STUDENTS' TRANSITION BETWEEN CONTEXTS OF MATHEMATICAL PRACTICES IN GHANA

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Mathematics is a subject that appears to be studied in school curriculum all over the world. However, whilst in some societies mathematical practices reflects the mathematics that is studied in schools, in other societies some of the mathematical practices in the society differ from those in schools. This paper reports on some of students' transition experiences in mathematics in Ghana, where some of the mathematical practices in the society differ from school. It also discusses the effect of some of these transition experiences on students' mathematical conceptions in fractions, and their implications for mathematics pedagogy in multicultural societies such as Australia.

Introduction

Ghana is located on the west coast of Africa and was a former British colony. English is the official and the national language of Ghana. Ghana practices thirteen years of pre-tertiary education and English is the medium of instruction from grade four. Like in many developing countries students performance in mathematics in Ghana both locally and internationally have not been the best (WEAC, 2006; Ministry of Education, Youth and

Sports, 2004). However not many studies have been conducted in Ghana to look at cultural influences on students' mathematics learning despite the fact that the literature points to the cultural nature of mathematics (see Bishop, 1988). Other researchers have also argued that culture of students and teachers affect mathematics teaching and learning (Presmeg, 2007; Seah, 2004).

Researchers are also pointing to the fact that learners bring meanings to their mathematics lessons (Abreu, Bishop & Presmeg, 2002; Fleer & Robins, 2005). Exploring these meanings and using them to the child's advantage in the development of their higher thinking process may result in better learning outcomes in mathematics (especially in a developing country like Ghana). However, it seems what educators need to know in other to see this happening in classroom setting is still not known (at least in the Ghanaian context). Abreu, Bishop and Presmeg (2002) therefore suggest the need to research how individuals and/or social groups experience their participation in and transition between two or more sociocultural mathematical practices.

In this paper, we consider transition as movement between contexts of practices or major cultural institutions- such as between home and school (Abreu, Bishop & Presmeg, 2002). Abreu, Bishop and Presmeg, (2002) have proposed four kinds of transitions (as Lateral transitions, Collateral transitions, Encompassing transitions and Mediational transitions). For the purpose of this paper we will dwell on only one of them, namely collateral transitions, as this best describes some of the transition experiences Ghanaian school children may go through.

According to Abreu, Bishop and Presmeg (2002);

> Collateral transitions, is where there are two related practices requiring relatively simultaneous involvement. Example is the situation where the school students' parents emigrated after being at school in their home country, and student is exposed to one set of mathematical practice and representation at home and another set at school. (p. 17)

In the Ghanaian home context it is very common for adults to describe a bucket three-quarters full of water as "insu sin" (in Fante dialect), and a bucket three-fifths full also as "insu sin". "Insu" means water whiles "sin" means less than whole. That is to say, in the home context there is no differentiation of unit fractions. That implies that a bucket half full of water, a bucket three quarters full of water etc are all described as "sin" which means less than a whole but the reverse is the school situation where children have to differentiate fractions

and even compare them. In the home context children make use of empty tins such as empty margarine cups and "Olonka" in measuring (see GNA, May 2009). The metric system of measurement is not usually used in the local markets both in urban and rural settings. Financial news on national radio usually quotes prices of commodities in these local units ("Olanka" etc) but unfortunately these local units have no place in classroom mathematics curriculum. The language of instruction in school (especially from grade four onwards) is different from the language most children use at home and even outside the classroom in most cases. The approaches students may use in representation of a typical arithmetic problem may also differ between contexts (home/school), as Abreu (1993) observed with children of Brazilian sugar cane farm workers where children are taught metric systems of measurement in schools whiles at home they used their local unit of measurement based on 'braças'. These struggles between school and home contexts of mathematical practices by Ghanaian students could be described as being collateral in nature. Literature suggests that such mismatch between out-of-school and school mathematics (as prescribed in school curriculum) usually constrain teachers from using out-of-school mathematics since they are obliged to follow the school curriculum (Abreu, 1995).

Purpose of study

The purpose of this study was to find how students experience mathematics between home and school contexts; focusing on identification of fractions. It also explored how teachers handle cultural differences students bring forward in mathematics lessons and why they handle it the way they do.

Research questions

The following research question were posed to guide the study

1. How do primary school students experience identification of unit fraction in everyday situation and in classroom situation?
2. How do teachers handle cultural differences students bring forward in mathematics lessons?

Methodology

In this study, a qualitative research design was used to collect data from 4 grade six, 4 grade four students and their teacher (same for both grade levels) in one average school in

the Cape Coast Metropolis of Ghana. This school was purposely chosen amongst a group of average schools because this school was divided on the use of out-of-school mathematics (OOSM) in in-school mathematics (ISM). Thus this school represented two extreme cases of schools that prohibit the use of OOSM in ISM and schools that accept the use of OOSM in ISM. Grades four and six students were chosen because grade four constitutes a transition from lower primary to upper primary, it is also the level where students begin to learn mathematics in the English language in Ghana. Grade six was chosen because grade six marks the end of primary school and transition to junior high school. The researcher (first author) interviewed students and their teacher (teacher C) in October 2008. Students' interviews consisted of two sets of activities namely out-of-school task and in-school task. Each of the tasks consisted of two activities namely Task I and Task II. The out-of-school Task I required students to identify a glass one-sixth full of water (Glass A1) and a glass one-fifth full of water (Glass B1). Whilst the out-of-school Task II required students to identify a glass half full of water (Glass A2) and a glass three-fifths full of water (Glass B2). Parallel paper and pencil tasks were set for students in the in-school tasks I and II. The out-of-school task was administered first, followed by the in-school task. Also interviews with grade four students were held separately from grade six students. Before interviews with the students consents from parents and students were sought. Teacher C was interviewed amongst other things, on some of cultural differences students bring forward in mathematics lessons, including fractions. Consent was also sought from Teacher C before the interviews. Results from interviews with students and Teacher C are presented below.

Results

The results are presented in two parts below. The first part involves how students experience identification of fractions in out-of-school and in-school tasks. Whilst the second parts reports on how Teacher C handles the culture differences students bring forward in mathematics lessons.

Identification of fractions in out-of-school and in-school tasks

Out-of-school task: Results from children activities at home show that grade six students had difficulty identifying unit fractions in the out-of-school task. None of them was able to identify one-sixth while only one of them was able to identify one-fifth. Looking

at the content of Glass A1 (one-sixth) they gave varied responses orally; SC61 said one-quarter, SC64 said one-third, SC62 said a half and SC63 said two-thirds. They provided their written responses as shown in Figure 1.

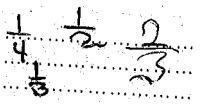

Figure.1: Grade six students' presentation of content of Glass A1in out-of-school task 1

Similarly, looking at the content of Glass B1 (one-fifth) they gave varied responses orally; SC61 said one-quarter; SC64 said one-third whilst SC62 and SC63 said one-fifth (which is the correct answer) and one-fourth respectively. They provided their written responses as shown in Figure 2.

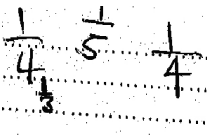

Figure 2: Grade six students' presentation of content of Glass B1 in out of school task 1

When the two sets of glasses (A1 and B1) with their content were presented to them to compare, one would have expected S61 and S64 to say that they are equal. But all of them said the content of Glass B1 was more than Glass A1.

Also none of them was able to identify three-fifths (Glass B2). All students but S63 identified the content of Glass B2 as half; S63 said it was two-thirds. However all of them were able to identify half (content of Glass A2). Comparing the content of the two Glasses one would have expected all but S63 to say they are equal but all of them said the content of Glass B2 was more than Glass A2.

In both the two out-of-school tasks relating to the identification of fraction (Task I and Task II) the most common fraction name that students used often was half (eight times). This was followed by a quarter (three times).

Results from interviews with grade four students revealed that none of them was able to identify one-sixth and one-fifth in the out-of-school Task I. They identified the content of Glass A1 (one-sixth) as a quarter and the content of Glass B1 (one-fifth) also as a quarter, as shown in Figure 3.

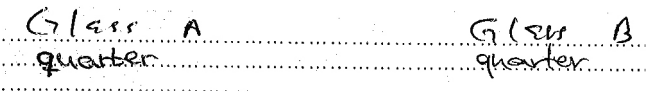

Figure 3: Grade four students' presentation of content of Glasses A1 and B1 at home

In comparing the content of the two glasses (A1 and B1) all of them said content of Glass B1 was more than Glass A1.

Interviews with grade four students revealed that the majority (3 out of 4) of them could correctly identify the content of Glass A2 as half in task II. Only S43 identified it as a quarter. However, none of them could identify three-fifths in Glass B2. They gave varied responses in describing the content of Glass B2. S41 identified it as "quarter to full", S42 had no idea, S43 identified it as a half and S44 identified it as "more than half". All of them identified the content of Glass B2 as being more than Glass A2 when they were asked to compare them.

The most common fraction name that the grade four students used often in Task I and Task II was quarter (nine times), followed by half (four times).

In- school task: The results from in-school task on fractions also showed that grade six students had difficulty identifying fractions. They tend to concentrate on the number of partitions in the whole and the shaded portion to decide on what fractions they are dealing with rather than looking at the shaded portion in relationship with the whole. For example in identifying one-fifth they counted five divisions and one shaded portion and presented their answers as one-fifth. They were therefore able to identify one-sixth and one-fifth in the in-school Task1 without problems. They however had difficulty identifying half (a fraction they were able to identify in the out-of-school task) in in-school Task II. This was because they could not easily figure out the number of divisions (see Figure 4).

Figure 4: Grade six students' presentation on identification of a half in-school task II

This is an indication that their notion of part whole relationship in fractions in school

is limited to number of shaded portion(s) divided by number of divisions instead of relationship between the whole and the shaded portion(s) of the whole.

Grade four students approached Task I and Task II in the in-school tasks the same way the grade six students approached it. They also concentrated on the number of partitions in the whole and the shaded portion to decide on what fractions they are dealing with rather than looking at the shaded portion(s) in relationship with the whole. They were able to correctly identify one-fifth, one-sixth and three-fifths in Tasks I and II. But they were unable to identify half correctly in the same task (see Figure 5).

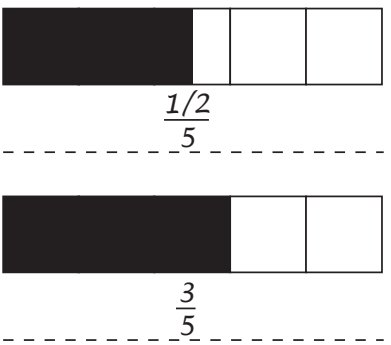

Figure .5: Grade four students' presentation on identification of a half in-school task II

Teacher C's handling of the cultural differences students bring forward in mathematics lessons

According to Teacher C (TC) the cultural differences children usually bring forward in lesson on fractions involves unequal sharing "... when it comes to sharing between an elderly person and then a younger person the application of fractions becomes difficult". Fair share in the Ghanaian context does not necessarily mean equal sharing. TC identified comparing fraction as being difficult for children and perceived culture as contributing to the problem of identification of fractions, "yes it interferes their learning, when comparing the fractions that is where the problem comes ...'. TC handles culture difference by using the school knowledge to help the children to keep the home aside:

> We don't consider you as the eldest or whatever but equity, we want to share it equally, especially taking the class, we are all in this class, say six or four so we share it equally. That is how I solve the problem.

TC concentrates on the school's way of doing mathematics because she has to follow what the syllabus says, "that is what the syllabus that has been provided for us to follow says". TC believes if students bring up OOSM in ISM she has to teach them what the syllabus says, "they (students) know the home one so if they bring it up you teach them what the syllabus says or what has been prepared to be followed".

Discussion

The majority of the students were able to identify half in the out-of-school activity perhaps due to that fact that it is the only unit fraction that has local name (fã). However "fã" does not mean equal halves, it means about mid point. Thus three-fifths may also be categorised as "fã". Students' difficulty in naming the other units fractions may be due to the fact that in out-of-school setting they do not differentiate unit fractions. Thus with the exception of half which could mean about midpoint all the fraction are described as less than whole (sin). Thus the two fraction names in the culture are "fã" and "sin". However "sin" could mean "fã" and "fã" could mean "sin" since half does not mean equal halves (as already noted). Quarter and half were the most common fraction names perhaps because these are the two most common units of measure of liquor/liquids in the out-of-school setting. Even some local music that mentions liquor such as "Atea Special" quotes a quarter as a unit of measure of "Apeteshe" [local gin]. Some of these kids are usually sent by adults to buy liquor in bottles. Others may help parents who sell liquor in drinking spots. Thus the fact that the researcher poured water from a bottle visible to students into a glass may have suggested to some of them that it may be either a "quarter" or "half".

The results further reveal that students experienced fractions differently in in-school and out-of-school activities. They were able to identify one-fifth, one-sixth and three-fifths (fractions they could not identify in out-of-school activities) in in-school tasks. They were however not able to identify half (a fraction they were able to identify in the out-of-school task). Thus their notion of fractions in school was limited to number of shaded portion(s) divided by number of divisions in the whole.

The finding from interviews with Teacher C confirms Fleer and Robin's (2005) assertion that students bring their everyday knowledge to learning situations in school. Teacher C's approach to handling cultural differences by concentrating on what the syllabus states also confirms Abreu's (1995) assertion about the tendency for teachers to ignore culture difference and concentrate on syllabus in context where out-of-school mathematics differed from in-school mathematics.

Implication of findings

The implication of these findings are that students who experience one set of mathematics in everyday setting and another set of mathematics in the school setting are likely to relate practical mathematics activities in school with their everyday mathematical experiences. They are also likely to experience concepts which differ between school and everyday contexts differently in classroom. Teachers in context where students experience different set of mathematics between home and school contexts and those in countries that host many emigrants like in Australia may have to look beyond students' mistakes in dealing with such students. As proposed by Bishop (2002), rather than ignoring culture differences they could be utilised to help students' mathematics learning. This may go a long way to help improve students' performance in mathematics and also help them to make connections between the different cultures of mathematics.

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