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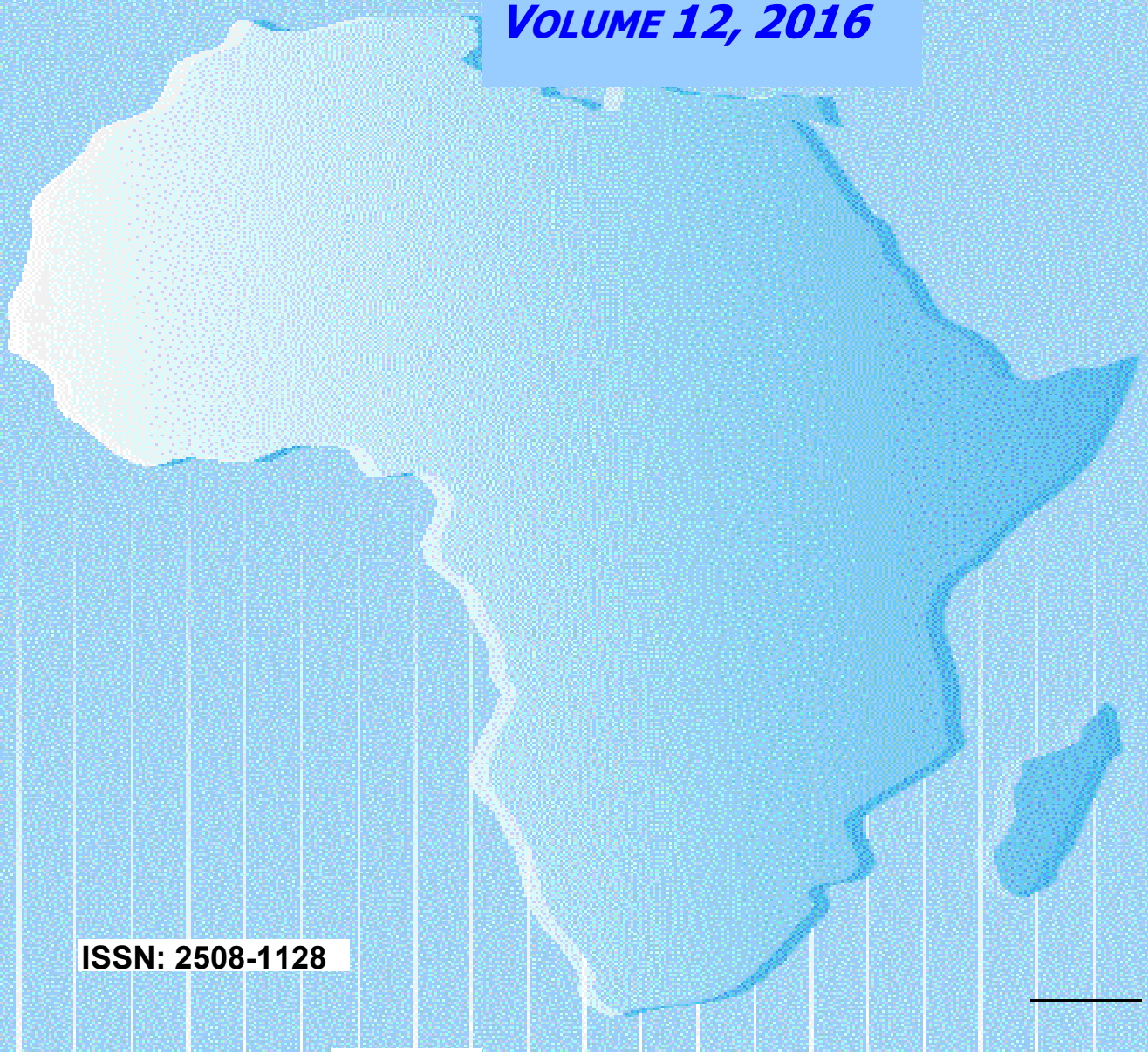

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Cultural influences on Ghanaian primary school pupils' conceptions in measurement and division of fractions

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Abstract

This paper reports on a study which investigated how pupils' notions of measuring and sharing in out-of-school setting reflect their conceptions and practices in school. Two focus group interviews were carried out with 16 primary school pupils, eight each from grade 4 and grade 6 in two average achieving schools (one each from rural and urban schools) in Ghana. Qualitative analysis of pupils' activities on measuring and division of mixed/decimal fractions showed evidence of cultural influences on the participants' conceptions and practices in measurement of capacity and division of a mixed/decimal fraction by a whole number in the real life situation. It did not appeal to grade four pupils to share/divide a half of an object. Findings from the study appear to confirm the local aspect of mathematical knowledge and recommends the need to help pupils to draw on and integrate every day and school mathematical knowledge in the teaching and learning situation.

Keywords: fractions; division; measurement; conceptions, culture

Introduction

Culture is conceptualized as complex of shared understanding which serves as a medium through which individual human minds interact in communication with one another (Bishop, 1988). Ethnomathematics researchers have argued for a difference between mathematics encountered in the local culture/society and school mathematics (Bishop 1988; D' Ambrosio, 1985). Bishop (1988), for instance, argued for a difference between "m" mathematics (encountered in the local culture/society) and "M" Mathematics (the western/international mathematics). In-school mathematics refers to western/international mathematical practices which the child usually acquires through formal schooling. Out-of-school/everyday mathematical practices as used in this paper refer to mathematical practices experienced in everyday life which may not be the same as school/western mathematics. This knowledge constitutes knowledge acquired through cultures as the child grows. However, the author does not intend to treat these categories as if they are always mutually exclusive (Moschkovich, 2007). This is because some everyday/cultural mathematical practices do reflect school practice. For example, sharing according to seniority which forms part of the social justice system in the Ghanaian culture reflects the concept of proportions (in the application of fractions) in school. The distinction between in-school and out-of-school mathematical

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practices has been made to help explain how the latter reflects Ghanaian primary school pupils' conceptions and practices in school in some cases. This paper does not intend to promote one kind of mathematical knowledge at the expense of the other. It looks at how pupils' everyday mathematical practices reflect their conceptions and practices in school, and the need for mathematics teachers and curriculum developers to take cognisance of possible influences of everyday mathematical practices in the teaching and learning of school mathematics.

Ghana is located on the west coast of Africa and was a former British colony. English is therefore the official and the national language of Ghana. Ghana practices fourteen years of pre-tertiary education and English is the medium of instruction from grade four. Like in many developing countries, pupils' performance in mathematics generally, and the concept of measurement (including fractions) particularly, in Ghana, has not been as good as it should (Duedu et al, 2005; Davis & Hishashi, 2007). However, literature suggests that measurement (including fraction)is important for future study of mathematics (Bright & Clement, 2003; Clarke, Sukenik, Roche & Mitchell, 2006). Bright and Clement (2003) argue that measurement is important as both a foundation for many applications of mathematics in real life and an essential element of more sophisticated mathematics. Fractions are important in the future study of rational numbers, for example (Clarke, Sukenik, Roche & Mitchell, 2006).

The concepts of measurement and fractions which have been cited as being difficult for Ghanaian pupils (Davis & Hisashi, 2007; Davis, 2004; Davis & Ampiah, 2009) are all deeply rooted in the Ghanaian culture. Measurement in traditional Ghanaian culture is similar to those that have been reported in literature as being done in other parts of Africa (Takuya, 2003; Zaslavsky, 1973). Measurement of capacity of grains and chilli in the Ghanaian culture, for example, involves the use of local standards of measures. Grains of maize, for instance, are measured using "Olonka" (a local unit of measure) (see Figure 1). Table 1 presents examples of the units of measures which were used in an address by Mr. Akuffo-Addo, a then Ghanaian opposition leader, on the state of the Ghanaian economy highlighting the increasing cost of living in Ghana (GNA, May 2009b).

Table 1 **Local unit of measures of staples and their costs showing the rising cost of living**

Item	Price in January	Price in May	Local unit of measure
Gari	GH¢1	GH¢ 1.60	olonka
Maize	GH¢1.70	GH¢2.50	olonka
Yam	GH¢1.50	GH¢3.00	tuber
Rice	GH¢63.00	GH¢75.00	50-kilo bag
Plantain	GH¢0.45	GH¢1.00	5fingers
Vegetable oil	GH¢2.50	GH¢3.50	1 liter
Tomatoes	GH¢0.50	GH¢1.00	four small fruits

A look at the units of measures used for tomatoes, maize and plantain for example, from the excerpt of the address, shows that the SI units of measures which are used in Ghanaian schools continue to remain as abstract school concept. Other units of measure of rice for instance include "half-margarine cup", "margarine cup", "Olonka" and "rubber" (Figure 1).

One margarine cup and a half margarine cup (i.e. $1\frac{1}{2}$ margarine cups of rice)

An '*Olonka'* and a margarine cup

Figure 1Units of measure for rice

Physical properties that are often measured from vegetables and fish, for example, are different in-school and out-of-school contexts. Weight of these items often form the focus of measurement in school. While in out-of-school context the situation is very different (see Figure 2). The capacity of these items is often considered.

Groups of four or five (depending on size)

Figure 2 Measurement of vegetables and fish in the Ghanaian local market

Although the focus of this paper is on measurement of capacity and weight, it would interest the reader to know that these gaps between out-of-school and in-school mathematical practices are not limited to only weight and capacity. In measurement of length, for example, unknown distances are usually described in terms of known distance. For instance, the distance from Town A to Town C may be described in the out-of-school situation, in most cases, in relation to a known distance from say Town X and Town Y. Thus, the distance from Town A to Town

B may be described as being "half of" or "same as" or "twice as" the distance from Town X to Town Y.

Sharing, which forms the basis for the introduction of fractions as division in school, is also widely practiced in the out of school setting in Ghana. Despite pupils' rich knowledge background in measurement and fractions, through their culture, they have difficulty studying these two concepts in school.

One source of pupils' difficulty might be due to gaps that exist between school mathematics and out-of-school mathematics in Ghana (Davis, Bishop & Seah, 2009). Gaps appear to exist between the way pupils experience measurement and fractions in the out-of-school and in-school settings. The school mathematics curriculum does not make these concepts relevant to pupils' everyday practices. It does not give room for some of the everyday mathematical representations and logic. "Olonka", for instance, is a local unit of measure which is known and used by all Ghanaians but has no place in the school mathematics curriculum (Ministry of Education Science and Sports, 2007; Ministry of Education, 2012).

The Ghanaian primary school mathematics curriculum does not mention "Olonka", for example, as a standard unit of measure. Meanwhile "Olonka" is known and used by all Ghanaians. Very few of the local units such as milk tins are often used when introducing the concept of measurement in grades one and two. However, this trend does not go beyond grade two. From grade two onwards the use of elements of culture cannot be seen in the development of the concept of measurement. In grade six, for example, no mention is made of the use of local units in measuring perimeter. The activity suggested in the curriculum include measuring the sides of the objects in metres (m), centimetres (cm) and millimetres (mm) and then adding them together in order to find the perimeter (Ministry of Education Science and Sports, 2007; Ministry of Education, 2012).

A lesson observation on the teaching of perimeter reported by Mereku (2004) succinctly describes the situation. In this lesson, Mereku reports of a grade six teacher who introduced the concept of perimeter by reviewing concepts of polygons using cut-out shapes such as square and hexagon. The teacher showed the shape and asked pupils to describe the properties – number of sides, square corners or right angles. The teacher then drew two rectangles on the chalk board and wrote down the formula for perimeter, $p = 2(l + w)$. Through questioning she guided pupils to identify lengths and widths of the rectangles and then asked them to substitute these into the formula to calculate the perimeter. The teacher worked one or two examples and asked for some volunteers to try some more on the chalkboard. The teacher then wrote five similar exercises from the mathematics textbook on the chalkboard and asked pupils to copy them in their notebooks and do as home work.

Examination of the lesson presented shows clearly that concept formation in measurement pays very little attention to the local culture. Unlike in grade one where the local units are often used in the development of the concept of measurement, the reverse was the case in this lesson. The questions that come in mind are, why should this be the case? Are curriculum developers in countries such as Ghana aware that measurement practices at home, just as in the school, involve finding how much of an attribute and therefore pupils' societal/cultural practices involving measurement could be employed to teach measurement meaningfully at all levels in the primary school?

Also, fair share in fraction as a 'fracturer' (as in breaking of objects into parts) and the use of fraction in everyday language, especially in comparing two things (Freudenthal,1983), in the school context, may not be the same as in the home context in the Ghanaian culture, and the author supposes in many cultures as well. It is possible for a junior colleague, for instance, to accept less than half of a parcel shared between him/her and a senior colleague as a fair share. Thus, fair share may not always imply equal share as in the classroom situation. In one context it may be interpreted as equal share and in another context it may be interpreted as what is satisfactory to those who are sharing. All these differences in the representation of measurement and fractions in-school and out-of-school contexts affect what counts as mathematics for teachers during teaching and learning situations in the classroom (Abreu, 1993; Civil, 2002; Presmeg, 2002).

The author acknowledges that fair share deals with social justice, which is not mathematical in itself. However, the author believes that fair share is embedded in mathematical practices, especially those involving sharing. Mathematics is created by humans as they engage in practises such as counting, locating, measuring, designing, playing and explaining (Bishop, 1988 pp. 182-183).Thus, if a teacher mentions share, for example, in the process of teaching fractions, the learner will bring all his/her experiences on sharing to bear in the learning situation. The learner will not leave his/her experience at the door of the class (Fleer & Williams-Kennedy, 2002). Moschkovich (2007), for example, argues that "as teachers and pupils engage in conversations, they bring in multiple meanings for the same utterances and they focus their attention on different aspects of any situation" (p.26). It is therefore possible that pupils will focus attention on social justice in a practical problem involving division/sharing in lessons on measurements and fractions, for example (as will be seen in this study). Teaching of mathematics for conceptual understanding should therefore take into account the societal and cultural practices of the pupils (Hedegard & Chaiklin, 2005), including social justice systems.

Some researchers perceive mathematics as a subject that is developed in the four walls of classroom and disseminated to the outside world. They therefore find it awkward associating mathematics with culture (Pias, 2011). However, others have shown the local aspect of mathematics (Scholnick, 1988; Barton, 1996; Bishop, 1988; D'Ambrosio, 1999).Scholnick (1988), for instance, argues that:

> it is taken for granted that mathematics learning is embedded in a cultural context. Yet there are many cultural contexts within a society so everyone does not approach adding and subtracting in the same way … it is equally important to specify the necessary bridging structures between home and school and between one concept and another that enable the child to learn mathematics. (p. 87).

Many ethnomathematics researchers have argued about the cultural nature of mathematical knowledge (Barton, 1996; Bishop, 1988; D'Ambrosio, 1999), and the fact that the culture of pupils and teachers affect mathematics teaching and learning (Presmeg, 2007; Seah, 2004). Exploring ways by which the local culture affects mathematics pedagogy, and using them to the pupils' advantage in the development of their higher thinking process may result in better learning outcomes in mathematics, especially in a country like Ghana where gaps exist between school mathematical practices and out-of-school mathematical practices (Davis, Bishop & Seah, 2009).

As this study sought to research issues relating to culture and mathematics conceptions, Vygotsky's seminal theories on learning provides a way into the author's problem which helped to frame this study. The author perceives Vygotsky's work as bringing together cultural knowledge alongside school concepts.

Vygotsky (1934/1987) distinguishes two kinds of concepts, the one being everyday concepts and the other scientific concepts. From Vygotsky's perspectives, an everyday concept is acquired through the child's participation in social activities within the child's culture. Their (everyday concepts) development occurs in out-of-school settings, they are experienced based, situated and often spontaneous. Scientific concepts on the other hand are systematic. They are acquired through a system of formal instruction. Gallimore and Tharp (1990) therefore refer to these as "Schooled" concepts because they arise through the social institution of schooling. Panofsky, John-Stener and Blackwell (1990) argue that everyday and scientific concepts are interconnected and independent and that their development is mutually influential and that the one cannot live without the other.

Several studies have shown that pupils' everyday mathematical practices in their cultures could be a useful resource for teaching and learning of school mathematics (Cherinda, 2002; Draisma, 2006; Saxe, 1985; Pinxten & Francois, 2007). Draisma's study in Mozambique, for instance, showed how the use of gestures and oral computation, which formed part of pupils' cultural practises, helped them to perform arithmetic effectively. In this study grade two pupils could use finger counting and verbalisation of their answers to do sums up to hundred. Ethnomathematics approach does support teaching and learning not only at the primary school level but also at the secondary school level. Cherinda (2002), for example, found from her study in South Africa that the use of twil weaving, which formed part of secondary school students' societal/cultural practices enhanced their understanding of sequence and series.

However, some authors have cautioned about the use of ethnomathematics approaches (Laridon, Mosimege & Mogari, 2005; Rowlands & Carson 2002). Rowlands and Carson (2002), for example, argue that mathematics taught should not be built on pupils' cultural background. They argued further that "Mathematics involved in a study of an artefact may have nothing to do with the actual mathematics of the relevant culture" (p.93). The question is, what happens if the mathematics in the artefact relates to the actual mathematics in the relevant culture? Is it not possible that using that meaningfully will help pupils to understand school mathematics and avoid the usual question, of what use is this concept except for marks? Laridon, Mosimege and Mogari (2005) in their study on Ethnomathematics research in South Africa also observed that "teachers responded differently to ethnomatthematical pedagogy" (p. 138). Despite some criticisms about the use enthnomathematics approaches in the teaching of mathematics, many researchers have shown that cultural activities do improve pupils' mathematics achievement in the classroom, as they often promote meaningful learning of school mathematics to children from developing countries, especially (see Cherinda, 2002; Draisma 2006, for example).

Although Vygotsky's theory and other socio-cultural studies in mathematics have shown that pupils' everyday concepts influence the formation of school concept (Draisma, 2006, Owens, 2001; Owens & Kaleva, 2007), not many studies have been conducted in Ghana to look at cultural influences on pupils' mathematics learning (Davis, Seah & Bishop, 2009),especially in measurement and division of fractions. However, pupils experience these two concepts

differently in-school and out-of-school settings. It is against the background of the paucity of research studies on culture influence on pupils' conceptions in mathematics generally, and on measurement and division of fractions particularly, that this study was designed to explore how the local culture influences pupils' conceptions of measurement of capacity and division of fractions.

Purpose of study and the research questions

The purpose of this study was to explore how the local culture influences the way pupils experience measurement of capacity and division of mixed/decimal fraction by a whole number in the real life situation in school. Division of mixed fraction and decimal fraction were chosen because the use of local units of measurement (focusing on capacity) will lead to mixed fractions while the use of measuring scale (focusing on weight) will lead to decimal fractions. As already noted in the introduction, the former practice reflects pupils' societal/cultural practice while the later reflects school practice. The research questions that guided the study were:

1. How do primary school pupils experience measurement of capacity in real life problems in school?
2. How do primary school pupils experience division of a mixed fraction/decimal fraction by a whole number in real life problems in school?

Methodology

In this study, a qualitative research design was used to collect data from eight grade six andeight grade four pupils in two average schools (one each from a rural and an urban school) in the Cape Coast Metropolis of Ghana. Qualitative approach was employed in order to monitor and document how the local culture influences pupils' conceptions and practices. Thus, it was employed to gather in-depth information on how pupils' conceptions and practices reflect their local cultural practices. Cape Coast Metropolis was chosen because of the role it plays in maintaining the Ghanaian/African traditional culture. Cape Coast, for example, continues to host Pan African Festival (PANAFEST), a festival which brings together Africans from the African continent and those in the diaspora and showcase to them the traditional African/Ghanaian culture. Grades four and six pupils were chosen because grade four constitutes a transition from lower primary to upper primary, also as compared to the lower primary pupils, grade four pupils are more matured to explain their procedures to the researcher. Grade six was chosen because grade six marks the end of primary school and transition to junior high school.

Clinical group interviews were carried out with grade four and six pupils in the rural and urban schools. Four groups were formed, two (one each for grade four and grade six) in each of the context of schools (rural and urban). Each group comprised four pupils consisting of a mix of above average, average and below average achieving pupils in mathematics. Interviews with grade four pupils were held separately from grade six pupils in each school. The pupils' interviews consisted of two sets of similar activities which involved measurement and division of maize and rice. Task I required pupils to measure and share a given quantity of maize among three children who assisted on a farm (that is, $10\frac{1}{2}$margarine cups of maize from the use of margarine cup or 4.2 kilogrammes from the use of measuring scale). Task II required pupils to tell the quantity of rice in a container and then share it among three children and show their

solution on their worksheet. Similar activities were given to ascertain the consistency in pupils' approach to the problem. Pupils were informed to feel free to request any measuring instrument(s). In each of the focus interviews, the tasks were presented to the group and the author asked the pupils questions on their processes and thinking as they went through the activities. Task I was administered first, followed by Task II. These activities were pilot tested in a school in Elmina district in Ghana to ensure that they elicited valid responses before they were used in the main study. Although the tasks were practical in nature, they were also mathematical in sense that they engaged the pupils in mathematical ideas (New Zealand Ministry of Education, 2010), by focusing their attention on mathematical concepts involving units of measurement and division of numbers (sharing). Before interviews with the pupils, consent from parents and pupils were sought. The author made a short presentation about the purpose of the research in each of the classes and invited pupils to participate after the presentation. The pupils who volunteered to participate in the study were each given an ascsent form to fill. Parents' consent forms were sent to them through the pupils and returned to the author through the pupils on the day pupils' interviews were held.

Results

The results are presented in two parts below. The first part involves how the urban school pupils experienced measurement of capacity and division of mixed/decimal fractions in Task I and Task II, while the second part involves how the rural school pupils experienced the same concepts in Task I and Task II.

Results from urban school children's activities

Task I: Both grade six and four pupils approached their solution in an informal way. They requested a margarine cup (see Figure 1), as a unit of measure and used it to find what each of the three children would get by successively going round three containers with a cup of maize, and verbalizing their final answers. Grade six pupils shared the maize equally, as shown in the excerpts from interviews below:

> **R**: [presents a bag containing maize to pupils and tells them it is to be shared among three children who assisted on a farm and asks them to a) measure and tell the amount of maize in the bag, b) share the maize among three children and tell how much each will get and c) write their solution on their worksheet. Tells pupils to feel free to request anything they need to measure the maize]
>
> **Esi**: [leads discussion; with the help of other group members, she sets three things comprising an empty tin and two rubber bags on a table. She successively puts one margarine cup of maize in each of the three things; she goes round for the second and the third times. She goes round the three containers with a half margarine cup, the whole maize gets finished from the bag]
>
> **Pupils**: Each of them will get three and half cups [chorus]
>
> **R**: so how much maize was there in the bag?
>
> **Pupils**: [orally] it is ten and half cups [chorus]
>
> **James**: [present their solution in diagrams as shown in Figure 3]

However, grade four pupils shared according to ages, as shown in the excerpts of the interviews below:

Aku: [puts three empty containers, one in front of Tay, Sam and Kate, on a table. Using the margarine cup, she measures one cup of maize and puts in each container. She goes round the second time and the third time. She then measures one cup and gives it to Kate, and keeps the rest in a margarine cup (that measured a half cup).]

R: what about the half cup?

Aku: [explains in Fante (the local language spoken in the research local)] It is the remainder; it is too small for me to share it among them. I cannot give it to either of them [referring to Tay and Sam] because they are of the same age and if I give it to Kate that would be too much, so I will keep it.

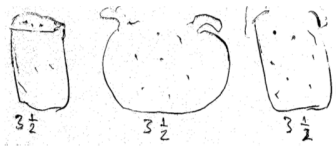
R: so what was the total amount of maize in the container?

Pupils: [orally say] ten and half [chorus]

R: write down your solution on the work sheet

Kate: [presents their solution in prose as shown in Figure 3]

Grade 6 pupils' presentation



Grade 4 pupils' presentation

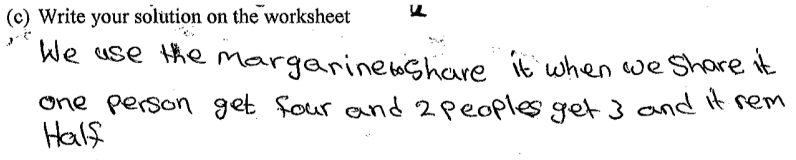


Figure 3 **Urban school pupils' presentation on measurement of capacity and task involving $10\frac{1}{2}$ divided by 3**

Task II: As with Task 1, both sets of pupils approached their solution in an informal way. They requested a margarine cup as a unit of measure and found what each person would get, by going round each of the three containers with a margarine cup of rice. They found the total number of cups of rice through oral computation. However, while grade six pupils shared equally and presented their solution using diagrams similar to those in Figure 3, grade four pupils shared according to ages and presented their solution in prose (as was done in Figure 3).

Results from rural school children's activities

Task I: Both grade six and four pupils approached their solution in Task I in similar manner (an informal way), using the margarine cup, to arrive at their various answers. The two sets of pupils, however, approached sharing differently. Grade six pupils set three containers, and went round each of these containers with a margarine cup of maize to find out what each person would get, before finding the total number of cups of maize through oral computation as, "ten and half"(chorus). Oye presented the group's solution in meaningless prose, as shown in Figure 4.

Grade four pupils set three containers, and then went round each of the containers with a margarine cup of maize three times. As with the grade four pupils from the urban school, Ato (who was the eldest among them) was given one cup from the remaining. This made Ato's share of the maize four cups. The remaining (which measured a half cup) was put aside because, "the maize [half cup] was not sufficient." (Mark) They presented their final answer as 4, 3, 3 and a half. They could not write down their solution neither in prose nor in a mathematical equation.

Grade 6 pupils' presentation

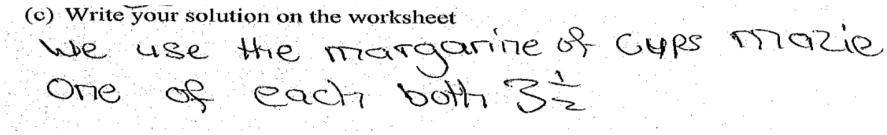


Figure 4 **Rural Grade 6 pupils' presentation on measurement of capacity and task involving $10\frac{1}{2}$ divided by 3**

Task II: As with the Task I, both sets of pupils approached their solution to Task II in an informal way, using a margarine cup. Grade six pupils followed the same procedure they used in sharing the maize in the Task I to share the rice, to arrive at their correct answers of $10\frac{1}{2}$ and $3\frac{1}{2}$ respectively. Thus, the pupils found what each person would get (that is, $3\frac{1}{2}$) before finding the total number of cups of rice as ten and a half cups, through oral computation ($10\frac{1}{2}$). As with Task I, they presented their solution in meaningless prose as, "we use to margrine [sic] cups of rice."

The majority (3 out of 4) of the grade four pupils requested a measuring scale, once they were presented with the rice to measure, and share among three people in Task II. Only Bob requested the local unit of measure ("Olonka"). Grace puts the bag of rice on the measuring scale, but none of them could read it, they remained silent. Mark later said, "sir [referring to the author] we want the margarine cup." Ato explained, "we have not used some [scale] before."

With the help of other group members, Bob measured all the rice into two containers (and had ten and a half cups). They verbalized what each will get as three and half, in chorus. Unlike inTask I, where they shared according to seniority, they rather shared the rice equally among the three in Task II. Thus, each had three and half cups. Here also they could not write down the approach they used in sharing.

Discussion and Conclusion

All the pupils used the margarine cup in the activity. Even in the rural school where grade four pupils attempted to use the measuring scale, they finally requested the local unit of measure because; "we have not used some before" (Ato). This finding is similar to those of Owens and Kaleva (2007) whose study with teacher education students in Papua New Guinea also found an extensive use of informal units of measure. This use of the local units of measure is mainly cultural, because the SI units of measuring capacity based on grams and kilograms remains an abstract school concepts in Ghana (GNA, May 2009a).

However, the assertion by Ato that they have not used some (measuring scale) before appear to bring in the pedagogical aspect of why pupils preferred the use of local unit of measure as compared to the measuring scale. It appears teachers do not make use of measuring scale in the teaching and learning of measurement in school, in spite of the fact that pupils rarely get the opportunity to use measuring scale in their everyday practice outside school. Although the current Ghanaian mathematics curriculum emphasizes the use of measuring scale (Ministry of Education Science and Sports, 2007, p. 62; Ministry of Education, 2012, p. 88), one is not sure whether teachers make use of it. Informal conversation with teachers in both schools after the activities revealed that the schools had no measuring scale.

The author was never taught measurement with the help of measuring scale while he was a primary school pupil in Ghana, neither did he use measuring scale to teach measurement when he was a primary school teacher in Ghana 20 years ago. He never saw a measuring scale in the class of any of his colleague teachers during the teaching of measurement. It is therefore not surprising to the author that Ato said they had not used measuring scale before.

Pupils from both the urban and rural schools approached division as repeated subtraction, an approach which is linked to out-of-school mathematical practices (Nunes, Schliemann & Carraher, 1993). Differences underlying the assumptions in division in school and out-of-school in Ghanaian society might account for the use of division as a repeated subtraction. Unlike school, where homogeneity is assumed and therefore items are automatically divided equally, in the out-of-school situation the assumption of homogeneity does not always hold, except in the case of sharing money.

In sharing rice, for instance, it is unlikely for those sharing to assume that the whole bag of rice is wholesome. In reality quite a number of the pupils sell rice so they are aware that many of the rice grains get rotten towards the bottom of the bag of rice. Based on this knowledge it would not appeal to pupils to share a given quantity of rice by dividing it by the number of people sharing. This is because some would get more unwholesome rice than others. In order to ensure fair share, they would rather approach the division as a repeated subtraction. This out of school notion also appears to influence pupils' conceptions and practices in mathematics at school, as was seen throughout the activities in the two schools. This has implication for mathematics pedagogy, especially in problem posing in class. In posing practical problems involving sharing of grains, for example, teachers have to put in conditions that would enable pupils to assume homogeneity so that items are automatically divided equally, as in the case of money.

Issues about fair share in the out-of-school context appeared to have influenced pupils' conceptions and approach to the problems. Grade four pupils from both the rural and urban schools shared according to seniority, and this was acceptable to all the children involved in the sharing. While this notion of sharing according to seniority could be helpful in the teaching of proportion in future, it has the tendency to create cognitive conflict in the minds of these primary school pupils.

Pupils approached the problem by first finding what each person had before orally adding them together to get the amount of maize/rice in the bag. Only grade four pupils from rural school found the capacity of rice in Task II before sharing it among the three children. The general approach used by the pupils reflected what pertains in the out-of-school setting. Grade six pupils used this approach to arrive at their correct answers (as ten and a half cups, and three and a half

respectively). While grade four pupils (from urban school) also used similar approach as well as out-of-school logic in sharing to arrive at their answer to $10\frac{1}{2}$ divided by three as, "four, three, three remainder a half".

However, Aku's reason for leaving a half as the remainder; "I cannot give it to either of them [referring to Tay and Sam] because they are of the same age and if I give it to Kate that would be too much, so I will keep it", shows that it did not appeal to these pupils to share a half cup of maize. This in the view of the author is cultural; it constitutes societal and cultural practices of a typical Ghanaian pupil. The use of continuous quantities or numbers is not common in the Ghanaian culture. The remaining half cup of rice could have been given out as a dash to the owner of margarine cup that was used to share the rice, in the everyday situation. It is therefore not surprising to the author that some of these pupils could not imagine sharing a half cup of maize. This is an example of cultural influence on the pupils' thinking in mathematics activities in school, and therefore highlights the need to respect all cultures present in the mathematics classroom (Presmeg, 2007; Scholnick, 1988).

Both grade four and six pupils could not write their answers as mathematical equations/sentences (involving division). Pupils' inability to write mathematical equations/sentences could be pedagogical. One is not sure whether teachers take pupils through mathematical sentences and how to write those sentences in equation form. A further study may help to unearth what the actual situation is.

It is evident from this study that even though most of the out-of-school mathematical conceptions and representations in Ghanaian society have no place in the Ghanaian school mathematics curriculum (Davis, Bishop & Seah, 2009), this did not prevent pupils from using out-of-school mathematical representations/logic in their activities in school. This finding shows the local aspect of mathematical knowledge (Barton, 1996; Bishop, 1988), and influence of everyday/out of school knowledge in the teaching and learning situation in the classroom. The question for mathematics educators generally, and mathematics education researchers in Ghana particularly is "how do we provide an adequate way of teaching that enables children to draw on and integrate local and school/academic mathematical knowledge in the teaching and learning situation?"

References

Abreu, G. de. (1993). *The Relationship Between Home and School Mathematics in a Farming Community in Rural Brazil.* Unpublished PhD, University of Cambridge, UK.

Barton, B. (1996). Making sense of Ethnomathematics: Ethnomathematics is making sense. *Educational Studies in Mathematics, 31*(Special Issue), 210-233.

Bishop, A. J. (1988). *Mathematical enculturation a cultural perspective on mathematics education*. Dordrecht: Kluwer Academic Publishers.

Bright, G. W., & Clement, D. H. (2003). *Classroom activities for learning and teaching measurement 2003 year book NCTM*. Reston, VA: National Council of Teachers of Mathematics.

Cherinda, M. (2002). *The use of a cultural activity in the teaching and learning of mathematics: Exploring twill weaving with a weaving board in Mozambican classrooms.* Unpublished PhD, University of the Witwatersrand, Johannesburg, South Africa.

Civil, M. (2002). Everyday Mathematics, Mathematicians' Mathematics, and school Mathematics: Can we bring them together? In M. E. Brenner & J. N. Moschkovich (Eds.), *Everyday and academic mathematics in the classroom* (pp. 40-62). *Journal for Research in Mathematics Education Monograph No. 11*. Reston, VA: National Council of Teachers of Mathematics.

Clarke, D. M., Sukenik, M., Roche, A., & Mitchell, A. (2006). Assessing fraction understanding using task-based interviews In J. Norotna, H. Moraova, M. Kratka & N. Stehlikova (Eds.), *Proceedings of the 30th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 337-344). Prague, Czech Republic: PME.

Davis, E. K., Bishop, A. J., & Seah,W. T. (2009). Gaps between in-school and out-of-school mathematics in Ghana. *Mathematical Connections, 8,* 1-15.

Davis, E. K., & Hishashi, K. (2007, January 13-15). *Country Report - Children*. Paper presented at the Third workshop on the International research project towards Endogenous Development of Mathematics Education, Tokyo, Japan.

Davis, E. K., Seah, W. T., & Bishop, A. J. (2009b). Students' transition between contexts of mathematical practices in Ghana. In D. Martin, T. Fitzpatrick, R. Hunting, D. Itter, C. Lenard, T. Mills & L. Milne (Eds.), *Mathematics of prime importance* (pp 62-71). Melbourne: Mathematics Association of Victoria.

D' Ambrosio, U. (1999). Ethnomathematics and its first international congress: Granada (Spain), September 2-5, 1998. *ZDM, 31*(2), 50-53.

Draisma, J. (2006). *Teaching gesture and oral computation in Mozambique: Four case studies.* Unpublished PhD, Monash University, Melbourne, Australia.

Duedu, C. B., Atakpa, S. K., Dzinyela, J. M., Sokpe, B. Y., & Davis, E. K. (2005). *Baseline study of Catholic Relief Services Assisted Primary Schools in the Three Northern Regions of Ghana* Cape Coast: CRIQPEG, University of Cape Coast.

Fleer, M., & Williams-Kennedy, D. (2002). *Building bridges: Literacy development in young indigenous children*. Canberra, Australia: Australian Early Childhood Association.

Freudenthal, H. (1983). *Didactical phenomenology of mathematical structures*. Dordrecht, The Netherlands: Reidel.

Gallimore, R., & Tharp, R. (1990). Teaching mind in society: Teaching, schooling and literate discourse. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications and applications of socio-historical psychology* (pp. 175-205). Cambridge: Cambridge University Press.

Ghana News Agency (GNA). (May 2009a). Ghanaians reject weighing scales-Pilot project reveals. Retrieved May 21, 2009, from http://www.ghanaweb.com/GhanaHomePage/NewsArchive.

Ghana News Agency (GNA). (May 2009b). Akuff-Addo's press statements. Retrieved May 27, 2009, from www.ghanaweb.com.

Hedegaard, M. & Chaiklin, S. (2005). *Radical-local teaching and learning, a cultural historical approach.* Aarhus, Denmark: Aarhus University Press.

Laridon, P., Mosimege, M., & Mogari, D. (2005). Ethnomathematics research in South Africa. In R. Vithal, J. Adler & C. Keitel (Eds.), *Researching mathematics education in South Africa* (pp. 133-160). Cape Town, South Africa: HSRC Press.

Mereku, K. (2004). *Mathematics curriculum implementation in Ghana*. Accra, Ghana: Danjoe production.

Ministry of Education (MOE). (2012). Mathematics syllabus for primary schools. Ghana Education Service.

Ministry of Education Science and Sports (MOESS). (2007). Mathematics syllabus for primary schools. Ghana Education Service.

Moschkovich, J. (2007). Examining mathematical discourse practices. *For the Learning of Mathematics, 27* (1), 24-30.

New Zealand Ministry of Education (2010), Mathematical Task, Activities and Tools. Retrieved September 29, 2012, from www.nzmaths.co.nz.com .

Nunes, T., Schliemann, A. D., & Carraher, D. W. (1993). *Street mathematics and school mathematics*. Cambridge: Cambridge University Press.

Owens, K. (2001). The work of Glendon Lean on the counting systems of Papua New Guinea and Oceania. *Mathematics Education Research Journal,13*(1), 47-71.

Owens, K., & Kaleva, W. (2007). Changing our perspective on measurement: A cultural case study. In J. Watson & K. Beswick (Eds.), *Proceedings of the 30th annual conference of the Mathematics Education Research Group of Australasia* (pp. 571-580). Sydney, Australia: MERGA.

Panofsky, C., John-Steiner, V., & Blackwell, P. (1990). The development of scientific concepts and discourse. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications an applications of socio-historical psychology* (pp. 251-267). Cambridge: Cambridge University Press.

Pias, A. (2011). Criticisms and contradictions of ethnomathematics. *Educ Stud Math,* 76, 209-230.

Pinxten, R., & Francois, K. (2007). Ethnomathematics in practices. In K. Francois & J. P. V. Bendegem (Eds.), *Philosophical dimensions in mathematics education* (pp. 214-227). New York: Springer.

Presmeg, N. C. (2002). Bieliefs about the nature of mathematics in the bridging of everyday and school mathematical practices. In G. Leder, E. Pehkonen & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education?* Dordrecht, The Netherlands: Kluwer.

Presmeg, N. (2007). The role of culture in teaching and learning mathematics. In F. K. Lester (Ed.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 435-458). Charlotte, NC: Information Age Publishing.Seah, W. T. (2004). *Negotiation of perceived value differences by immigrant teachers of mathematics in Australia.* Unpublished PhD, Monash University, Melbourne.

Saxe, G. B. (1985). Effects of schooling on arithmetical understanding: Studies with Oksapmin children in Papua New Guinea. *Journal of Educational Psychology, 77*, 503-513.

Scholnick, E. K. (1988). Why should developmental psychologist be Interested in studying acquisition of arithmetic? In R. R. Cocking & J. S. Mestre (Eds.), *Linguistic and cultural influences on learning mathematics* (pp. 73-90). Hillsdale, NJ: Lawrence Erlbuam Associate Publishers.

Takuya, B. (2003). *Principles of curriculum development based on ethnomathematics in developing countries: Development of verb-based curriculum and its application to mathematics education in Kenya.* Unpublished PhD, Hirsohima University, Hiroshima, Japan.

Vygotsky, L. S. (1934/1987). Thinking and speech (N. Minick, Trans). In R. W. Rieber & A. S. Carton (Eds.), *The collected works of L. S. Vygotsky* (Vol. 1, pp. 37-288). New York: Plenum Press.

Zaslavsky, C. (1973). *Africa counts, Number and pattern in African cultures*. Chicago: Lawrence Hill Books.

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