Chapter - 5

Results II: Mathematical Practices in School

This chapter analyses the mathematical learning practices in a school setting at Egicikeni village in Lundazi District. It attempts to examine how the mathematics practices the learners were accustomed to in their community interacts with the school ones. Common mathematics knowledge is here defined as the knowledge that cuts across the two settings: in the school, that is, the epistemic practices that emerge as learners interact with the mathematical tasks, the pedagogy and the classroom environment.

The chapter has four parts; the first part presents the teaching and learning context, that is, the resources in the classroom where the observations took place. The second part presents lesson observations of mathematics practices in grade one (the first encounter with school for the learners) while the third part presents the mathematical practices vis-à-vis the content and procedures and the pedagogical aspects focusing on mathematics knowledge in grade six class. The fourth part explores the learners’ interpretation of mathematics tasks outside and in school.

5.1: Teaching and Learning context

This section gives the context of teaching and learning in the school. It begins with the physical facilities/requisites of the classroom(s) followed by the learner and teacher profiles.

5.1.1: Physical facilities and learning requisites

Many classrooms were not adequately equipped. The desks were not enough to go round; three and sometimes four learners shared a desk meant for two. Sitting itself did not cause problems, but writing was difficult, and thus some learners used their laps for writing. The picture was similar in many rural areas as Ministry of Education (MoE) gave the figure of 8.5 percent of rural learners sitting on the floor due to shortage of desks (MoE, 2001). Learners shared books as these too were not enough to go round the class. One book was shared among 3 to 4 learners, which was not convenient. According to the report of the Zambia National Assessment Project (2001), the country-wide results showed that only 26.8 percent of learners met the target set by the Ministry of Education of one book per two learners in mathematics.
The grade six classroom had a chalkboard which was partially rough on one side. Writing on one side was clear while on the rough side was too smooth and slippery. The writings on this side were not as clear especially to learners sitting at the back of the class. The survey by the MoE (2001) described the condition of the chalkboards as poor. The classroom for the sixth grade was bare in terms of wall charts and other learning requisites. The first grade class however, had charts on the walls and many other teaching and learning aids. These included flash number cards, charts showing heaps of fruits with a corresponding number, charts showing family and number, counters (manufactured), stones and sticks (brought by learners), pencils and books. Pictures depicting sets of pets were also seen hanging on the walls.

5.1.2: Learner profile

The average age of the sixth graders under study was between 12 and 13 years with girls being younger compared to boys. However, the age varied more in the case of boys, some of whom were as old as 17. The reason for the advanced age among boys was explained as being due to their parents keeping them busy to look after cattle. Lack of school fees was yet another excuse given. (The situation has now improved as government has abolished fees in schools.)

Absenteeism and late coming were a common occurrence for learners in the class. While the class had 55 learners registered on roll, the daily attendance was 50 or less. The first class in the morning was usually affected as some learners reported late. Absenteeism was attributed to commitments to their house hold chores. The affected learners were requested by their parents to assist in some jobs at their homes. Other reasons for late coming were unpredictable weather condition, inability to read watches and know exact time, etc.

5.1.3: Teacher profile

The majority of teachers in the primary school in the rural areas were males and vice versa in the urban areas. According to the MoE statistics for the Eastern Province of Zambia, 63.2 percent were male. In the research site (school), out of ten teaching staff, only three (3) were females.

The teacher who handled the research class has Senior Secondary Education academic qualification. He went through a two year pre-service training course. This
was the trend for the teachers of grades 5 to 9 in the system. Teachers of Middle and Upper primary school grades had either a two-year pre-service teacher-training certificate or a diploma or an advanced primary teachers' certificate (MoE, 2000).

5.1.4: Classroom Organisation

The classroom was arranged according to groups. The desks were arranged as in figure 5.1.1. Learners sat six to seven per group. Both grades had the same arrangement.

Figure 5.1.1: Classroom lay out

The grade one class also had mats laid on the floor in front facing the teacher's table (see appendix). Next to the teacher's table were several teaching aids. This space in front of the teacher's table and close to the board and teaching aids, is called 'Teaching Corner' (TC). Learners moved from their respective groups in single file to the teaching corner (TC) where the teacher introduced new concepts or gave instructions. The learners sat on mats.

5.2: Mathematics learning practices in grade one class

This section presents learning practices in the first grade class in mathematics at Nkunda Primary school. In order to understand the common mathematical knowledge practices in the sixth grade class the class to first come into contact with school mathematics was also observed. The class was observed during the second term of the school (May - July term). The learners had already spent one term in school. Ten lessons were observed and during this time the class dealt with writing of 1 up to 20, counting, addition and subtraction. Notation for addition and subtraction operations was introduced e.g. $6 + 7 = \square$, $9 - 5 = \square$
Presented below are the excerpts of some of the classroom practices and discourses observed by the researcher. The classroom discourse during a typical lesson on ‘counting and addition’ is presented below.

**Lesson 5.2.1: Lesson on counting and addition of numbers**

1. T: Tukadoli pakwenda! ... [Teacher starts a song which starts a process of groups moving to the Teaching Corner (TC) in single files].
2. Ls: Tulelingana [Learners respond to the songs and they move in single file to the front of the class]
3. T: Ninjani wiza penda mupaka pa 15 naku lemba! (Who will come here to count up to 15 and to write the number)
4. Ls: Ine aticha, Ine aticha, one, two, three, Ine a ticha (Me teacher, me teacher ... ) [Learners shout for attention as others begin to count, causing noise and disorderly behaviour in class]
5. T: Para ukhumba kuyowoya, wuska woko, tikuchita wuli? (If you want to say something, you put up your hand! What do you do?)
6. Ls: wuska wuko! (You put up your hand) [They chorus]
7. T: Tuchita wuli (How do we do that?)
8. Ls: A ticha, a ticha, a ticha (Teacher! Teacher! Teacher!) [Many learners demonstrate how it is done by raising their hand, mostly the right hand]
9. T: Chiwawa, tikati wuli pa chongo mu class? (Noise, now what did we say about noise in class?)
10. Ls: Chiwawa yayi mu kilasi! (No noise in class) [Learners demonstrate by putting their fingers on their lips, a sign of sealing the lips]
11. T: Iwe yiza kuthanzi wuchite iyi (You come forward and do this one)
12. [Learner goes to the board, fails to count up to 15, another one goes to write on the board. The rest look at the work. He manages to count and write the number 15. Then teacher writes the following numbers on the board; 15, 16, 17, 18, 19, ...... and learners are putting up their hands!]
13. T: Para tafuma apa tizenge phani? Naomi (What is the next number, Naomi) Para tafuma pa eighteen, tikwiza pha? (What is the next number after 18?)
14. Naomi: [She wrote ‘2’ on the board].
15. Other learners: A ticha babuda, ine a ticha! Ine, ine a ticha! A ticha! (Teacher she has made a mistake, me teacher, me teacher, teacher!)


17. Ls: 19

18. T: A liyese wakhale pa eyekha payekha!, Iwe kugona yayi! Khazikika pasi! Iwe wupulikenge! Lembani ‘date’ - lemba date makora. (Now each you seat on your own. You, don’t sleep, you sit. Write the date, write it properly)

19. [At this stage there is a knock on the door and about seven learners walk in, all came from one village was told.]

20. Ls: A ticha tha mwabapanisa aba! Ka bachelwa! (Teacher, you punish those, they are late)

21. T: Kusukulu tikwiza mochelwa yayi! Lino mwabombokwa tiyeni khalani. (At school we do not come late! Today you are lucky, come in and sit)

22. 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]

23. [Two groups remains at Teaching Corner, while Nthoci and Papaya work on writing of numbers 15,16,17,18,19, 20, repeated on each line]

24. [The remaining group, dealt with how to add. The teacher writes 6 + 4
And advised learners to use the sticks which they had!]

25. 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]

26. Ls A ticha , a ticha! A ticha! Ine napenda! (Teacher, teacher, me I have counted!)

27. T: Tapenda ‘7’ (Have we counted seven?)

28. Ls: eeh! Eeh! (Yes! Yes!) [Many respond accordingly]

29. 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]
30. 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 = ]

31. [Teacher writes 7 + 8 = and guides the learners, taking step by step in counting on as a strategy for addition!]

32. 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]

33. T: Another exercise 9 + 4 =

34. 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?)

35. Ls: a ticha! Ni 13! (Teacher it is 13!)

36. T: sono yawumalilo iyi (Now the last problem)

37. [Teacher writes 9 + 6 =

38. Sono iyi machite mwekha, ine niyowongeko chaa! [after a brief pause] (Now this one you do it on your own – me I won’t speak) Mwasanga? (Have you found the answer)

39. Ls: ‘15’ a ticha! [some pupils shout!] (15 teacher)

40. T: Ok, Ok

41. L: A ticha Eleni wotuka! Anso bolemba yayi! (Teacher, Eleni is insulting, she is not writing)

42. T: Zakuno Eleni kuno tikutuka chaa! Wapulika (Come here Eleni, here we don’t insult, you understand?)

43. [As learners finish their work, they start talking to each other, and the noise increases as more learners finish]

44. T: Uyo bwamalizya waniwe book ni chonge! Imwe ba ‘Ntoci’ lindizyani ndakhe! (Those that have finished, give me your books, I will mark them. Those belonging to Ntoci, wait) [Teacher starts song which restores order in the class, there is silence again.]
Table 5.2.1.: Mathematical practices as observed in a lesson on ‘counting and addition’

<table>
<thead>
<tr>
<th>Category</th>
<th>Turns in which these occur or are used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogic aspects</td>
<td>3, 5, 7, 9, 11, 13, 16, 18, 21, 22, 24, 27, 29, 30, 31, 32, 33, 34, 36, 38, 40, 44</td>
<td>21</td>
</tr>
<tr>
<td>- instructing i.e. explaining, giving work, examples, initiating learners to school etc</td>
<td>3, 12, 24, 25</td>
<td>4</td>
</tr>
<tr>
<td>- learner support e.g. use of chalk board, teacher assisting learners</td>
<td>4, 6, 8, 10, 12, 14, 15, 17, 20, 26, 28, 35, 39, 41</td>
<td>14</td>
</tr>
<tr>
<td>- learner participation e.g. answering questions etc</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>- teacher assessing learners’ work e.g. marking, walking around</td>
<td>1, 2, 42</td>
<td>3</td>
</tr>
<tr>
<td>- regulatory talk e.g. stop noise, don’t copy etc</td>
<td>3, 11, 13, 18, 24, 25, 29, 31, 33, 34, 37, 44</td>
<td>12</td>
</tr>
<tr>
<td>Source of Knowledge</td>
<td>12, 25, 44</td>
<td>3</td>
</tr>
<tr>
<td>Justification of Knowledge</td>
<td>3 – 12, 12 – 17; 24 – 26</td>
<td>7</td>
</tr>
<tr>
<td>Nature of knowledge e.g. use of definition, procedural talk, conceptual talk, enquiry, contextual talk</td>
<td>27 – 30, 31 – 32, 33-35, 37 - 40</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>stanzas/loops</td>
<td>3</td>
</tr>
</tbody>
</table>

Analysis of lesson

The teacher started the lesson with a song which was a signal to learners to stop doing whatever they were doing. Learners then moved to the front in single file (each group made its own line) facing the Teaching Corner (TC) (Turn 1). At this stage all groups moved to the front. Teacher asked for a volunteer who would count up to 15 and to write the number on the board. The learner that attempted to count up to 15 failed he went up to 11 and could not proceed, another learner attempted correctly (Turn 12). The teacher started another problem, which is, finding the next number in a counting...
sequence. The focus of the first part of the lesson was on counting and writing down the figures at least for the whole group.

The teacher gave work to two groups as they prepared to leave the front of the classroom. This group worked on writing numbers that is repeating the same figures in each line in their exercise books. To the group that remained in front, 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. Then they were 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 25, 26, 27).

The teacher led the learners through an exercise of addition and writing down the answers to, a) \(7 + 5 =\) b) \(7 + 8 =\) and c) \(9 + 4 =\) (Turns 30, 31, 33). He left the final one \(9 + 6 =\) to the learners to do on their own. The teacher got all the learners at the TC interested and active as they counted the sticks. The learners were enthusiastic, keen and active in the class activities. They shouted and jostled for attention from the teacher (Turns 4, 8, 12, 15, 26, 28, and 39). “Me, teacher, me teacher etc”, this characterized most of the class time. Demonstration of required behaviour was done with fun, just as when they counted sticks to arrive at their sums.

The teacher used Tumbuka language as medium of instruction in almost all cases. English terms were brought in only when the local terms needed a description rather than a simple word, for example ‘class’ (Turn 9), ‘box’ (Turn 30), ‘book’ (Turn 44).

When there was noise in class (Turn 4) the teacher seized the opportunity to remind learners about the behaviour required in class when one wanted to speak. The learners apart from stating what was supposed to be done also demonstrated (Turns, 6, 8) how. They put their fingers on their mouths, indicating sealing of the mouth. All learners participated enthusiastically. The teacher also cautioned one learner who used abusive language to another, other learners were at the same time warned that ‘insulting’ was not allowed in school or class (Turn 41, 42). The teacher also attended to other social and as well as class management issues. Late comers were cautioned and reminded not to come late to school (Turn 20). Other learners advocated punishment for their friends for coming late. The teacher ignored their advice.
The teacher taught social skills required in class. In this particular lesson the teacher referred to noise in class and how to get a chance to speak in class. Listening and waiting for one’s turn were other social attributes touched on. The other behaviours observed in the classroom were following directions, sitting still and paying attention to the teacher, completing or working on tasks without engaging in disruptive behavior etc. These were embedded in the daily routine and instructions given by the teacher. Orderliness was yet another social skill that was imparted, just as acknowledging those in authority and visitors to the class. Learners were taught to stand up each time a teacher walked into class. These modes of respect were not just for the teachers. The children showed similar behaviours to visitors whom the teacher indicated were in a position of authority. A standard greeting in English for the purpose was rehearsed and said (That is: Good morning sir/madam! How are you? We are very well. Thank you). The learners were also taught to walk in single file(s) into their classroom or when they were moving into another room, and also when taking their position in their groups. The dress-code, which was highlighted in the uniform for both sexes, was yet another social etiquette that was taught to new learners to school.

The social behaviour of the learners in various parts of the school (mathematics class included) were under watchful eyes of the teacher(s). A range of sanctions were available to the teacher to aid him/her in instilling discipline and ensuring compliance in school or class. Reinforcement or compliance to the school/class norms was emphasised. The social and academic skills were achieved through a system of sanctions, threats and punishments. Excerpt 5.2.1 below provides a peek at the situation;

**Excerpt 5.2.1**

T: Tolani ma book yinu (Get your books!) Iwe Sara wulije phensulo (Sara you don’t have a pencil) Nikupatikenge kuno! (I will chase you from my class!)
Sara: Nibweleke, naluba (should I borrow? I forgot mine)
[At this stage teacher nods to Sara to borrow from her friends, but there is noise in class]
T: Isaac wupanga chiwawa, yiza apa ngwada pasi (Isaac, you are making noise, come and kneel here!)
Isaac: Aah a ticha, nga ndine nekha! Na uyu! (Aah teacher it's not me alone! Even this one!)
T: Mose zani apa! (Both of you come here!)

The teacher scolds a girl (Sara) for not being ready for class. She forgot a pencil and did not have anything to write with. He threatens her with banishment from class. While solving her problem the other children started talking loudly again in class. The teacher meted out punishment to the noisemakers. The teacher punished partly to be fair. The two offending learners were made to kneel in front of the class. Learners were initiated into a practice of punishment for non-compliance or not performing as expected.

The teacher explained some of the behaviours exhibited by the learners and his own expectations to the researcher, in Excerpt 5.2.2:

**Excerpt 5.2.2**

R: Why do you keep referring to 'here' (school)? Why should learners behave differently here?
T: It is different here. Here we need order, we follow time and since they are many, we can only understand each other if one speaks at a given time and not all at the same time. At times, outside the classroom, learners shout, which we do not allow here. Well they can shout during Physical Education (PE) but not in class.
R: What about 'standing up' when a visitor walks in?
T: It is to show respect – I know in the community they kneel or squat or sit down, but, here, they have to stand. Also, it helps in calming or drawing attention or restoring order. Everyone will stop whatever they are doing because in the village they just play all day. Here they have to learn.

The researcher paused a question to the teacher about why there were differences between school and local community life. The teacher explained the distinction between community life and school life. He loosely suggested that in the community, there was no turn taking, though he quickly qualified his statement, referring to games/sports or play situations of the learners. He talked about order and justified the rule due to large
numbers of learners in class. When he was asked about modes of showing respect to elders/visitors, the teacher also explained the different ways of showing respect to elders/authority. He justified the school practice that it was helping ‘order’ in the classroom. The teacher’s view on the manner of respect accorded to the elders and people in position of authority in the community was that it was not consistent with ‘school practice’.

The excerpt 5.2.1 and 5.2.2 and Table 5.2.1 show that the first contact with school offers appropriate introduction to social and academic skills that are compatible with the school norms. From the outset the first grade teacher seeks to initiate the fresh learners into the school culture. The teacher constantly reminds learners about how to behave in school/class. The discourse in the class from the teacher to the learners is mostly one of informing and enlightening the learners on the way the school operates.

Further, the following practices were observed in the grade one class:

Teacher’s Practices

The teacher operated in front of the class most of the times, except when marking learners’ books or helping some learners as they worked on a given exercise. The board in front of the class was used most of the times either by the teacher himself or a learner responding to a teacher’s request to do a ‘sum’ on the board. The discussion with pupils focused on what was written on the board. Teacher’s questioning and probing, led the discussion. The learners responded either individually or they chorused the answers. In general, the written text on the board provided the basis for dialogue between the teacher and the learners. The procedure/algorithm and the general rules for solving certain mathematical problems/task were emphasised as they were displayed on the board. The language of instruction was Tumbuka, though in some instances it was interspersed with some English terms, for example ‘class’, ‘box’, ‘book’ etc.

The learners on their part participated through a number of activities and responses. Learners answered questions posed by the teacher; they wrote down exercises in their notebooks and did some of the work on the chalk board on request by the teacher. Learners were supported in these activities through teaching aids, such as, counters, sticks, stones etc. The lesson in Excerpt 5.2.1 highlights some of these practices in the grade one class.
The teacher advises learners to use sticks, he instructs and guides them in the addition sequence. Learners on their part, count sticks, put them on one side and count another set and put them on aside. Then, they put the two heaps together and count them; the resulting count is indicated in the box. The addition and counting process is facilitated by the sticks and the teacher guides the learners. Individual learners are invited to write numerals on the board. The teacher lets the rest of the learners observe how the numerals are written. The sequence of the numbers is another aspect that the teacher focuses on. Learners respond to the teacher’s questions as they count to a stated number. Some learners could not count beyond 15, while some were skipping some numbers in their counting.

Source of Knowledge

The teacher acted as the source of knowledge; he gave instructions, examples, explained, demonstrated procedures, and above all, he was the final assessor of the activities and work in the classroom.

Nature of Mathematical Knowledge

The mathematics learning practices in grade one involved learners matching directly the sticks, counters etc with the numbers, in their counting or addition or subtraction problems. The lesson (see Lesson 5.2.1) in previous section highlighted this aspect of the nature of knowledge. The learners manipulated the objects in order to arrive at desired or requested answers by the teacher. Further, classroom mathematics was linked to what the learners were familiar with in their community. The teacher introduced the counting, and the arithmetic operations in such a way that there was fun in the numbers and in the counting.

mathematical knowledge and epistemic practice

The first grade teacher introduced understanding of the mathematics knowledge in school in a similar manner to the community’s. He used the concrete materials as he introduced the concepts of number. The learners used their informal (community) ways to count (which the teacher also used). They were also made to gradually learn to arrange and produce knowledge in the school mathematics way. Thus, the first graders were allowed to work in a common epistemological ground. The teacher labeled the concepts with school mathematics terms, symbols and registers.
The next section looks at epistemic basis of mathematical knowledge phase is further explored in the grade six class of Nkunda primary school in detail.

5.3: Mathematics Learning Practices in Sixth Grade

This section has three parts; observation of classroom practices, researcher’s brief intervention in the class and selected learner’s mathematics practices in and out of school.

5.3.1: Mathematics practices in grade six class

Fourteen lessons were observed in grade six class during which the class learnt the following concepts:

i) place value, that is, reading and writing down of numbers greater than Ten Thousand (>10,000),

ii) factors: factors of numbers, common factors, highest common factors, lowest common factors, common multiples, prime factors of numbers, finding highest common factors using prime factors and revision of the section and

iii) fractions: fraction in diagrams, addition and subtraction, finding the lowest common denominator, changing from mixed number to improper fractions, and addition and subtraction of mixed and improper fractions.

The place value task took three lessons, factors took six lessons and fractions took seven lessons. Due to poor attendance by some learners, there was repetition of some parts of the lessons.

Sample lessons reported verbatim will shed some light. The full lesson 5.3.1 below on ‘writing fractions in their lowest terms’ highlights some of these practices in greater detail.

Lesson 5.3.1: writing fractions in their lowest terms

1. T: Today we will look at writing fractions in their lowest terms! When we are told to write fractions, we know that fractions have two figures one on top, the other the bottom. [Teacher wrote \( \frac{10}{25} \) on the board and pointing at the figure 10 he asked learners] What is this?

2. Ls: numeral,
3. Ls: number
4. T: Numerator – what is 10? [Teacher pointing at ‘10’ and saying numerator!]
5. Ls: It is a numerator
6. T: and what is this called? [Teacher pointing at ‘25’ in the given fraction]
7. Ls: dunomileta!
8. T: what has she said?
9. Ls: dumineta [Other learners laugh as they also try to say it their own way]
10. T: Tiyeni tipulike icho waku yowoya munyithu! (Listen to what your friend is saying!) What did she say? Say it again! Ok! it is called ‘denominator’ [Teacher wrote the term on the board] Now to find the fraction in its lowest terms what we use is prime numbers
   a. Lets find the lowest fraction of \( \frac{10}{25} \) [Then teacher proceeded to write \( \frac{10}{25} = \frac{2 \times 5}{5 \times 5} \)]
      What is common between these [Teacher was referring to \( \frac{2 \times 5}{5 \times 5} \)]
      taona makora tose?(Have you all seen?)
11. Ls: 5 [They also agree ‘eih!’]
12. T: 5 into 5
13. Ls: zero!
14. T: No! No! It is 1 Now 1 times 5 is 5 [Teacher writes \( \frac{10}{25} = \frac{2}{5} \) ] Pali number inyakeso iyo inga jila umu? (Is there another number that can go into? ..[Teacher pointing at 2 and 5]
15. Ls: yayi! (No!)
16. T: Ok! \( \frac{2}{5} \) is the lowest fraction
17. [Teacher writes \( \frac{9}{12} \) on the board] Who can do this? What are the prime factors of 9? [Teacher generates 3 x 3 with the help of the learners] What about 12, what are the prime factors of 12?
18. Ls: 6 x 6 [Other learners interject] aaah, aah Yayi (No): 4 x 3

19. T: What did we say about 6 and 4? These are not prime numbers!

So here we have \[ \frac{9}{12} = \frac{3}{4} \]

Here only 3 is prime and so we divide by 3.

So our final fraction will be \[ \frac{3}{4} \]

20. T: vinga suzya? (Is there a problem?)

21. Ls: yayi! (No!)

22. T: if I give you three and wafwapo kamoza or tubili mbwenu nikhowolenge! (...if you get one wrong then I will cane you!)

23. Ls: ah, a ticha! (aah teacher) [Learners protest the suggestion from the teacher, that if one gets a sum wrong he/she will be ‘caned’]

24. [Teacher writes an exercise on the board]

a) \( \frac{10}{15} \)  
b) \( \frac{4}{6} \)  
c) \( \frac{8}{20} \) 

25. T: Write these quickly [Learners fidget with their books looking for maths books and pencils/pens] Para wachelwa nipela tikumaking’ange chaa! (If you delay I won’t mark your book!) Remember to write the date for today! [Learners whisper to each other, others are counting using their fingers, others are checking ‘tables’ at the back of their exercise books, others show their work to their friends to check whether they are ok or not]

26. L: A ticha, kuti tisange answer apo tiku chita wuli? (Teacher, how do we find the answer there?)

27. T: You divide \( \frac{10}{25} \) by 5 like this

\[ \frac{10}{25} = \frac{2}{5} \]

5 into 10 is 2, then 5 into 25 is 5! Ok!

28. L: yes a ticha! (Yes, teacher!)
29. T: Copy the problems properly on the board! Mwaona umo nalembela ine pala? Namwe mulembe thene thene! (Have you seen the way I have written on the board? You should also write the same way!) Show your steps! Show your steps! Kuyuzing'a yili common- mwapulika! Bekani apo pa bodi! (Use the number that is common, look at the board!) I will mark the next 10 then I will stop! [Teacher moves around the class marking and checking learners books]

30. T: kwakhala ‘8’ minutes (8 minutes remaining)
31. Ls: a ticha, a ticha! (Teacher, Teacher) [Learners put up their hands, they would like their books to be marked!]
32. T: Kwakhala ‘5’!(5 minutes remaining!)
33. Ls: a ticha, a ticha! (Teacher, Teacher!)
34. T: Kwakhala ‘1’ (1 minute remaining) [Some learners stand and rush to the teacher with their books, they surround him, all eager to have their books marked!]
35. T: Ok! ,Ok,!, put your books down here! Let’s look at the board. Ruth come and do the first one!

36. [Ruth goes to the board to work out the problem $\frac{10}{15}$, she wrote ]

$$\frac{10}{15} = \frac{2}{3}$$

37. T: Uyobolenge, chete chete yayi! (Talk, don’t just write quietly, you should say 5 into 10 [Learners answer ‘2’] 5 into 15, [Learners respond, three] [The learner repeated what the teacher said, but she is barely audible, teacher dismisses her]. Ok the answer is $\frac{2}{3}$

38. T: Number two! Iwe! (you)

39. L: [A learner moves to the board and writes $\frac{4}{6} = \frac{2\times2}{3\times2} = \frac{2}{2} = \frac{3}{2}$]

40. Ls: Wazyola iwe! Yayi wateta a ticha! Wazyola! Lembe makora, three yize pasi!( You have reversed them, teacher, he is wrong, He has reversed the numbers. The three should come down) [The learner in front of the board, did not know what to rub, as other learners were saying ‘me teacher’, ‘me teacher’]
41. T: Iwe lemba makora, pulika ivo baku phalila banyako! (You write properly, listen to what your friends are saying) [The learner rubbed and wrote $\frac{2}{3}$]

42. T: Ok! Ghawumalilo, nijani wachitenge? (Now the last one, who is going to do it?)

43. Ls: ine a ticha, ine a ticha (Me teacher, Me teacher) [Many learners volunteer to do the sum on the board]

44. T: Ok, iwe (You)

45. Ls: Ine a ticha, Ine a ticha! (Me teacher, me teacher) [Other learners volunteer]:

46. T: Iwe tikati wuli – yuzi ma prime numbers! Munyake? Nijani wanga muvwilako! Ok, iwe (You! what did we say, use prime numbers. Now another one, who can help him? Ok you ) [Another learner goes to the board and writes $\frac{8}{20} = \frac{2 \times 2 \times 2}{2 \times 2 \times 5} = \frac{2}{5}$]

47. T: Iwe waona umutiku chitila! Wabeka? (You, have you seen how it is done, check! [Learner nods the head as he looks at the board]

48. T: Ok, tomorrow tizamupitilizya (we shall continue)

The mathematical practices as observed in detail are presented and analyzed in Table 5.3.1.

**Table 5.3.1: Mathematics practices as learners dealt with the sub topic writing fractions in their lowest terms**

<table>
<thead>
<tr>
<th>Category</th>
<th>Turns in which these occur or are used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogic aspects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- instructing i.e. explaining, giving work, examples, initiating etc</td>
<td>1, 4, 6, 8, 10, 12, 14, 17, 19, 24, 27, 29, 35, 37, 38, 42, 44, 46, 47</td>
<td>20</td>
</tr>
<tr>
<td>- learner support e.g. use of chalk board, teacher assisting learners</td>
<td>1, 29, 30, 32, 34</td>
<td>5</td>
</tr>
<tr>
<td>- learner participation e.g. answering questions etc</td>
<td>2, 3, 5, 7, 9, 11, 13, 15, 26, 36, 39, 40, 47</td>
<td>13</td>
</tr>
<tr>
<td>- teacher assessing learners’ work e.g.</td>
<td>19, 29, 30, 32, 34</td>
<td>5</td>
</tr>
</tbody>
</table>
marking, walking around
- regulatory talk e.g. stop noise, don’t copy etc
Source of Knowledge
Justification of Knowledge
Nature of knowledge e.g. use of definition, procedural talk, conceptual talk, enquiry, contextual talk

Analysis

The lesson was on the concept of fractions. Learners were taught a fraction as a part of a whole. The teacher tries to extend this concept. The lesson has six blocks or loops/stanzas. The teacher adopts a particular approach to introducing or instructing learners in the identified blocks. The first block appears at the beginning of the lesson (turns 1 to 10). During this loop, the teacher tries to find out if learners still remember the fraction concepts of ‘numerator’ and ‘denominator’. The teacher uses the board to focus learners’ attention. The teacher poses questions to learners to check if they remember the terms ‘numerator’ and ‘denominator’ (Turns 1, 4, 6, 10). The learners are not thinking about the numbers in terms of fractions. Instead their responses focused on the sign ‘10’ where the teacher was pointing. They gave answers such as ‘numeral’, ‘number’ (Turns 2 and 3), which were not necessarily wrong but the teacher did not comment on these, instead he reminded the learners that it was called ‘numerator’ (Turn 4).

The teacher proceeds to the sign 25 and asked learners what it was called. The learners were now able to recall though not accurately (in terms of term used). One learner said, “Dunomileta” (Turn 7), meanwhile other learners laughed. The teacher gives the correct term and writes it on the board for all to see. He requests all learners to say it aloud. The teacher is wholly in charge; leading and posing questions and directing the learning in class. The next loop the teacher introduces the new concept for the day/lesson. The teacher shows how a given fraction is reduced to its lowest terms (Turn 10). The teacher laid out the steps, writing each step clearly on the board. He involved
learners in dividing the numbers using the common factors. One learner responded that 5 divided by 5 is zero (turn 13), the teacher just gave the correct answer without involving more learners (Turn 14 and 15). The teacher introduced the topic/concept through outlining a procedure of reducing the terms to their lowest, terms.

The second example was done the same way (Turn 17 to 19), the teacher involved learners in answering questions leading to finding the lowest terms of the given fraction $\frac{9}{12}$. The teacher talked about prime factors of 9 which he got by posing questions to learners. The learners apparently did not grasp the concept of 'prime' as they gave answers such as 6 and 4 (Turn 18). The teacher concluded the second example, by indicating that only 3 was prime that is only 3 could be used.

The next loop of the lesson, the teacher gave the learners an exercise to do. The teacher gave three (3) problems, and attended to individual queries (Turn 26, 28), as he moved around the classroom looking at learners work and marking. As he looked at learners' work, he emphasized that they should present their workings and answers the way he did on the board himself (Turn 29). The last phase of the lesson, the teacher invited learners to the board to do the given exercise. The teacher requested Ruth (one of the learners) to do the problem. She was asked to do it the way the teacher did it, that is, soliciting for information from other learners. The procedural talk of the teacher was repeated by the learner (Turns 36 and 37). Learners, however, did not follow this request and simply wrote what they thought was right on the board without talking to the class.

A part from the academic aspects, the teacher also engaged in regulatory talk (e.g. see Turns 25, 29, 35 and 41). The teacher cautioned learners about writing quickly (turn 25) or copying the work properly from the board (Turn 29). The teacher advised learners about where to put their books and to look at the board. The teacher led the lesson; he did this through a total of 17 turns (see Table 5.3.2). He posed questions, he instructed where learners were not able to understand or follow what he wanted. He questioned (posed questions) till he got to the required answer.

The teacher's actions were reciprocated by the learners. The learners participated in the classroom activities through answering teacher's questions directly or through writing on the board. The learners answered the teacher's questions either individually or
through shouting in groups. In turns 2, 3, 5, 7 etc learners responded directly to the teacher’s questions. In turn 26 a learner posed a question to the teacher asking for an explanation on how the answer was found. The teacher, however, referred her to the laid out procedure on the board. The learners also participated by answering some problems on the board on request by the teacher (see Turns 36, 39, 40, 46)

The learners abstracted knowledge about fractions, the abstraction which arose from objects or experiences in their environment. This formed the common understanding of knowledge between community and school. The teacher, however, introduced or tried to extend this knowledge by bringing in the concept of equivalents or lowest terms. The learners at this stage were required to abstract not from experience in general, but from operations or mathematical structure established so far. It is this abstraction/understanding that was particular to common mathematical knowledge in school that caused difficulties to learners. Learners per se were able to think abstractively but the teacher’s approaches were not supportive of smooth development of this.

Lesson 5.3.2 focuses on other factors.

Lesson 5.3.2: Lowest Common Factor

1. T: Last time we were looking at what?
2. Ls: Sets! [Learners chorused the answer]
3. T: What name did we give numbers that when we divide this number there is no remainder? [Teacher wrote number 18 on the board and pointed at it as he poised the question]
4. Ls: 12
5. T: No
6. L2: 1 [The teacher said ok]
7. L3: 2 [The teacher said ok]
8. L4: 3 [The teacher said ok]
9. L5: 6, and other pupils mentioned 9 and 18 [The teacher accepted these as he wrote them on the board. He chose those to answer or give the next factor]
10. T: What are these numbers called? Tikati ni vichi agha ma numbers? (What did we say these numbers were?) [Teacher is speaking while pointing at the factors
written on the board. Learners put up their hands, and the teacher selects who to attempt an answer]
11. Ls: Factors
12. T: What about 24, what are the factors of 24? [Many learners put up their hands, and the teacher chooses who to answer as they generate the factors of 24]
13. Ls: 1, 2, 3, 4, 6, 8, 12, 3, 24 [The teacher writes on the board. He ignores wrong numbers given without enquiring about how a learner came up with such a number]
14. T: What is common been these two sets of factors?
15. Ls: 2, 1, 3, 6 [The learners generate/mention the common factors one at a time, again wrong answers are ignored]
16. T: what are these called?
17. Ls: Common factors! [Learners chorus the answers]
18. T: These are called “Common factors” – say it all!
19. Ls: “Common factors!”
20. T: [Teacher draws on the board two sets, containing members of ‘factors of 18’ and ‘factors of 24’

21. [Then teacher introduces new topic. He writes the following on the board, LOWEST COMMON FACTORS]
22. T: What are the factors of 21? [Teacher writes 21 on the board, many learners put up their hands, and the teacher picks one. He picked a non volunteer)]]
23. Ls: 1
24. T: Is she correct?
25. Ls: Yes [Some learners answer “yes”
26. T: Others? [Teacher meant other factors of 21]
27. Ls: 7, 3, 21 [With teacher leading, learners generated the factors, but there were
wrong figures given also e.g.6]
28. Ls: 6
29. T: Is he right?
30. Ls: Yayi aticha, wa buda! (No teacher, he has made a mistake) [Teacher did not
find out why learner gave 6 as a factor, he just proceeded to
31. write
   \[21 = 1 \times 21 = 3 \times 7\]
   On the board, indicating the factors as well as showing how they should be
written]
32. T: Now lets look at factors of 24 [The teacher writes 24 again. The factors
written earlier were rubbed from the board]
33. Ls: 1, 2, 4, 6, 8, 12, 24 [Learners shout the factors in a less orderly way. The
teacher cautions them by saying “One at a time!”]
34. T: Taluwapo vichi apa? (What have we forgotten here?) [Teacher is pointing at
the list, 3 was omitted]
35. Ls: 3!
36. T: You see what I did here. [Teacher was referring to \(3 \times 7 = 21\) and \(1 \times 21 = 21\)
case] Now do the same here for 24 and its factors
   \[3 \times 4\] (Learners respond, yayi!(No!) challenging their friends]
37. [Teacher writes on the board as learners suggest the factors
   \[1 \times 24, \ 2 \times 12, \ 6 \times 4, \ 3 \times 8\]
38. T: These are the factors of 24. Have you seen what we do? This is how we do it.
   Now I will give you an exercise, so that you can try to find factors of numbers in
your books. Get your books; [Learners fidget around, getting their books, others
looking around for pens. The teacher writes the following exercise on the board
“Write the factors of (a) 25, (b) 36, (c) 28” This is the order you should follow

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[ The teacher was referring to what was written on the board. Learners work on the exercise, talking among themselves as some looked behind where the researcher was seated.]

39. Ls: A ticha bopanga choongo aba! (Teacher these are making noise!)

40. T: No noise! I will mark only the first 10 books. If you are not amongst these, then you will mark your own work.

41. A ticha apa nilembe wuli? (Teacher here how will I write?)

42. T: Bona apa namu tangu chitila! (Check here, the way we did it) [Teacher refers learner to the work on the board. There is silence]

43. [Teacher moves around checking learners’ work. Surprised at some learners’ pace he says, “banyinu bamala, sono imwe na sono muchali kulemba date? (Your friends have finished, and you are still writing the date)]

44. [Learners keep checking the back of their exercise books; they were checking the multiplication tables. Some learners are asking their friends. Others are literally copying their friends’ work that has already been marked. Some pupils are seen counting using their fingers. There is some low inaudible noise. But it was difficult to pick up what they were saying to each other.]

45. T: Nyengo yamala! (Time is up!) [Learners rush to the teacher to have their books marked.] No, No! not now, its time up

46. T: Ok! Lets look at the board, mumene wayambila ka samu kamoza! Mabuku pelekani kuthazi, - many jimoza samu walemba olo zones! Ababalekenge kupeleka mabuku, niza muchonga chaa! Sono mose bekani kuno! (All this time you have just written one sum! Hand in your books, whether you have finished one or all. If you do not submit your book for marking, I will never mark your book. Now all of you look here) What are the factors of 25?

47. Ls: 1 T: Correct? Ls: Yes! T: Next!

48. Ls: 5 T: correct? Ls: Yes! T: next!

49. Ls: 25 T: correct? Ls: yes! T: next!

50. Ls: nanga 10? (What about 10?) [Other learners oppose!]

51. Ls: Awe! Yayi, a ticha wateta (No, no teacher, he is wrong)

52. T: what about 36? [Teacher meant factors of 36]
53. [Teacher and learners generate the following factors, with teacher leading, the learners responding according]
54. 1, 2, 3, 4, 6, 9, 12, 18, 36
55. Ls; 6 yunjila! (6 goes into it)
56. T: 17?
57. Ls: yayi, awe! (No!, No!)
58. T: Lets look at 28! What are the factors of 28?
59. Ls [With the teacher leading they generate 1, 2, 3, 4, 7, 14. 28 as factors of 28]
60. T: Is 3 a factor of 28?
61. Ls: awe, yayi! (No!) [Teacher does not explain why 3 is not a factor of 28- just ends at its not! He rubs it off the list]
62. T: Any other?
63. Ls: 28
64. T: 2 into 28?
65. Ls: 14
66. T: 4 into 28?
67. Ls: 7
68. T: 6 into 36?
69. Ls: 6! [Learners answer together, the teacher is using the board as a source/confluence of ideas, his and supposedly learners' ideas meet. Teacher and learners go through all the factors. Not all learners are participating; only a few are active]
70. T: Let's not forget this [Teacher was pointing at the board showing how the sums are done.] Remember when you get a sum wrong, you must make corrections!]
71. Ls: Yes! [Learners shout 'yes' at same time]
72. T: Monitor collect all the books for marking. [The teacher instructs the class monitor to collect the books. The lesson took longer than 40 min.]

The lesson began with revision of the previous lesson. In order to focus on the mathematical practices, specific attention was paid to the categories as outlined in Table 5.3.2.
Table 5.3.2: Mathematics practices in a lesson on factors of numbers in grade six class.

<table>
<thead>
<tr>
<th>Category</th>
<th>Turns in which these occur or are used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher instructing, i.e. explaining, giving work, giving examples, initiating learners into school habits, leading class with posing questions</td>
<td>1,3,10,12, 14, 16, 18, 22, 24, 26, 29, 32, 34, 36, 38, 48, 52, 56, 58, 60, 62, 64, 66, 68</td>
<td>24</td>
</tr>
<tr>
<td>Supporting learners e.g. use of aids like chalk board, and other teaching/learning aids, individual attention etc</td>
<td>3, 9,10, 13,20,22,31,32,37,42,46,69,70</td>
<td>13</td>
</tr>
<tr>
<td>Learner participation e.g. answering questions, going to the board to solve problems, asking questions, copying work, doing exercises etc</td>
<td>2,4,6,7,8,9,11,13,15,17,19,23,25,27,28,30,33,35,39,41,44,47,48,49,50,51,54,55,57,59,61,63,65,67,69,71</td>
<td>36</td>
</tr>
<tr>
<td>Teacher assessing learners work’s e.g. verbal responses, marking written work, watching what learners are doing etc</td>
<td>5,6,7,8,24,29,38,40,43,44,47,48,49</td>
<td>13</td>
</tr>
<tr>
<td>Regulatory talk or classroom management e.g. stop noise, one at a time, don’t copy from your friends etc</td>
<td>40,45,46,70,72</td>
<td>5</td>
</tr>
<tr>
<td>Source of knowledge – textbooks, teacher or other</td>
<td>3, 5, 13, 18, 20, 21, 26, 31, 34, 38, 43, 46, 60, 56, 64, 66, 68, 70</td>
<td>19</td>
</tr>
<tr>
<td>Justification of knowledge – is there any proof of solutions, verification etc</td>
<td>5, 6, 7, 8, 18, 27, 36, 54, 70</td>
<td>9</td>
</tr>
<tr>
<td>Nature of knowledge – as depicted through use of definition to introduce topic/concept, use of procedures, teaching steps, conceptual talk –teachers/learners focusing on conceptual development, contextual talk – whether lesson/concept is ground in local context Enquiry methods if used etc</td>
<td>3 – 11, 12 – 20, 21 – 31, 32 – 38, 46 - 70</td>
<td>5 loops or stanzas</td>
</tr>
</tbody>
</table>
Analysis of lesson

Just as the lesson on writing fractions in their lowest terms, there are discernible loops or blocks. The turns 3 to 11 focus on factors of 18, the next loop, turns 12 to 20 focus on factors of 24, then there is another identifiable episode (Turns 21 – 31) focusing on highest common factors. The teacher revisits factors of 24 in the loop, turns 32 to 38, but this time focusing on highest common factors, and finally the teacher and the learners go through the exercise which was given to the learners in class on the board.

In each of the loops, the teacher uses questioning technique, posing questions to learners. The first two stanzas/loops are revision parts of the lesson. The teacher looks at factors of number, a concept already introduced earlier. However, even the new concept is taught the same way, the teacher explains/describes what has to be learnt with the help of chalk and board work, and followed it up with questions. Even where the learners take charge of solving problems on the chalkboard, the procedures they use are the same.

In the first loop, the teachers’ exposition is about revising factors of numbers. He starts the lesson with a question about factors “What name did we give to numbers that when we divide by another number we get no remainder?” The learners, instead of answering the question gave ‘factors’ of 18 (Turns 4, 6, 7, 8, 11 etc). Learners later gave the answer (see Turn 11). The next loop of the lesson, the teacher writes 24 on the board and asks for factors of it. The learners ‘shout’ the factors one by one. The teacher approves the correct ones and ignores the wrong ones as he writes on the board. The teacher takes the opportunity to ask for the common factors between 18 and 24. The learners obliged and together with the teacher, they put the figures in the appropriate slots in the diagram. This led the teacher to introduce the concept of the day. This was in loop 21 to 31. As in the other stanzas, the teacher uses the same approach to deliver his lesson. He poses questions, which learners answer. The teacher does not bother, why some learners give unexpected answers for 6 (Turn 28). All the teacher asks is whether the learner is right or wrong.

The lesson on factors was introduced through the common mathematical knowledge of sets, learners were familiar with the concept of sets and from this concept the teacher introduced factors as sets of numbers obeying a particular rule. Learners in
this case were not expected to abstract from concrete materials or empirical knowledge, but were expected to abstract from operations or relations already established or abstracted. The concept of factors could be reduced or likened to pattern recognition in an addition or multiplication algorithm.

\[
\begin{align*}
1 & \text{ added } 24 \text{ times } (1 \times 24) \\
2 & \text{ added } 12 \text{ times } (2 \times 12) \\
3 & \text{ added } 8 \text{ times } (3 \times 8) \\
4 & \text{ added } 6 \text{ times } (4 \times 6)
\end{align*}
\]

The next stanza the teacher builds on this established knowledge to tackle or introduce the concept of ‘prime factors’. However, from the learners’ responses they did not grasp this concept.

5.3.4: Nature of common mathematical knowledge in school

The nature of mathematical knowledge in the grade six was projected as abstract. This was characterized by procedural talk, definition of terms, pattern recognition and in a few cases conceptual talk. The Lesson 5.3.2, showed that the teacher utilized procedural talk most of the time. In turn 10 the teacher laid out the procedure for reducing a fraction to its lowest terms. The teacher repeated this approach several times in the same lesson. Turns 17 to 19 and also turns 36 to 37, the teacher engaged in procedural talk. The talk by the teacher was one of initiating the learners through posing questions and the learners answering, and then the teacher acknowledging whether right or wrong. Similarly the teacher utilized the same approach in lesson (see Lesson 5.3.1) on ‘lowest common factor’, the loops turns 3 to 11, 12 to 20 and 21 to 31. The teacher poses questions and learners answer. Even where learners were called upon to do the problems on the board, they used the same approached that the teacher used.

The teacher utilizes the same method to ‘help’ learners to abstract the new concepts in the school mathematics way. That is, poses questions to the learners to which he already knows the answers to, engages in procedural talk, shows on the board how the work should be done etc. He does not follow up ‘wrong’ answers, which are indicators of how learners’ think arising from their experiences. A similar pattern when handling or extending common mathematical knowledge to new abstract levels is observed. The
Excerpts 5.3.2 and 5.3.3 below highlight some of the statements and approaches depicting the nature of common mathematical knowledge in school.

**Excerpt 5.3.2: Finding the lowest common denominator of a given fraction.**

4. [The teacher wrote \( \frac{1}{2} - \frac{1}{3} \) on the board]

5. T: How do we do this? How do you subtract one third from half?

6. Ls: One:

7. T: Is he correct?

8. Ls: Yayi (no):

9. T: What do you do? First remember you have to find the common denominator of 2 and 3. Of what?

10. Ls 2 and 3: [Learners said it in unison]

11. T: What is the lowest common denominator of 2 and 3?

12. Ls: Four!

13. T: Is he right?

14. Ls: Yayi a ticha (No teacher)

15. T: Who can help him?

16. Ls: six

17. T: Correct, then we write like this, remember?

\[
\frac{1}{2} - \frac{1}{3} = \frac{6}{6} \times \frac{3}{3} = \frac{2}{6} = \frac{3}{6}
\]

18. Ls: 3 a ticha (3 Teacher)

19. T: Then what do you do? Multiply 3 by 1 and put your answer here [Teacher showed the learners on the board where to put the numbers] How many times does 3 go into 6?

20. Ls: 2 [Learners chorus the answer]

21. T: Ok, then we have [Teacher continued with the problem on the board writing]

\[
\frac{1}{2} - \frac{1}{3}
\]
3 minus 2

22 Ls: 1 [Many learners at the same time]

23 T: Nipela yam ala (Then it is finished) Have you seen?

24 Ls: eeh! (Yes!)

The teacher wrote \( \frac{3}{6} - \frac{2}{6} = \frac{1}{6} \) on the board and asked learners on how to carry out the subtraction problem. The solution to the problem was outlined on the board in order for learners to emulate. The teacher involved learners in finding the common denominator between 2 and 3. The teacher was not concerned with wrong answers (Turns 6, 12). The learners mentioned one and four, but the teacher just asked the rest of the learners whether the suggested answers were right or not. The teacher was concerned with laying out a correct procedure (see Turns 17 and 21). As stated before learners were familiar with the concepts of fractions, but in oral and practical sense. It was part of common knowledge, except in school, the concepts were labeled and depicted in written symbols. The symbols were subjected to manipulation or algorithmic procedures, that is, the abstraction took on from different premises rather than empirical phenomena, the abstraction was based on system of relations or 'designed' procedures for achieving short forms of the same or facilitating addition, subtraction, multiplication or division algorithms. The teacher tried to introduce the common mathematical knowledge (knowledge of fractions) understanding of school, where learners had to add, subtract, multiply or divide.

The entire discourse was based on the work on the board. The learners were to observe and take in the steps to resolve the tasks. The new concepts were dependant on the previous concepts, without knowledge of the previous concepts or objects, a learner would have difficulties comprehending the new set of 'rules or procedures'. The entire exercise was done on the board with the teacher instructing the learners on how to carry out a subtraction problem in fractions.
The next Excerpt 5.3.3 shows the teacher guiding the learners along the nature (mode) of the concepts.

**Excerpt 5.3.3**

1. **T:** Sono bekani apa! (Now look here!)
   [Teacher wrote $1 \times 3 = 3, \ 2 \times 3 = 6, \ 3 \times 3 = 9, \ 4 \times 3 = 12, \ 5 \times 3 = 15, \ 6 \times 3 = 18$ on the board]

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 $1 \times 4 = 4$, as pupils respond giving the multiples following the pattern of the example – multiples of 3].

3. **Ls:** $2 \times 4 = 8, \ 3 \times 4 = 12, \ 4 \times 4 = 16, \ 5 \times 4 = 20, \ 6 \times 4 = 24$ [Teacher wrote these on the board, as learners gave the answers. Teacher was asking, 3 times $4 = ?$, then next ni vichi (is what)? Ok 4 times $4 = ?$ and so on]

4. **T:** These are the first six multiples of 4 which are 4, 8, 12, 16, 20, 24.

5. **T:** Sono tiyeni tisange (Now lets find the) multiples of 5, what are the first multiples of five?

6. **Ls:** $1 \times 5 = 5, \ 2 \times 5 = 10, \ 3 \times 5 = 15, \ 4 \times 5 = 20, \ 5 \times 5 = 25, \ 6 \times 5 = 30$ [Teacher leads the generation of the multiples, shouting $1 \times 5 = ?$ as learners contribute]

7. **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 [Again teacher with learners generated the following; $1 \times 6 = 6, \ 2 \times 6 = 12, \ 3 \times 6 = 18, \ 4 \times 6 = 24, \ 5 \times 6 = 30, \ 6 \times 6 = 36$]

Teacher started by asking the learners to look at the board. He wrote a pattern of $(1 \times 3), \ (2 \times 3), \ ...$ and so on, generating multiples of 3. As learners were looking at the pattern and the numbers, the teacher introduced the concept of ‘multiples’. He reinforced the concept with another example of multiples of 4. He then went into steps (procedures) of how to generate the multiples (lines 2 and 3). He gave two more
examples, multiples of 5 and 6, generating the multiples with learners on the board. He reminded learners about knowing the math multiplication tables by heart.

The teacher used the board to let learners focus their attention on it. He used it extensively to show patterns and procedures for working out the ‘sums’ and presentation of final work. He involved learners by letting them answer ‘one word’ answers such as ‘3 times 4’. The teacher went through multiples of five and six as a way of establishing the pattern/procedure for obtaining multiples. 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 but hoped that learners would see the pattern and deduce for themselves. There was an assumption that this was apparent. The approach was similar to other previous lesson(s). The teacher presented the procedure to be used to deal with the tasks.

In other instances, the teacher focused on the concepts to be grasped. The lesson closest to this is given below in Lesson 5.3.3 on place value and reading of large numbers.

**Lesson 5.3.3: place value and reading of numbers greater or equal to 10,000**

1. T: How many digits has this number [Teacher wrote 44075 on the board for all learners to see]
2. Ls: 5 a ticha (5 Teacher)
3. T: What does this figure stand for in the number? [The teacher is pointing at the second 4 in the number]
4. Ls: Hundred
5. Ls: Yayi a ticha, ine a ticha (No teacher, me teacher) [The rest of the learners, disapprove, they are putting up their hands to give the 'correct' answer]
6. T: Munyake (Another person)
7. Ls: Ine a ticha, ine a ticha (Me teacher, me teacher) [Learners were calling for attention from the teacher to give the answer]
8. T: Ok, Iwe Mbonyiwe
9. Mbonyiwe: Thousand
10. T: What about this figure here? [Teacher was pointing at ‘7’ on the board for the number 44075]
11. Ls: Tenth
12. T: Is she right?
13. Ls: Yayi a ticha (No teacher)
14. T: Ok, Iwe yezyako (Ok you, you try)
15. Ls: Tens
16. T: Good, who can read this number aloud?
17. Ls: Four-hundred and forty thousand, seventy five
18. Ls: Yayi a ticha wabuda (No teacher he has made a mistake)
19. T: Ninjani wamуввileko? (Who can help him?) Ok iwe (Ok you)
20. Ls: Forty-four hundred and seventy-five
21. Ls: Yayi, a ticha wabuda (No teacher, she is wrong)
22. T: Imwe bana mwati mupulika? (You children, do you listen?) Munyake, ok
Yakobe (Another one ok Yakobe)
23. Yakobe: Forty-four thousand and seventy-five
24. T: Ok, mose pamoza, tiyeni welezyanipo (Ok, altogether say it)
25. Ls: “Forty-Four Thousand and Seventy-five”
26. T: Good [Teacher writes the number 1000700 on the board] Who can read this
number aloud?
27. Ls: Ine aticha, ine a ticha [Learners compete for chance to speak]
28. T: Ok, Iwe musungwana (Ok you girl)
29. Ls: One million seven hundred
30. T: Is she right?
31. Ls: eeh (Yes)
32. T: Ok, Who can read this aloud [Teacher writes 206,740 on the board] Ninjani
wayezyeko? (Who will try?) Iwe (you)
33. Ls: Twenty-six thousand and seventy-four hundred
34. T: No, Munyake, ok iwe Timothy you try
35. Timothy: Twenty and six thousand, seven hundred and forty
36. [Teacher goes step by step asking for the place value of each of the figures on the
board. He wrote 206740 and with the help of the learners puts the place value on
top of each figure]
Then writes the place value meaning separately for each in addition format

2 0 6 7 4 0

We have Two Hundred and six Thousand, Seventy Hundred and Forty. Do you see? Mwabeka mose? (Have you seen, all of you) Any questions? Now I will give you an exercise to do. Take your books

Table 5.3.3: Mathematics practices as learners dealt with the sub topic place value and reading of large numbers

<table>
<thead>
<tr>
<th>Category</th>
<th>Turns in which these occur or are used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogic aspects</td>
<td>1, 3, 8, 10, 12, 14, 16, 19, 24, 26, 28, 30, 32, 34, 36</td>
<td>15</td>
</tr>
<tr>
<td>- instructing i.e. explaining, giving work, examples, initiating etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- learner support e.g. use of chalk board, teacher assisting learners</td>
<td>1, 3, 10, 26, 32, 36, 38, 39</td>
<td>8</td>
</tr>
<tr>
<td>- learner participation e.g. answering questions etc</td>
<td>2, 4, 7, 9, 11, 13, 15, 17, 18, 20, 21, 23, 25, 27, 29, 31, 33, 35</td>
<td>18</td>
</tr>
<tr>
<td>- teacher assessing learners’ work e.g. marking, walking around</td>
<td>12, 19, 22, 30, 40</td>
<td>5</td>
</tr>
<tr>
<td>- regulatory talk e.g. stop noise, don’t copy etc</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Source of Knowledge</td>
<td>3, 10, 16, 24, 26, 32, 36, 37</td>
<td>8</td>
</tr>
<tr>
<td>Justification of Knowledge</td>
<td>24, 32, 36</td>
<td>3</td>
</tr>
<tr>
<td>Nature of knowledge e.g. use of definition, procedural talk, conceptual talk, enquiry, contextual talk</td>
<td>1 – 25, 26 – 31, 32-36, 39-</td>
<td>4 loops</td>
</tr>
</tbody>
</table>

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Analysis of lesson

The lesson was a continuation of the previous lesson on writing and reading of numbers. The numbers were of 10, 000 and above. The teacher started the lesson by writing the number 44075 on the board for all to see (Turn 1). He posed questions to learners to ascertain if they understood the position of the figures in the number. One learner attempted (Turn 4), but got it wrong. The teacher did not follow up the wrong answers he proceeded with the lesson. The correct answer was given (Turn 9) and he moved on to the next digit on the number (turn 10). He acknowledged the correct answer and gave positive feedback (Turn 16). The next part of the loop, the teacher focused on reading the number learners attempted (Turns 17, 20, 23) and once one succeeded, the teacher ended the stanza. Rather than explaining what was taken into account when reading a number, the teacher asked the whole class to say it aloud, as if that in itself explained or made learners understand.

The learners in the loop just analyzed were participative but only to an extent. Learners answered the teacher’s questions (Turns 2, 4, 7, 9, 11, 15 etc). A few learners, (about a third of the class) were active in a class. The active learners responded to the teacher’s questions and also interjected when a wrong answer was given by their colleague(s) (Turns 5, 7, 13, 18, 21). The teacher got surprised when some learners gave wrong answers (an indication of lack of understanding (Turn 22). The teacher asked if the children listened or not. Nonetheless, he did not explain the concepts, but focused on the final answers.

The next given example was approached the same way, that is reading out aloud the number 1 000 700 (Turn 26). The selected learner got it right first time and the teacher moved to the next problem or task. The teacher then asked learners if they could read the number 206, 740 (Turn 32). A similar pattern as before was repeated. The teacher rejected the wrong attempts (Turns 34, 35). The teacher tried to establish the place values of each of the figures on the number (Turn 36). The teacher went through the process step by step and provided the correct way to read the number. He involved the learners in stating the place value for each of the positions that the figures occupied. The board as stated earlier was used extensively to show and to focus learners on it.
The teacher tried to focus on understanding of place value for each of the figures in the numbers as a way of explaining why numbers were read or written the way they did. Although the lesson was about reading and writing numbers larger than 10,000, the discourse also focused on the concept behind the readings, that is the place value. The teacher in this lesson tried to focus on the place value and thus engaged in conceptual talk.

Number and numeration were also concepts that were widespread in the community. Learners were not accustomed to counting up to such large numbers, but the lesson was extending their knowledge of number and numeration. The notation and symbols were partly familiar to the learners as the local currency utilized thousands in some notes (For example, K100, K500, K1,000, K5,000, K10,000, K20,000, K50,000). The teacher utilized a similar style of teaching except this time he posed concept probing questions. The epistemic practices in terms of pedagogy were the same in all the lessons observed.

5.3.2: Source of Knowledge

The source of the mathematics learnt was first and foremost the teacher. The teacher occupied a place between learners and the books. The teacher was the sole provider of the mathematics knowledge in class. The teacher initiated, led and guided the learners in all aspect of their mathematics activities in class. Within the observed lessons, interaction between and among learners as source of knowledge was almost nonexistent. Further, school mathematics knowledge was predominantly theoretical (was introduced without links to the concrete objects/activities) and hence the teachers and text books held the knowledge for the learners at this level.

5.3.3: Justification of Knowledge

It was rare to find learners question or ask questions about whether some statements needed proof or validation. Out of the fourteen (14) mathematics lessons observed, the classroom discourses did not include a proof or validation of the concepts. There were cases of verification or reverse back procedures to check the concept(s), but it was assumed in all the lessons (at this level) that the truth or validity of the concepts/content was self evident or it was thought not necessary to prove or validate any of the concepts under consideration as excerpt 5.3.4. exemplifies:
Excerpt 5.3.4.

1. T: What are the first six multiples of 4? What do we begin with? We began with one! So [Teacher begins to write $1 \times 4 = 4$, as learners respond giving the multiples following the pattern of previous example.]

   $2 \times 4 = 8$, $3 \times 4 = 12$, $4 \times 4 = 16$, $5 \times 4 = 20$, $6 \times 4 = 24$ [teacher writes as learners give the answers.]

2. Ls: 4, 8, 12, 16, 20, 24

3. T: 3 times 4 = ?, then next ni vichi? (What's next?) Ok 4 times 4 = ? etc

   These are the first six multiples of 4 -- 4, 8, 12, 16, 20, 24. Sono para tachita divide by 4 agha ma number tikusanga vichi? (now we divide by 4, these numbers what do we get?) 4 into 4?

4. Ls: 1

5. T: 4 into 8?

6. Ls: 2

7. T: 4 into 12?

8. Ls: 3 [The teacher continued till 24.]

   Teacher asked for the first six multiples of 4 (line 1). The teacher led the discourse as he wrote on the board for all to see. Learners provided the answers as he kept asking '1 x 4' '2 x 4', and so on (line 2). Then, the teacher asked learners what would happen if he divided the multiples by 4. Together with the learners, they came up with the set; 1, 2, 3, 4, 5, and 6 (lines 3, 4, 5, 6, 7 and 8).

   The teacher after generating the multiples with the learners, he showed how the original set he used for generating the multiples of numbers could be obtained back. He used division algorithm as a multiplicative inverse. This was done to convince the learners that the result they got was correct. The idea however, did not come from the learners, but the teacher.

   Similarly in the case below the teacher converted mixed numbers into improper fractions as a way of verification or checking the 'correctness' of the sums based on the algorithm carried out
Excerpt 5.3.5.

T: Now even here this is not proper! So tikuchita thene (This is what we do) we divide so that we change from improper to mixed number. [The teacher was referring to 19/3]

\[
\frac{19}{3} = 6\frac{1}{3} \text{ (mixed number)}
\]

Now if we wanted we can change this back into improper fraction. Then this is what we do!

\[
6\frac{1}{3} = \frac{19}{3}
\]

What do we do?

With pupils working out 6 x 3 and adding 1. This is what we do!

The teacher gave the learners an improper fraction. He explained the procedure for putting it into a mixed number. Then he demonstrated the procedure for taking it back as an improper fraction. Again it was the teacher’s idea to verify, the learners took it as presented. The teacher verified some of the knowledge which could be checked.

The section below focuses on common mathematics in context that was familiar to learners. This was an intervention programme in the same class by the researcher which lasted for six lessons.

5.4: Mathematics Practices in Context

The researcher took over the class, and was given the topic ‘Ratio’ to teach. Instead of teaching the topic, in the formal way, the class was given three tasks. The tasks given to the class were set in local context (see Figure 5.4.1). Gerdes (1985) purports that setting a task in a real context leads to an understanding that mathematics may be used to ‘transform reality’. Contexts are used to create confidence in learners by developing their capacity to understand, develop and use mathematics. The tasks were explained to the groups in Tumbuka and English languages while essential information was written on the board for those who had difficulties with reading. Further, learners were put into groups to attempt the tasks but they worked individually. Before embarking on the tasks learners were asked to go through the problems to ensure that everyone understood the task.
**Figure 5.4.1: Tasks in context**

<table>
<thead>
<tr>
<th>TASKS/ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 1 (Group 1 and 6)</strong></td>
</tr>
<tr>
<td>Two girls, one older than the other were playing a jumping game. When the younger one jumped 2 times, the older one jumped 3 times. The young girl was called Mbonyiwe and the older one was called Nthongase.</td>
</tr>
<tr>
<td>a) When Mbonyiwe jumped 4 times, how many times did Nthongase jump?</td>
</tr>
<tr>
<td>b) Nthongase jumped 15 times, how many times did Mbonyiwe jump?</td>
</tr>
<tr>
<td>c) The total number of jumps of Mbonyiwe and Nthongase was found to be 30. How many jumps did each one of them make?</td>
</tr>
<tr>
<td><strong>Task 2 (Groups 2 and 5)</strong></td>
</tr>
<tr>
<td>Tiyezye and Mateyo were drawing water and pouring it into a large bucket. The water was going to be used for making bricks. Tiyezye had a 3 litre bucket while Mateyu had a 5 litre bucket.</td>
</tr>
<tr>
<td>a) When Tiyezye drew 9 litres of water, how many litres of water did Mateyo draw?</td>
</tr>
<tr>
<td>b) Mateyo on the second day drew 30 litres of water. How many litres did Tiyezye draw?</td>
</tr>
<tr>
<td>c) On the last day a total of 64 litres of water was drawn. How many litres did Tiyezye alone draw? - What about Mateyo? How many trips did they make to the well?</td>
</tr>
<tr>
<td><strong>Task 3 (Groups 3 and 4)</strong></td>
</tr>
<tr>
<td>There were two villages; Chiduli and Dambo. Chiduli had four families while Dambo had eight families. This meant that Dambo village had twice as many families as Chiduli. In 2005 there was famine and the government brought ‘relief maize’ to distribute to the two villages.</td>
</tr>
<tr>
<td>a) The maize was distributed fairly though there was limited stock. Dambo village received 10 bags. How many did Chiduli village receive?</td>
</tr>
<tr>
<td>b) The second time Chiduli village received 30 bags. How many did Dambo village get?</td>
</tr>
</tbody>
</table>
| c) The third time around, the government brought 24 bags. How many did each
The performance of the learners was as given in Table 5.4.1.

**Table 5.4.1: Showing results of three tasks on ratio**

<table>
<thead>
<tr>
<th>Task</th>
<th>Number of learners successful</th>
<th>Number of learners =46</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>9</td>
<td>16</td>
<td>56.3</td>
</tr>
<tr>
<td>b)</td>
<td>8</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>c)</td>
<td>2</td>
<td></td>
<td>12.5</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>8</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>b)</td>
<td>7</td>
<td></td>
<td>43.8</td>
</tr>
<tr>
<td>c)</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>9</td>
<td>14</td>
<td>64.3</td>
</tr>
<tr>
<td>b)</td>
<td>8</td>
<td></td>
<td>57.1</td>
</tr>
<tr>
<td>c)</td>
<td>2</td>
<td></td>
<td>14.3</td>
</tr>
</tbody>
</table>

There were six groups, four groups had eight learners each, and the other two had seven learners each.

Sample solutions from a select few in class (see appendix A)

**5.4.1: Learners' reaction**

The learners were organized in 6 groups but they worked individually on the tasks and efforts at encouraging them to work in groups did not yield any positive results. The start to the problem was characterized by doubts and unpreparedness to the task(s). It took a long time to get learners to show their solutions. The first and second part of the task in each of the tasks were attempted well, with slightly over 50 percent of learners doing so correctly. The third part of each task was poorly attempted. In all the three parts in each of the six groups nearly all did not attempt it, despite adequate time being given to them. The Excerpts 5.4.1 and 5.4.2 highlight the learner's apprehensions, doubts and unpreparedness at attempting the tasks.
Excerpt 5.4.1
1. Ls: Teacher, now here how are we going to find the answer? [Learner was referring to task 2]
2. R: Do you understand the question? What does it say?
3. L: Teacher, it says; if this one draws 9 litres, then what about this one? [The learner was pointing at the work in her exercise book]
4. R: This bucket contains how many litres?
5. L: 5 litres
6. R: So how do you find the litres for Mateyo?
7. Ls: Tell us sir! [At this stage, all group members were listening in, and many joined in asking the researcher to explain how]
8. R: No! Do it on your own, the way you have understood the question!

Learners were visibly unprepared for the tasks. They did not know what to do and thus asked the researcher to explain how they were going to find the answer (line 1). They asked the researcher to tell them how to do it, “Tell us sir” (line 7), almost signifying that their task was to write down what the teacher says and how he wants it. Meanwhile learners confirmed that they understood the task but they did not know how to begin the task. Learners wanted to have a template for answering the question.

Learners were unsure of themselves in terms of solution processes and also about what to write in the exercise books as they did not have examples to draw from. Meanwhile they understood the problem but could not figure out how to resolve it. Despite the encouragement to the learners to use all available ways known to them to resolve the situation or solve the problem they felt they could not write such solutions in their exercise books as one learner asked, “Teacher, do we write in the books?” They were not sure of the acceptability of their ‘solutions’. They wrote down only final answers.

The third part of the task posed difficulties to almost all learners. This type of problem required formulation of a mathematical relationship. The basic ratio was given, but the problem required a painstaking tedious process in terms of manipulation of numbers. For example “The third time around the government brought 24 bags. How
many did each village receive?” (see Figure 5.4.1). The problem could be resolved from acting out or referring directly to the empirical experience which required a painstaking tedious process in terms of manipulation of numbers. Learners, however, were accustomed to this kind of abstraction of mathematics which was derived from concrete or experiential knowledge.

On the part of learners, their hesitation was due to not knowing what to do or the approach to use. Those that managed to get the solution, however, could not explain how they got their answers. The Excerpt 5.4.2 highlights their difficulties;

**Excerpt 5.4.2**

1. R: How did you find the answer?
2. L1: Here teacher, if one gets 10 bags then there will get 20
3. R: Why?
4. L1: Teacher because these are many!
5. R: Why didn’t you give these 18 bags?
   (L1 gets stuck, couldn’t explain and another learner took over)
6. R: How did you find this?
7. L2: Teacher, these are many – then they are the ones who will get many
8. R: What about 9 and 15?
9. L2: Teacher I counted. When here they get 4, then there they get 8, when here they get 8, then there they get 16, then it’s 8 plus 16 is 24!

Learners could not answer precisely how they obtained their answers. Though, many learners got the first part of the problem right, they could not explain why and how they resolved it. As one learner put it, “These are many” (line 4), but could not go beyond this in his explanation. For example, when asked why they did not offer 18 bags to the second village (line 5) he withdrew from the dialogue. However, in lines 7 and 9 the learner attempted and tried to explain the pattern and how she arrived at the solution. None of the learners referred to the ratio as a relationship that had to be kept in order to resolve the task successfully.
5.5: Other Tasks on Ratios

Learners were further given tasks on ratios as given in Figure 5.5.1

Figure 5.5.1: Tasks in ratio

1. Share 40 sweets between Pamela and Maya in the following ratios
   a) 3:5   b) 2:3

2. Write the following ratios in their lowest terms
   
   (a) ΔΔ Δ
   (b) Δ Δ

3. Convert and write the ratios in their lowest terms
   a) 1m : 25cm   b) 400 mm : 60cm

The learners performed as shown in Table 5.5.1 below

Table 5.5.1: Showing results of learners attempts at problems on ratio

<table>
<thead>
<tr>
<th>Question</th>
<th>Number of learners resolving task out of 42</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a)</td>
<td>23</td>
<td>54.8</td>
</tr>
<tr>
<td></td>
<td>b)</td>
<td>66.7</td>
</tr>
<tr>
<td>2. a)</td>
<td>10</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>b)</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>c)</td>
<td>26.2</td>
</tr>
<tr>
<td>3. a)</td>
<td>08</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>b)</td>
<td>14.3</td>
</tr>
</tbody>
</table>

The questions were attempted by all learners present in class. On this particular day 42 learners were present.
5.5.3: Learner reaction/performance

The first problem was attempted well but the other two were poorly done. The first one had over 50 percent successful attempts. The first part of the second question was done well, that is translating from objects to numbers, but after that, learners had difficulties putting ratios in their lowest terms (see sample solutions of learners). The third problem proved very difficult for learners. The first part required learners to convert meters to centimeters before tackling the simplification of the resulting ratio. The conversion was a problem and so too was the reducing of ratios to their lowest terms. A sample of the learners solutions are presented below;

Sample solution

The learners were asked to 'share 40 sweets between Pamela and Maya in the given ratios, one being 3 to 5 (3:5). A solution from one learner in her book was as follows;

Learner solution

3 : 5

*** ***** = 8

******* *********** = 16

"(she continued this pattern till …)

"*

***/***/****  ********/******/*****

***/***  ******/*** = 40

15 25

The learner's strategy was to arrange the 'concrete' objects in a particular way. Keeping the ratio in mind, the learner used the tallies and counted, and counted on to get the answer or the total along the row. She got the sum correct. When she reached 15 and 25 the total came to 40.

Similarly in the second question, the learners did the first part well

□ □ □ □ □ □ □ □ □ □ □
4 to 8 (4 : 8) was written without difficulties as it had direct link to the context (concrete materials). However, simplifying this while maintaining the ratio was problematic. What appeared to be the missing link was the idea that the relationship could be maintained but by using smaller numbers. This pattern was replicated when learners dealt with measurements, relationship(s) between different measuring units. When learners were asked to convert from one unit of measure to another learners found the exercise difficult. The Excerpt 5.5.1 highlights some of their difficulties;

Excerpt 5.5.1

1. R: The task requires us to change/convert the meter into centimeters. How many centimeters are in a meter?
2. Ls: 30, 50, 100 [Learners shout answers at the same time]
3. R: Which is the correct answer? Give me the meter ruler, ok now how many centimeters does this have?
4. Ls: aah, a ticha ine, (aah, teacher me) Hundred! [Learners now see and they shout at the same time 'hundred']
5. R: [Then, 100 : 25, was written on the board] How do we simplify this – or how do we write this ratio in its simplest form? This relationship in its lowest terms?
6. Ls: Don’t know!
7. R: What is common between the two figures 100 and 25?
8. L4: 5
9. R: How many times does 5 go into 100 and how many times does it go into 25?
10. L2: 20, there! (pointing at 100)
11. R: And into 25?
12. L3: 5
13. R: Then what we have is 20 : 5 Is this the lowest ratio form?
14. L1: Yes teacher!
15. R: Why do you say that?
16. L1: because now there is 5
17. R: Is there a number that can go into 20 and 5 without leaving a remainder?
18. L4: No teacher! One! Three!
19. R: okay, okay, one at a time, what number can divide 20 and 5 without a remainder?
20. L2: Palije (There is none)
21. L3: Teacher 5!
22. L4: No! No!
23. R: Why did you say five?
24. L3: 5 into 20 is 4 Ah no teacher I am wrong!
25. R: No! finish it, what about 5 into 5?
26. L2: One! No! (holds hand on mouth, with an expression of mistake committed)
27. R: Yes! It is one! (teacher wrote 4 : 1 on the board)

The learners appeared to guess or do a trial and error hoping or relying on the teacher to bail them out (lines 8, 18, 20 and 26). They sounded out their 'solutions' to the teacher for approval or disapproval. They did not particularly seem to have the basis or the explanation for their answers. The learners abstracted mathematical knowledge easily which was directly matched with practical realities. The difficulty learners had was abstracting from action or operations that is from relations that did not have empirical referents.

The teacher in the lessons looked at earlier (see Lessons 5.3.1, 5.3.2, 5.3.3) focused on this aspect of mathematical knowledge. The mathematical knowledge's understanding in school is different, as it is meant to introduce learners to other tools for solving problems especially formal mathematics ones.

5.6: Learner Mathematical Practices in the two settings

This section focuses on the practices of the learners as they deal with mathematics outside and in-school. The four selected learners in group discussions were engaged in tasks exploring their mathematical practices in different contexts.
Learners were given the following tasks in Tumbuka. The tasks were explained in Tumbuka and English. The context was four (4) learners talking informally with the researcher outside the classroom.

Figure 5.6.1: Problems on sets set in the community for discussion with selected learners

```
"In a village there were eleven (11) people who grew various crops for food and for commercial purposes. The following people grew maize and tobacco; Nyirenda, Tembo, Zimba and Nyirongo, while Munga, Phiri and Banda grew maize and cotton. Mr Thole and Mr Ziba grew maize only while Mr Hara grew tobacco only and Mr Lungu grew cotton only.

1. How many people grew maize?
2. How many people grew cotton?
3. How many people grew Tobacco?
4. How many people grew Groundnuts?
5. How many people grew Cotton and Tobacco?"
```

The learners after listening to the information attentively responded correctly to all the questions posed after the problem statement. After the oral task, learners were engaged in a discussion.

Excerpt: 5.6.1 Learner discourse on sets

1. R: Sono mulichitapo zibalo za mutundu uwu? (Have you done such sums in school before?)
2. Ls: yayi! (no) [Learners respond together]
3. R: Nanga ma sets muli chita? (What about sets, have you done sets in school?)
4. Ls: Eeh! (Yes!) [Learners respond in chorus]
5. R: Sono izi nima set yayi? (Now, is this not about sets?)
6. Juliet: Yayi! (No!)
7. R: What is a set? [No response! Silence]
8. Kayange: zama set tikachita (We have done sets) intersection – pala pali tunthu uku na uku, sono volingana ndivo tikuyika apa –pakati.(When there are some common things in this group and this group we put them here in the middle)

9. Zodzi: Zinyake tika chita za union (We also did ‘Union of sets’) para vose villi pamoza mbwenu ni union (That is you put everything together)

10. R: Sono izi tachitanga, nazo zama set yayi? (Now, what we have been doing, is this not about sets?) [Silence, puzzlement, not sure]

11. Soko: Tilije sambila! (We haven’t learnt about this)

The task was on sets, involving the concepts, universal sets, intersection sets, empty set and union of sets. The learners after listening to the information attentively responded to all the questions successfully. There was no hesitation on the part of learners. The solutions did not reflect the set notations as given in school setting.

When asked, the learners refused ever having done such problems before but admitted they had learnt about sets. The researcher asked further if what they had just done was about sets, to which they indicated that they were not sure. They meanwhile went through the concepts learnt in sets: intersection and union and responded (Turn 11) “We did not learn such”.

The learners denied doing such sums at school yet they did. When pressed, they recalled that they had done. They were amused that there were similarities between the concepts in the two contexts. The concepts were the same except they were not formally called sets in the community. The learners did not realize they were dealing with sets while in the community. They comfortably resolved all the questions arising out of the tasks/problem as they had the picture (goal) of the problem and the situation.

Nonetheless, the learners could not explain adequately why they did not use their ways in the classroom. As one learner put it, “We did not learn”, it appeared for learners the two areas were separate at least in their verbal explanations. Learners were also given the following task on a different day and asked to solve it. Informally the four learners were asked how they would go about solving it. This was a follow up of class lessons

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Figure 5.6.2: Tasks on ratio for discussion in groups

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Share 28 mangoes between Hana and Diwa in the following ratio 2 to 5</td>
</tr>
<tr>
<td>b) Find the basic ratio of Hana’s mangoes to Diwa’s given that out of 42 mangoes, Hana received 18 while Diwa got 24.</td>
</tr>
</tbody>
</table>

The discussion with the four learners is presented in Figure 5.6.3 below.

Learner discourse 5.6.3: After part (a) of ratio question on mangoes

1. R: What is the question asking for?
2. Soko: Sharing mangoes
3. Kayange: But sharing how?
4. R: That’s a good question, how are the mangoes to be shared?
5. Soko: Me I don’t understand ratios
6. R: Who can explain to her what ratio means
7. Zozi: How to share something
8. R: Give an example
9. Zozi: Like when people are not sharing equally, but one gets more
10. R: Is he right? Is that how you understand ratio?
11. Soko: Yes, sometimes one can get more or sometimes less
12. Juliet: Lowest ratio, you can get 1 to 1
13. Ls: [Other learners disagree] No!
14. Juliet: But we got in class
15. Kayange: That was not sharing
16. R: Could it be explained in terms of sharing?
17. Soko: No
18. R: Why not?
19. Soko: Because then they will get the same
20. R: But can’t you share equally?
21. Zozi: But teacher that was finding lowest ratio
22. R: We can share equally, then you get 1 to 1, you can also share amongst 3, 4 or more people. Like here we are five (5) we can share seven mangoes. The girls
can have two mangoes each and us, we get one each. You understand? But in our task, how many people are sharing?

23. Kayange: Two
24. R: How are they sharing the mangoes?
25. Juliet: When one gets two, the other one will get five?
27. Zozi: When Hana takes two, Diwa will receive five mangoes
28. R: How many does each get of the 28 mangoes?

[At this stage, the learners pick their pens and paper and start working out the solution. After a while, one learner breaks the silence]

29. Zozi: Hana gets …
30. R: Wait for your friends to finish. Have you all finished?
31. Soko: No teacher
32. R: Ok, now what did you get?
33. Zozi: Hana gets 8 mangoes and Diwa gets 20
34. R: Other answers
35. Ls: We got same
36. R: How did you do it?
37. Juliet: I just worked it out. I shared out the 28 mangoes
38. Soko: You give Hana 2, then give Diwa 5, then again give Hana another 2 and Diwa another 5, until the mangoes are finished.

Analysis

In the figure above (Learner discourse: 5.6.3) learners toil with the idea of ratio. The concept of sharing is alluded to and used, but it does not have the same meaning to the learners as they use it in the community. Ratio is quantitative relation between two amounts showing the number of times one value contains or is contained within the other.

Soko mentions sharing while Kayange appropriately asks a question about how the sharing is to be done. Soko says that she does not understand ratios (Turn 5). Soko and Zozi confirm misunderstanding in ratio (Turn 9 and 11). The two learners thought in ratios where sharing was involved, it meant not sharing equally, either one got more or less. Nonetheless, even for the learner who said lowest ratio (Turn 12), it did not mean,
he understood it as being equal, but it was 1 to 1. All the learners had misconception of the ratio(s) (Turns 13, 14, 15, 17, 19 and 21))

Learners pick up the idea of sharing in terms of ratio (Turns 25 and 27), and they thus embark on the problem (Turn 28). The learners approach the task using the informal way such as ‘physically’ sharing out the mangoes in the given ratio (Turn 37 and 39). Though ratio was a mathematical statement showing relationship between two or more amounts showing the number of times one value contained another, learners handled it based on a link to the sharing of mangoes. When it came to solving, they did it in the same way it would be done ‘if mangoes were physically shared’. The learners’ solutions showed that in place of ‘real’ mangoes, tallies or dots were used to depict the same. This clearly showed that their nature of thinking was still empirical.

The second part of the task was problematic from the start. The everyday concept of sharing may have confused the learners, but it was a common approach of giving out items in the community. The learners had the concept of sharing, including sharing equally. The concept of ratio, as encountered in school, employed ‘new’ understandings different from the community usage.

Discussion on the second problem “Find the basic ratio of Hana’s mangoes to Diwa’s given that out of 42 mangoes, Hana received 18 while Diwa got 24” is presented in Learner discourse 5.6.4.

**Learner discourse 5.6.4: Discourse on part (b) of the ratio problem**

1. R: How do you do this one?
2. Kayange: Teacher is it not 2 and 5 … its given
3. R: No, this is a different problem. How do you find the basic ratio? How did they start sharing for Hana to get 18 and Diwa 24. How do you find that?
4. Ls: [Learners remain quiet]
5. R: What’s the problem?
6. Ls: Teacher its difficult, how to know how they started
7. R: The ratio of Hana’s to Diwa’s is 18 to 24, now how do you reduce this to its lowest terms? Where there will be no common factor between them
8. Zozi: Sir, we subtract?
10. Juliet: No divide, like we did in class
11. Soko: Divide with what?
12. Kayange: What is common
13. Soko: Like what?
14. R: You have done factors, what is the highest common factor between 18 and 24?
15. Kayange: Six
16. Zozi: Six!
17. R: Ok, six goes into 18 and 24. How many times in 18?
18. Ls: 3
19. R: And in 24?
20. Ls: Four!
21. R: So what’s the basic ratio or lowest ratio?
22. Soko: 3 to 4

Analysis

The learners got stuck in this second problem as the learner discourse above highlights. First, one of the learners (Kayange) thought the ratio was the same as the previous question (Turn 2, that is, 2 to 5). But the researcher explained that it was different and helped to clarify the task/problem. The learners understood the problem, but were at a loss as to how to resolve it (Turn 4, 6 and 8). The learners then got into a guessing game (Turn 8 and 10) trying to remember their classroom work. The terms “lowest term”, “Common factor” may have triggered the idea of division from the learners. Juliet said, “divide like we did in class”. The problem was resolved as taught in class, using the highest common factor between the two numbers 18 and 24, and using it for division to obtain the lowest terms of the ratio (Turns 15, 16, 18, 20 and 22).

Learners got stuck in this particular problem, as they did not appear to have a way of finding the basic ratio. They were able to obtain the “mangoes” for Hana and Diwa, given a basic ratio of 2 to 5 in the first part of the problem. However, in the second part, the basic ratio is what they needed to find and they had no idea of ‘de-constructing’ the
'final' ratio of 18 to 24 to its basic terms, using their informal ways. The school mathematics knowledge came to their aid.

Though the situation appeared like depending on the context, learners invoked appropriate knowledge forms for the setting further analysis of the tasks showed that, the task on sets and the ratio part (a) have a one-to-one correspondence between the objects and the numerals. The empirical phenomena under consideration, of crops and farmers, and mangoes to be shared between Hana and Diwa, could directly be matched with the resulting numerical relations. In the case of crops and farmers, for example, for the question, "How many people grew tobacco?" learners had to find the people who grew tobacco and then count them to find the number. To find the number of people who grew cotton and tobacco (union of the two sets), learners listed or mentally found the people who grew cotton only, then those who grew tobacco only, and counted these up to find how many grew both. Similarly, in the sharing of mangoes, learners, 'shared out' the mangoes by counting as per 'instructions' of the problem: seven mangoes to Diwa for every two given to Hana. The tasks could be visualized and manipulated mentally, or with the help of physical aids or marks on paper.

The second part of the problem on ratio, did not offer a similar case of direct match with empirical phenomena. While the learners understood the tasks, it was difficult to 'visualise' how the 'original sharing' could have started. Trial and error was an option, but learners did not use it. The understanding of common mathematical knowledge in school (common factors) was brought in but it did not have direct bearing with empirical phenomena. The algorithm could have been carried out with any numbers, and in this case without reference to Hana and Diwa's context.

5.7: Summary
An overall summary of mathematics learning practices/behaviours the first grade and the sixth grade are presented in Tables 5.7.1 and 5.7.2. Some sample indicative statements and activities of the sub themes are shown under the general categories of pedagogic practices, source of knowledge, justification and nature of knowledge. The frequency tells the prevalence of the attribute. Language of instruction was another aspect that was noted.
Table 5.7.1: Mathematics learning practices in grade one at Nkunda Primary School

<table>
<thead>
<tr>
<th>Theme</th>
<th>Indicative statements / activity (sample)</th>
<th>Frequency</th>
<th>Language</th>
<th>Source of Knowledge</th>
<th>Nature of knowledge</th>
<th>Table 5.7.2 shows the pattern of mathematics practices in grade 6.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pedagogical aspects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher’s role</td>
<td><strong>Instructs; explains, gives work, exercises, examples</strong></td>
<td>270</td>
<td>Tumbuka</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-introduction/initiation</td>
<td>“This is how we write”, “This is what we do here”, “At school we do not insult”, “Don’t make noise”, “If you want to talk, put up your hand”, “we don’t play in class”, “stand up haven’t you seen the visitor”, demonstration of procedures, “walk in a straight line”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-learner support</td>
<td>“bring your books here for marking”, “start a song ...” “use the sticks you have ..” “Count the stones ..” use of aids e.g. stones, sticks, cards etc</td>
<td>230</td>
<td>Tumbuka</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-learner participation</td>
<td>“Answer the question .”, “Write in your books”, “Come to the board “, “Teacher do we write this “ “Use sticks for counting” “ Me teacher..”</td>
<td>280</td>
<td>Tumbuka</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-evaluation/assessment</td>
<td>“Do this exercise ...”</td>
<td>70</td>
<td>Tumbuka</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-regulatory talk</td>
<td>“Don’t fight, I will come and whip you”, “stop noise, you will be punished”, “I will beat you”, “Use pencil or I will chase you from class” “You sit down when writing”, “Kneel down here, you have come late”</td>
<td>210</td>
<td>Tumbuka</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.7.2 shows the pattern of mathematics practices in grade 6.
Table 5.7.2: Mathematics learning practices in grade six

<table>
<thead>
<tr>
<th>Theme</th>
<th>Indicative statements / activity (sample)</th>
<th>Frequency</th>
<th>Language</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogic aspect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher’s role</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-introduction/initiation</td>
<td>Instructs; explains, gives work, exercises, examples e.g. “This is how we write”, “This is what we do” ...</td>
<td>50</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td></td>
<td>“One at a time, do not shout!”, “Noise, you!” etc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-learner support</td>
<td>e.g. “What is your problem”, “Explain your difficulty” etc</td>
<td>150</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td>-learner participation</td>
<td>e.g. “Let me try”, “Teacher, should we write in our books” etc</td>
<td>210</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td>-evaluation/assessment</td>
<td>Exercises given/markd every lesson e.g. “Hide your work, don’t show others”</td>
<td>180</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td>-regulatory talk</td>
<td>e.g. “Stop noise”, “Don’t copy from your friends”, “Why are you late? You stay outside” etc</td>
<td>8</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td>Source of Knowledge</td>
<td>Teacher and mathematics textbooks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Justification of Knowledge</td>
<td>Teachers alluded to this aspect of knowledge</td>
<td>2</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
<tr>
<td>Nature of knowledge through approach to concepts e.g. by</td>
<td>e.g. “These are known as ...”, “What do you notice here?”, “Look here ...”, “This is what you do/write”, “Follow this ...” “Who remembers how to do this?”, “Look at the board ...” “What are these numbers called?”, “What is common between these two sets of factors?”, “What are multiples?”, “Do you remember what we said ..?”, “Have you seen ...” etc</td>
<td>680</td>
<td>English</td>
<td>Tumbuka</td>
</tr>
</tbody>
</table>
Learning Practices

The Tables 5.7.1 and 5.7.2 present summary of learning practices in first grade and the sixth grade. The tables show that the indicative statements in the lessons observed. In grade one the lessons were characterized by introductory statements or statements meant to initiate learners into a new practice. This appeared 270 times, which was an average of 27 times in each lesson. Thus, such statements as “This is how we write”, “Do not make noise”, “and put up your hand”, “Walk in straight line” etc were repeated several times. The learners were supported in their new learning environment. Even as the teacher initiated or introduced ‘new’ concepts or knowledge he adopted certain ways of making it easier for learners to cope. The teacher gave feedback timely, thus statements such as “Use the sticks you have”, “Count the stones …” all alluded to this aspect. The teacher also advised learners to use objects or materials that they were familiar with, such as, sticks, stones etc. In order to relax or call for order in class, the teacher initiated a song, where learners sung along.

The learners participated in the learning process through a number of ways. Learners either answered teachers’ questions or they wrote/answered teachers’ given exercises in their books. Using sticks or stones or any given aid learners physically manipulated these in counting. Some learners were requested to go in front of the class to perform a task or solve a problem on the board. The teacher evaluated learners’ work verbally or through marking of their exercise books. This was a daily occurrence which took place once or twice in a given lesson. The learners visibly enjoyed this aspect of time (feedback). The ‘ticks’ in their books were cherished.

The discourse in the grade one class focused on regulations in class and school. Learners were constantly reminded about good behaviour and social etiquette. From time to time the teacher corrected the behaviour of some learners as exemplified by such statements as “Don’t fight, I will come and whip you”, or “I will beat you”, “I will chase you away from my class”, “Kneel down here” etc. The talk also focused on cautioning learners on various forms or ‘bad’ behaviour. The teacher spent a considerable amount of time on appropriate social and academic skills needed in school.
In the sixth grade the teacher's instruction was also mostly characterized by explanations, giving work, giving examples, exercises, marking learners' work, demonstrating procedures, writing on the board etc. The chalk board was used extensively. The prevalence of statements indicating initiation of learners into expected classroom behaviours are drastically reduced compared to the grade one class.

Learners in the sixth grade also participated in the classroom activities by copying work from the board, writing down exercises in their note books, answering questions from the teacher, answering questions on the chalkboard etc. The learners were supported in their learning by the teacher through individual attention. The teacher also supported the learners by providing feedback (marking their books). The teacher's authority and class management skills were demonstrated through the teacher's class control of the class. This was exemplified through statements such as, "Stop noise", "Don't copy from your friends" etc. The incidences of regulatory talk in this class decreased in number compared to the first grade class.

In the grade six class the teaching and learning practices re-enforced the nature of the mathematics projected, as the teacher focused on giving instructions and examples of the procedures to be followed (e.g. see Lessons 5.3.1, 5.3.2, 5.3.3 and Excerpts 5.3.1, 5.3.2). On the basis of instruction and examples(s) learners were expected to pick up ideas of what to do when given particular type of questions or problems. The examples gave a template for use in future cases of similar type of problem(s). The teacher introduced some concepts through 'pattern recognition' (e.g. see Excerpt 5.3.4). From a given pattern or behaviour of numbers, learners discerned a concept being taught or being brought to the fore. Learners dealt with such numbers maintaining the pattern or with the pattern in mind identified the missing numbers etc. Some concepts were introduced through definition of terms. The teacher defined the concept and instructed learners on how to handle it.

Source of knowledge

The teacher initiated and supported a series of things to do in the classroom. The teacher was the go-between the text book and the learners. The pattern of teaching continued even in the first graders class, the source of knowledge was the teacher who led in all aspects of teaching and learning. The teacher was the bridge between the textbooks
and the learners. The teacher initiated the mathematical concepts, and directed how far learners had to go, what they were to do etc. The learners only referred to textbooks directly when asked to by the teacher, and it was to do a chosen exercise in the textbook. The source of mathematical knowledge in the class remained the teacher and the textbooks.

Justification of knowledge

In the first grade the teacher presented work closely to what learners were used to in the community. In the community knowledge was rarely subjected to proof. In the sixth grade the mathematical knowledge was verified. The learners followed the examples and if the final answer was checked and marked, it never occurred to the learners that it could need proof or justification. In a few cases the teacher verified some procedures and solutions (e.g. see Excerpts 5.3.4 and 5.3.5), but even in these cases, the procedure did not amount to proof.

Nature of knowledge

In the first grade the teacher introduced school mathematics alongside the learners' community ways. The discourse was focused on labeling the concepts that learners already had and the teacher formalised the learners' knowledge. He utilized aids, such as sticks, stones as he introduced the school terms. The classroom talk was characterized by such statements as, "This, we write like this", "This is what we call a set", "you count these", "Remove four ..." etc.

In the sixth grade however, the indicators of some of the approaches, such as introducing a lesson through definitions, "This is what is meant by ..." or through pattern recognition through such statements as, "What do you notice here?", or straight teacher exposition of the concepts, "These are known as ..." The lessons were largely characterized by 'procedural talk'. Though there were some elements of continuity in the epistemic practices as far as knowledge forms are concerned, what was dominant now were relations between numbers without direct reference to empirical phenomena from which they arose.

The practices at the two levels grade one and grade six were slightly different in terms of nature of mathematical knowledge. In the first grade, the numeracy practices involved direct matching with objects in counting and in simple addition and subtraction
(e.g. see Excerpt 5.2.1). The learners were manipulating the counters, stones, sticks, body part (fingers) etc as they learnt the concepts of counting, addition and subtraction. Later in grade six, visibly absent were the objects (the aids) for carrying out the algorithms using the four operations; addition, subtraction, multiplication and division. Instead, the learners and teacher dealt more with logical and mathematical structures. However, learners continued using their body parts especially fingers to help in their algorithms (albeit unofficially). Mathematical knowledge in school was characterized by manipulation of numbers without direct reference to the objects. The lesson(s) were self-contained or based on previous taught lessons. (see Lesson 5.3.1 5.3.2, 5.3.3). This projection of mathematics went hand in hand with the adopted teaching and learning approaches.

Thus, from foregoing the mathematical knowledge understanding from the community and in school was different. The first grade teachers introduced mathematical knowledge in the school’s way through written symbols and terms. The teacher works within the epistemological basis of the learners’ everyday knowledge. The learners count physically the objects; either counting on or removing some (see section 5.2.1). This is a direct extension of the learners' orientation as the learning of number in the community involved or was accompanied by finger gestures. However, more than this the teacher has to label or introduce written symbols. Mathematical knowledge in grade six however, was characterized by manipulation of numbers without direct reference to the objects. The lesson(s) were self-contained and were mainly based on previous taught lessons.

In the first grade the teacher used concrete objects and thus, worked in the learners’ epistemological mode. However, in the grade six class the teacher presented mathematical knowledge as content and procedures. The starting points for some concepts were empirical experiences or were situations that could be related to concrete objects. There was an element of re-contextualising school mathematics knowledge to bridge with the everyday concepts. At this stage there was a hybrid of practices, that is, the empirically driven knowledge forms and the theoretical type appeared to blend as learners utilized either of the practices to deal with the tasks at hand. (e.g. see ratio tasks 5.4.1)
However, the teacher was not interested in the everyday knowledge system, and thus and only encouraged formal school systems. The other discourse type of mathematical knowledge was purely theoretical and learners had to deal with the new practice. The teacher led the discourse, utilizing the chalkboard extensively. Depending on the context learners invoked appropriate knowledge forms for the setting. Given a mathematical task outside school, learners used their everyday practices and when confronted with the same in school they struggled to present school practice(s).

The next chapter discusses these epistemic practices in detail looking at the context, and the contact points for everyday and school mathematical knowledge.