachers had difficulty identifying relevant out-of-school strategies beyond counting. Problem-solving strategies had to be taught, teachers felt, as routine procedures. Most teachers preferred drill and practice as a method that makes children quickly master mathematical concepts.

Lesson observations showed preference for whole class approaches (with some unstructured group work), lecture methods, low-level recall questions, and teacher demonstrations. In general, children were passive, either watching teacher demonstrations or writing individual exercises in their books. Children's out-of-school strategies, even their out-of-school experiences, did not form part of the teachers' serious business in helping children learn mathematics. In summary, teachers made little use of children's background knowledge, often considering it a hindrance to learning and best ignored; they made little attempt to connect

school mathematics to out-of-school situations and experiences; they made little attempt to link the culture of home to the culture of the classroom.

Such beliefs and practices could be one of the reasons why young children in the lower primary grades find learning of mathematics difficult, lose confidence in problem-solving and in some cases develop negative beliefs about mathematics (Anghileri, 1995, p. 2). Early childhood mathematics learning can and should start from the secure home-learning established before the child comes to school. This position is part of education policy in mathematics in Zimbabwe, which emphasises hands-activities, play-way methods and using children's experiences. It is strongly supported by research literature, with authors such as Whitebread (1995) arguing for teaching methods that favour an emergent mathematics, whereby mathematics is brought out of the child's everyday situations and experiences, and based on understanding. This background of everyday situations and experiences constitutes culture for the children. Indeed Lawton (1975) sees curriculum as selection from culture, and Skilbeck (1976) as a map of culture. From that perspective, the mathematics classroom for these children constitutes a culture vastly different from the one they live in beyond school. We argue instead that home culture is a powerful influence on mathematics learning and should be part of mathematics teaching in early childhood classes, so that mathematics instruction is more accessible, meaningful and above all enjoyable.

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