CHAPTER 5
UMHLANGA TARGET LESSONS: ANALYSES OF WORKSHEETS
AND THE LESSONS

The previous chapter provided an overall picture of the school setting and the nine lessons observed. In this chapter, I narrow the scope towards lessons in which the everyday or non-mathematical were summoned, namely, Lessons 1, 2, 7, 8 and 9. I discuss each of these lessons in detail, drawing in the learners’ engagement and responses to activities dealt with during the lessons. These details provide the basis for addressing research question number 2 for the study: how do learners act and argue in the face of mathematical activities which incorporate the everyday?

Learners engaged these activities within a classroom environment in which they interacted with their peers and the teacher. In Chapter 2, I argued that Bernstein’s notion of framing can be used to explain the teacher-learners relationship in the classroom, and also pointed out that framing hinges on two discourses: the regulative and the instructional. As Bernstein clarifies:

Further, any given framing positions the acquirer in an embedded pedagogic discourse. Rules of social order, relation and identity are embedded in rules of discursive order (selection, sequence, pace, and criteria). The first [rules] we have called regulative and the second instructional discourse.

(Bernstein, 1990:108)

In other words, Bernstein views an acquirer (a learner in this case) as operating within a within a regulated environment both in terms of content (instructional discourse) and in terms of acceptable behaviour (regulative discourse). With respect to these lessons I therefore focus not only on the inculcation of mathematical skills but on the inculcation of acceptable societal values and behaviour as well. What motivates this focus is the recruitment of the everyday in the mathematics lessons: Is the everyday recruited so that
it may serve as a vehicle towards the mathematics or as a basis to reflect on or start conversations relating to non-mathematical but significant social values?

In order to make more sense of the way learners engage activities in these lessons, I am compelled to take a step back and begin by focusing on the activities themselves. As highlighted in the previous chapter, the premise for choosing these lessons is that they are characterized by a blurred boundary between mathematics content and the everyday (i.e. weakly classified). In the course of analyzing the activities, I will argue that putting them under a single category (of weakly classified activities) conceals some significant distinctions which may impact the way learners engage them. In this regard, Bernstein’s construct of weak classification does not offer a language sufficiently concrete to describe these distinctions.

In Chapter 2 I introduced both Dowling’s notions (descriptive domain and public domain) and those constructed through this study (authentic/inauthentic and near/far categories) as useful theoretical tools to complement Bernstein’s construct of classification in analyzing tasks which incorporate the everyday. I encountered limitations though, in my attempt to use Dowling’s notions in Bulelwa’s class.

Firstly, the tasks in this classroom could not be viewed as descriptive because the mode of expression used in the tasks did not suggest a mathematical bias. For example, none of the tasks used letter symbols. Secondly, the tasks could neither be categorized as public because the qualitative differences in the tasks would be concealed. For example, the use of contexts such as flower petals, AIDS and ancient societies in mathematics tasks are all aspects that characterize the public domain nature of the tasks. However, I needed a language by which I could reflect on the different ways in which learners could relate with these different contexts. It is for this reason that Dowling’s notions are not used as analytical tools in this chapter. Instead, I complement Bernstein’s framework with the close-far and authentic-inauthentic framework, described in Chapter 2.
This chapter is divided into two main sections. In the first section I analyse activities used for Lessons 1, 2, 7, 8 and 9. This analysis will be based on the following:

1. The visible features of the worksheet
2. The drawing in of the everyday and
3. The categorization of activities according to the near-far and authentic-inauthentic framework.

The second section of this chapter provides a detailed account of each lesson and an analysis of the events in the lessons. In analyzing these lessons, I will focus closely on the way in which the teacher manages the everyday aspects of the activities in class and the way in which learners respond to these activities in class.

5.1 ANALYSING THE WORKSHEET

5.1.1 The nature of tasks
Activities in these worksheets were recruited from the following everyday contexts: ancient societies, AIDS and flower petals. This section intends to highlight and distinguish between items that made mathematical demands (focused on the mathematics) and items which did not (focused on non-mathematical everyday demands). Some items are unambiguously mathematical, for example, those requiring learners to perform calculations. Others are clearly non-mathematical, for example, tasks requiring learners to discuss the causes of AIDS. There are other items whose category was not as clear-cut. These are activities that required learners to provide a written explanation of their calculations. Given that learners in Bulelwa’s class are second language speakers of English and the written account was expected to be in English, it was necessary to reflect critically on this matter. I first highlight both the shortcomings and the strengths of categorizing these written accounts as mathematical. I will then highlight why I, nevertheless, categorized them as mathematical.
Non-mathematical nature of providing written accounts:

A task in which learners are required to perform a mathematical operation (like adding, differentiating or integrating) can be regarded as unambiguously mathematical as it requires some knowledge of mathematics. However, a task that requires a learner to describe the operation in the learner’s additional language may not easily be regarded as mathematical. Writing or talking about a calculation places a different demand on learners from performing a calculation itself. This is more so for learners at Umhlanga High whose dominant language is not English. As implied by Setati and Adler (2002), a second language speaker negotiates three linguistic hurdles in order to make sense of mathematics: mother tongue, the language of learning and teaching and mathematical language. A learner who, for example, fails to communicate a mathematics procedure (in spite of having performed it correctly) may be deemed mathematically incompetent. Yet, such a learner’s incompetence may be more linguistic than mathematical.

Mathematical nature of providing written accounts

Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, Olivier and Human (1997) suggest that sharing one’s thought about a mathematical procedure is an important aspect of learning mathematics. In engaging the question “Is there a trade-off between understanding and skill?” Hiebert et al (1997:06) suggest that, “If students are asked to work out their own procedures for calculating answers to arithmetic problems and to share their procedures with others, they will necessarily be engaged in reflecting and communicating”. Cobb captures these not-obviously-mathematical engagements in his notion of sociomathematical norms. These are classroom actions and interactions that are specific to mathematics. He draws a very useful distinction between these norms and what he terms social norms. The latter, writes Cobb (1998:34), are not specific to mathematics but apply to any subject matter area. The new South African curriculum considers an ability to communicate ideas as one of the key outcomes to be achieved by a mathematics learner. These arguments suggest that communicating (writing and talking) is not necessarily or exclusively mathematical. It qualifies as mathematical if it references mathematics.
There are thus some merits and demerits in regarding learners’ communication of ideas in a mathematics class, as either mathematical or non-mathematical, particularly in a language that is not their main language. In order to categorize these items, I turned to data and observed the way in which Bulelwa viewed the learners’ submissions. My interest was on whether she marked learners incorrect as a result of linguistic errors or whether she focused more on the mathematical idea the student intended to communicate. Learners’ written submissions to items (a) and (b) (in Figure 4.8 in page 93) used for Lessons 7 and 8 (which required descriptions of procedure) did not contain any significant grammatical errors. It was therefore not possible to observe, from these particular items, the extent to which language determined the correctness or incorrectness of a response. However, on account of the way in which she assessed the focus group, during Lesson 8, on item (g)*; it appears that Bulelwa did not regard the fluency in English as a significant factor in assessing learners. For example, learners’ response to this item consists of some grammatical errors like the sentence ‘by abstaining sex’ and ‘eating health food’, yet she assessed them as correct (signified by a ‘right’ tick). Therefore, Bulelwa did not consider learners’ limited linguistic capabilities in English as a factor upon which to evaluate the learners’ responses. Her intention for including items that required learners to describe seems to have been mathematical; and this motivated my basis for categorizing these items as such.

It is on the basis of this discussion that I have categorized some items as making mathematical demands and others as making non-mathematical demands.

**The categories**

Below are three tables drawn from going through each of the three worksheets used in lessons incorporating the everyday.

---

* These items/activities were non-mathematical in nature. However, the point being made here is that the substance of the answer and not the usage of English, mattered more in Bulelwa’s assessments of learners’
Table 5.1 Mathematical and non-mathematical demands made by worksheet (Figure 4.1) used for Lessons 1 and 2

<table>
<thead>
<tr>
<th>ACTIVITY REQUIRED</th>
<th>CATEGORY OF ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematical</td>
</tr>
<tr>
<td></td>
<td>requirement</td>
</tr>
<tr>
<td>Choosing a topic</td>
<td></td>
</tr>
<tr>
<td>Reading about a topic</td>
<td></td>
</tr>
<tr>
<td>Discussing the contents of the worksheet</td>
<td></td>
</tr>
<tr>
<td>Writing a summary of what was read</td>
<td></td>
</tr>
<tr>
<td>Presentation of a group’s discussion</td>
<td></td>
</tr>
<tr>
<td>Asking questions</td>
<td></td>
</tr>
<tr>
<td>Assessing the presentation</td>
<td></td>
</tr>
</tbody>
</table>

The worksheet used for Lessons 7 and 8 (see figure 4.8) demanded of learners to complete and describe patterns. Even though a ‘description’ may not be mathematical, ‘description of a mathematics pattern’ is premised upon some knowledge of mathematics. There were other demands, such as stating the causes of HIV/AIDS and ways to prevent the spread of HIV/AIDS; these were considered non-mathematical. Though not reflected in the worksheet, there was an additional item Bulelwa asked learners to engage. It read:

*What is the percentage of people of people suffering from aids related diseases around the world in the year 2000?*

I categorized it as an item which makes mathematical demands. This information is summarized in the table below.

---

responses.
Table 5.2 Mathematical and non-mathematical demands made by worksheet (Figure 4.8) used for Lessons 7 and 8

<table>
<thead>
<tr>
<th>ACTIVITY REQUIRED</th>
<th>CATEGORY OF ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematical</td>
</tr>
<tr>
<td></td>
<td>requirement</td>
</tr>
<tr>
<td>Finding a pattern and describing the pattern</td>
<td>✓</td>
</tr>
<tr>
<td>Finding a pattern and describing the pattern</td>
<td>✓</td>
</tr>
<tr>
<td>Completing the table</td>
<td>✓</td>
</tr>
<tr>
<td>Performing a calculation and explaining the answer</td>
<td></td>
</tr>
<tr>
<td>Performing a calculation and explaining the answer</td>
<td></td>
</tr>
<tr>
<td>Explaining the transmission of AIDS</td>
<td></td>
</tr>
<tr>
<td>Suggesting ways to prevent the AIDS transmission</td>
<td></td>
</tr>
<tr>
<td>Calculating the percentage of AIDS sufferers</td>
<td></td>
</tr>
</tbody>
</table>

The worksheet used for lesson 9 (see figure 4.9) demanded of learners to bring flowers to class, count the petals, observe and describe the pattern and then name the pattern. Counting and describing the pattern are mathematically demanding tasks. However, bringing a flower to class and naming the pattern are not mathematically demanding tasks. Naming a pattern in this case, mainly required learners to recall that the pattern they observed was a Fibonacci sequence, which they had encountered in previous lessons. The table below summarizes the categorization of tasks as presented above.
Table 5.3: Mathematical and non-mathematical demands made by worksheet (Figure 4.9) used for Lesson 9

<table>
<thead>
<tr>
<th>ACTIVITY REQUIRED</th>
<th>CATEGORY OF ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematical requirement</td>
</tr>
<tr>
<td>Bringing a flower</td>
<td>Non-mathematical requirements</td>
</tr>
<tr>
<td>Counting the petals</td>
<td></td>
</tr>
<tr>
<td>Observing the pattern</td>
<td></td>
</tr>
<tr>
<td>Describing the pattern</td>
<td></td>
</tr>
<tr>
<td>Naming the pattern</td>
<td></td>
</tr>
</tbody>
</table>

From analyzing these three worksheets, it is apparent that mathematical activities are ‘diluted’ with a substantial amount of the non-mathematical. For Worksheet 1, all activities make non-mathematical demands. It is thus weakly classified in relation to mathematics. For Worksheet 2, more than half the items make mathematical demands. In spite of its reference to the everyday, the demands in the worksheet are mainly mathematical. Worksheet 3 is equally balanced in terms of the demands it makes.

Overall, however, across all three worksheets there are 11 items making non-mathematical demands and 8 items making mathematical demands. Thus, for these three worksheets, there is a balance in favour of items that make non-mathematical demands on learners.

5.1.2 Visible features of the worksheet

Eric Love and David Pimm (1996:371) observe: “But the core element of a mathematics text is the use of written words and other symbols” (my emphasis). A common visible feature of these worksheets is the use of C2005 terminology. In all the worksheets, there is a specification, appearing in bold letters, of “phase organizer” and the “programme organizer”. A phase organizer is a broader context, theme or everyday
reality to which tasks in the worksheet bear relevance. In this regard, Worksheet 1 draws from a context of Culture and Society, Worksheet 2 draws from the AIDS context whilst Worksheet 3 draws on Nature. The programme organizer specifies this mathematical focus of the worksheets. Thus, number patterns is the mathematical focus of the three worksheets. In looking at the visible features of the three worksheets, my main aim is to see the extent to which the ‘other symbols’ are visible.

Except for the tables and numbers in Figure 4.1.9 (page 93) and Figure 4.1.10 (page 94) the worksheets are written almost entirely using everyday symbols. In particular, there are no logograms (mathematical signs), alphabetic symbols and pictograms, symbols conventionally employed in mathematics (Pimm, 1987:141). The visible features of these worksheets do not distinguish them as mathematical.

The low content of symbols used exclusively in mathematics and the specification of phase organizers suggests a desire to make the worksheet accessible to non-mathematics specialists. In terms of its visible features, the worksheets are not insulated from the everyday; they are thus weakly classified in this respect.

5.1.3 Drawing in of the everyday
The relevance of these worksheets for the study is the observation that they are used as vehicles to draw in the everyday. In each of the worksheets, the context is not mentioned in passing. The worksheet opens up with setting the scene and highlighting the way in which the mathematical content of number patterns is housed within the context. Note, for example, the way in which this is done in these three worksheets.

Extract from worksheet (Figure 4.1) used in Lessons 1 and 2

Since the beginning of time people have used different numbers and numerical patterns. Different cultural groups around the world developed number patterns relevant to their environments and needs. Most of these numerical patterns were developed more than 2000 years ago, although the way in which it was written down was very different.
In the introduction of number systems in different ancient groups, there seems to be some form of justification to learners on the relevance of the context to the learning of these number systems.

Extract from worksheet (Figure 4.8) used in Lessons 7 and 8

Mathematicians have studied number patterns for many years. It was discovered that there are links between mathematics and our natural environment and sometimes events occurring in our societies. For this reason an understanding of algebra is central to using mathematics in setting up models of real life situations.

The worksheet draws on the relations between the mathematics, natural environment and events occurring in our societies. It also suggests to learners that what they study in the mathematics classroom is in line with the practice of mathematicians.

Extract from worksheet (Figure 4.9) used in Lesson 9

This activity aims to show that:

- There are links between mathematics and our natural environment
- Mathematics is useful in describing patterns in nature

With some brevity, this worksheet is quite explicit, though not elaborative, on mathematics as a tool to describe patterns in nature.

What emerges from the three worksheets is that:
1. Mathematics is linked with the environment: it is not an island.
2. Mathematics can serve as a tool to engage the environment.

As a result, in these lessons, the justification for teaching mathematics is not recruited from within mathematics itself, it is drawn from the environment. This resonates with
C2005’s (South Africa’s new education curriculum) idea of breaking down strict boundaries between mathematics and other disciplines (DoE, 2000:16). That this justification is made known to learners suggests that learners’ awareness should be drawn towards the relevance of mathematics in the everyday realities.

In sum, the worksheets were characterized by a low content of mathematical symbols; and thus lacked one characteristic of a mathematical text (Morgan, 1988: 12). There is also a pronouncement of mathematics as part of a broader context. The uniqueness of mathematics is backgrounded and thus these worksheets may be considered weakly classified. The substance of this thesis, however, is the learners’ perspectives on the everyday which are most likely influenced by the way they relate to the contexts. For this study, the type of the everyday incorporated is significant because of the bearing it may have on the learners’ perspectives. An awareness that different types of the everyday may evoke different responses, from learners, led to the development of additional distinctions. In particular authenticity/inauthenticity and near/far as discussed in Chapter 2. In the following section, I apply this extended framework to tasks in the three worksheets in analysis.

5.1.4 Using the framework on weakly classified worksheets

In the five lessons where reference was made to the everyday, I reflect on the context and try to establish whether it resonates with learners’ experiences or not. This will enable me to categorise it as ‘near’ or ‘far’. I also reflect on the way it is used, and thus establish whether the task is, in addition, authentic or inauthentic.

Lessons 1 & 2: In this worksheet (see Figure 4.1 page 78) reference is made to the development of number systems in Egypt, China, India, Greece and Babylon. The period during which various developments took place as well as the practices attributed to these societies are authentic. However authentic this information is, it draws on practices that took place a long time ago and in places that are far away from the learners’ experiences. In other words, the context is remote with respect to time and place. Hence, the everyday in Lessons 1 and 2 can be classified as authentic and far.
**Lessons 7 and 8:** As discussed in Chapter 4, the worksheet used in Lessons 7 and 8 (see Figure 4.1.7 page 88), draws on the contexts of AIDS and world population, a context which is significant in South Africa and the province of KwaZulu-Natal. The government’s position on dealing with the AIDS epidemic has drawn heavy criticism from opposition parties, AIDS activists and the press (Sunday Times, 2001). In the province of Kwazulu – Natal, and in a township not far from where the school is located, Gugu Dlamini was killed for declaring her HIV positive status.

AIDS, is thus a context that resonates with the experiences of most learners in Bulelwa’s classroom; it is a near context. The figures used with respect to the population of AIDS sufferers are, however, not genuine. These figures are mainly meant to produce mathematical functions with which learners can engage. Therefore, the everyday context drawn in is inauthentic and near. For example, item (d) requires learners to use the table provided in order to determine the year in which ‘the number of AIDS sufferers will be greater than 6 000 million”. The answer yielded by this calculation is 2006 during which 8550.4 million will be suffering from AIDS, which assumes that in 2004 there will be 2137.6 million AIDS sufferers world wide*.

The second context in the worksheet, world population, does not resonate directly with the learners’ everyday experiences. In other words, it is not a phenomenon that learners encounter on a daily basis. It is therefore a ‘far’ context. However, world population is authentic because it is about an actual phenomenon. Like AIDS, the population figures used are inauthentic.

Items (f) and (g) respectively required learners to explain ways in which ‘AIDS is transmitted’ and to suggest ways in which ‘the transmission of HIV/AIDS virus can be prevented’. In this case, reference was made to the actual disease and thus the task could be classified as of authentic and near. Item (h) was added on in class. Bulelwa reasoned that she had observed that learners could not calculate percentages correctly.

* The World Bank website suggests that the number of AIDS sufferers in 2004 is 40 million.
Lesson 9: The worksheet makes reference to real flowers that learners had brought into the classroom. The activity required learners to bring a tangible object (a flower) and to physically count the number of petals in each of the flowers. Both the action of counting and the data generated from that activity were authentic. To the extent that data generated is authentic and the flower is an object accessible to learners, the everyday in this instance suits the category of authentic and close.

Table 5.4: Categorization of tasks in Umhlanga

<table>
<thead>
<tr>
<th>Context</th>
<th>Tasks</th>
<th>Genuinely used</th>
<th>Near or Far</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancient Societies</td>
<td>All</td>
<td>Yes</td>
<td>Far</td>
<td>Authentic and far</td>
</tr>
<tr>
<td>AIDS</td>
<td>(a) – (e),(h)</td>
<td>No</td>
<td>Near</td>
<td>Inauthentic and near</td>
</tr>
<tr>
<td>AIDS</td>
<td>(f) – (g)</td>
<td>Yes</td>
<td>Near</td>
<td>Authentic and near</td>
</tr>
<tr>
<td>Flowers</td>
<td>(a) – (d)</td>
<td>Near</td>
<td>Yes</td>
<td>Authentic and near</td>
</tr>
</tbody>
</table>

It thus appears that an authentic context may be used in an inauthentic way. AIDS, for example, was used inauthentically as a syndrome whose spread can be defined by a function \( f(x) = (2^{x-1997}) \) 16.7 million where \( x \geq 1997 \) and \( x \in \mathbb{N} \). The world population was, on the other hand, presented as a phenomenon whose growth can be defined by the function \( f(n) = 3.2^{\frac{n-1960}{40}} \) million where \( n \geq 1960 \) and \( n \in \mathbb{N} \).

Having discussed the activities in the worksheets, the next section focuses on the lessons in which these activities were used.
5.2 ANALYSIS OF CLASSROOM EVENTS FOR THE TARGET LESSONS

The discussion in this section will be structured as follows: I will first give an account of the first two lessons and then reflect on the events of these lessons in relation to the management of the everyday in the classroom, the moral values inculcated and the learners’ responses to activities presented. In the same way, I will present an account of Lessons 7 and 8 followed by an analysis of these lessons and lastly an account of lesson 9 and then its analysis.

5.2.1: Account of Lesson 1 and Lesson 2: Number development in ancient societies.

Lesson 1
The focus group was an all-girl group of seven: Thulani, Mpumi, Xolani, Leah, Linda Zondi and Linda Masondo¹. We learnt during the interview that each member had a specific role to play: Thulani was the ‘mover’, responsible for any task which required any form of movement. For this particular lesson, she was responsible for pasting the group’s chart on the chalkboard for the group’s presentation. Mpumi was the ‘reporter’, responsible for making presentations on behalf of the group. Xolani and Linda Zondi were the ‘scribes’, responsible for writing down the group’s ideas or thoughts. Leah was the ‘leader’, her task was to ensure that the group stayed focused on the task.

Bulelwa drew learners’ attention to culture and society as the phase organizer, the main theme around which the lessons on number patterns was based. She briefly explained the contents of Activity 1 (Figure 4.1 page 80). Each group was given a sheet which provided information regarding numbers systems used in either Egypt, Babylon, Greece or China and India. Having read and discussed each group was to appoint one member to present on its behalf. Bulelwa was quite explicit in what was expected of each

¹ Not the students’ real names.
presenter and the aspects which other groups were to use when assessing the presentation. She highlighted that during the course of the presentation:

T: …as she or he [any learner] presents, you look at how she’s presenting. Is she clear? Is she confident? Then you give him a mark on a scale of one to five. It’s explained on top. It is very weak, weak, average, good and excellent. You are evaluating each other. Then the next part is ‘Can you understand what the learner is saying? The particular person that is in front, do you understand what he is telling you? Remember that you did not read other groups…other countries, you did not read about them. So, when they tell you, you need to understand what they read [inaudible]. So you are going to note down that you could understand … you as a person (with more emphasis)… it means as a group. The use of language to explain the number system: Did they use language efficiently? Did you understand? When it comes to questioning time… the group, and not the person, remember you are giving marks to the group… Did the group respond to the questions asked by the class? If they responded well, then you give excellent. If you feel they didn’t, then you will give whatever mark you feel they should get. Then lastly, if you feel you need to add any criteria… so you, as a group, are going to write down what criteria is that and rate them on that particular criteria. Have we understood each other on that?

[Lesson 1, line 31, Umhlanga]

So Bulelwa placed emphasis on the clarity of the presentation, confidence in the manner in which the presentation is delivered, the extent to which the speaker is understandable, language usage and the way in which questions are responded to. These criteria do not only require mathematical ability; they also require non-mathematical attributes such as confidence and linguistic ability. Discussions amongst members of the focus group (on tape) were masked by the teachers’ voice. However, it was possible to hear (when the teacher was quiet) Mpumi suggesting to the group that they (as a group) should concentrate on and discuss the important points. Mpumi appeared the most active during discussions. She did all the writing and most of the talking. Bulelwa moved from one group to the next, clarifying each group’s task and attending to questions posed by group members. In interacting with the focus group, she clarified aspects that she felt the group should focus on as follows:

T: So what you are supposed to be doing, as she is writing…I mean she is a scribe; you should be reading through the topic…that is Egypt. Try to understand: What did they do?…How they developed the number system, their mathematics as it approached …in which year err….err [did they] develop their number system? Is there anything that you see to be different from what you are doing today?

[Lesson 1, Line 59, Umhlanga]
Bulelwa’s instructions to the group are more specific. She particularly advises learners to concentrate on the development of mathematics. There is thus lack of agreement between how these learners are to be evaluated (which includes the non-mathematical aspects) and what they are expected to focus on as a group (which is more about the mathematical aspects). So, whilst she expects learners to evaluate the form in which the presentations are to be made, she also expects the group to focus and prioritize a particular content in their discussion. What constitutes a legitimate text may thus not be clear for learners.

The first group to present was Group 1. Their presentation was based on number development in Greece. The learner’s presentation did not deviate significantly from the sheet the teacher gave to the group. No questions were asked of this learner. However, one query was registered: the presenter was not audible and upon this, the teacher asked the presenter to repeat. Mpumi presented for Group 2, the focus group. The presentation was on number development in Egypt. She was very confident and articulate during her presentation. The group’s writing on the page, which was pasted on the chalkboard, was difficult to read. As a result, the teacher asked the presenter to write one of the numbers on the chalkboard. Mpumi wrote down a million in ancient Egyptian (see picture below).

One learner asked why the Egyptians wrote on Papyrus. Mpumi’s response was that at the time there was possibly no paper, a point the teacher agreed with and elaborated on.

The substance of this lesson was the teacher’s explication of what would be considered a ‘legitimate communication’ (Bernstein, 1996:32). To this end, she identifies efficient use of the language to describe number systems and ability to deal with questions from
other classmates as vital aspects which indicate learners’ grasp of the lesson. However, as she interacted with various groups, she (at least with regard to the focus group) emphasized a need to concentrate on the development of mathematics. Both the mathematical and non-mathematical aspects are foregrounded. In this lesson, only two groups (Group 1 and Group 2) out of seven had an opportunity to present.

**Lesson 2**

For the second lesson, Group 5 was the focus group. Bulelwa reminded groups (learners) about their assessment responsibilities. The first group she called to present was Group 7. The presenter looked nervous, was hardly audible and presented with his back to the audience. His presentation was on Babylon. One learner asked about the period during which the Babylonians invented the number system. The teacher answered the question as neither the presenter nor the group on whose behalf he was presenting seemed to have the answer. Another learner criticized the manner in which the presentation was carried out.

During this presentation, members of the focus group (Group 5) Toto and Sandile shared some joke with Khanyisile. Sandile paid little attention to the speaker, yet he, like other learners, clapped hands once the presentation was over. Group 5 was the second to be called for presentations. Khanyisile presented for the group and her presentation was on Egypt. After the presentation, one learner enquired, on the use of two symbols for the number 1000 000 (incidentally, this is the same question Renuka asked Group 2 in the previous day’s post-lesson interview). Khanyisile was visibly taken off-guard by the question and in answering it, she suggested that perhaps the use of two symbols to represent a million was an attempt to show different things. Group 4 presented after Group 5. Group 4 discussed the development of number systems in ancient Greek society. The presenter, who was quite confident throughout her presentation, ‘spiced’ her conclusion by suggesting that ‘after a round of applause’ her classmates were free to ask questions. She was only asked one question (what number $\theta$ represents), which she answered correctly. At this point, the teacher registered her concern over the limited
participation of learners, which she attributed to their poor command of English. She suggested a solution:

**T:** You can also ask in Zulu. If you feel you have got questions but you don’t know how to put them in English. Because it is one and the same people that are asking questions. It means others were not listening, or they didn’t understand. (pause) Ok thank you Group 4. Can we have Group 3. If there is a group short on assessment form, you can still come and collect it.

[Lesson 2, line 29, Umhlanga]

Group 3’s presentation was on number development in China. The presenter mainly read from the poster and paper in his hand. He did not look confident and failed to respond to the questions asked of him. Two such questions were on whether zero was used in India and China and why 6 was considered a perfect number. For both questions, the teacher intervened as the learner was unable to provide correct answers. Bulelwa then registered her concern over groups (possibly like Group 3) that did not support its presenters. Group 6, the last group for the day, Group 6, presented on China and India. The presenter was confident and questions to the group were answered by group members.

Following the presentations, Bulelwa summarized the lesson by reflecting on aspects of mathematical significance for each of the ancient societies’ development of number systems. Throughout, she highlighted the way in which zero was used in these different societies: Babylonians used two symbols for 1 and 10 and represented zero by a space between two numbers. Egyptians developed Geometry and never used zero. Greeks, used twenty four symbols, some of which are still being used in trigonometry. These symbols included phi, theta etc. With regard to China and India, Bulelwa highlighted their use of zero and development of the concept of infinity. She especially pointed out that Chinese and Indians had a symbol for zero.

It is not clear whether Bulelwa’s focus on the mathematical aspects were meant to complement what she felt was not thoroughly attended to by learners or whether she prioritized it over what learners discussed in the classroom. The point, however, is that what was considered legitimate over these two lessons remain open (could be mathematical or non-mathematical).
Having summarised the first worksheet, Bulelwa tried to draw the learners’ attention to the relationship between number patterns and the number systems in ancient societies. In doing so, she advised learners to ‘forget’ about the ancient number system. She said:

T: Now it doesn’t end there, in terms of what we want to do in terms of looking at the number patterns. We have the number systems that we use today. You know that we have the digits 1, 2, 3 and zero and the negative numbers. We have integers, we have the real numbers which is the last system that you can go up to. Now what I want us to do is to look at the number patterns that are obtained from these number systems. Now we forget about the numbers that were used in the olden days and we focus on the numbers that are used today.

[Lesson 2, line 93, Umhlanga]

In Chapter 4 I argued that the contents of worksheets used for Lessons 1 and 2 were insulated from contents of Lesson 3. This insulation is also observable in Bulelwa’s suggestion for learners to ‘forget’ about the one theme (ancient number system) and or in order to move to another (the number patterns).

Bulelwa then handed out a new worksheet wherein she asked students to study the number patterns. The following is the task they were to engage (part of Worksheet 2).

6.2 Number pattern exercises:

- Do this activity in pairs
- Look at the following number patterns. Fill in the missing numbers.
- Write a sentence describing each pattern.

a) 1; 3; 5; 7; ...; ...; ...;

Khanyisile offered a correct response to this task. The task was to be continued the next day.
5.2.2 Analysing Lesson 1 and Lesson 2

**Instructional Discourse: Managing the everyday**

*Lessons* 1 and 2 were weakly classified and in her introduction, Bulelwa’s stance on the need to blur the mathematics-everyday boundary was clear. She introduced the lesson as follows:

*T:* As you’ve known … know that in the past we have looked at our own phase organizer: Culture and Society; we’ve specifically been looking at the shapes that our cultural society developed. We’ve looked at the shapes that we have on our houses, our dresses… how we dress. So we are trying to look further, still under culture and society, but looking further at the number patterns – how it was developed. We will be starting that today. (pauses)

[Lesson 1, line 4, Umhlanga]

In addition to being non-mathematical, the criteria for evaluating the presentations were subject to different interpretations. For example, a criterion such as ‘efficient use of language’ may be understood differently by learners. Learners were permitted, if they so wished, to add any criteria they regarded relevant in evaluating the presentations. In this way, the “framing value” (Bernstein, 1990) with respect to criteria was weakened. However, in engaging the groups and in summarizing the lesson, Bulelwa foregrounded the mathematical aspects of the lesson. In this way she strengthened the framing value with respect to the reading of the lessons.

There was thus a mismatch between the framing values that Bulelwa implied during the course of the lesson and in summarizing the lessons. For example, after a presentation by Group 2 (she mistakenly called it Group 4) on Egypt, she legitimized questions about the everyday non-mathematical aspects. She challenged learners:

*T:* Aren’t you interested to see what she thought that picture looks like? What does it represent? If you look at [a million]. If you view that particular million, what does it look like to you? [No response] OK, thank you Group 4 (sic).

[Lesson 1, line 104, Umhlanga]

Yet, in summarizing the lesson Bulelwa teased out the mathematics:

*T:* Now about the Egyptians. Not much was said about them except that they concentrated mainly on the geometry part of mathematics where they actually looked at the Pyramids. They wanted to work out the levels of the river Nile where they could work out where they could build their
houses. So they used trigonometry most of the time and geometry. But they did use the number systems most of the time where we are told theirs was not as confusing as the Babylonians though it was developed at the same time as the Babylonians, around 600 after the death of Christ. What else was said about the Egyptians? (Brief pause). It was said that they didn’t also have zero. Ok, and we also know that their number system was less confusing as the Babylonians

[Lesson 2, line 85, Umhlanga]

Of interest for this study is the consequence that this weak frame and weak classification or the “–C-F coding rule” (Bernstein, 1990:106) has on learners’ perspectives about the everyday. Bernstein has argued that children from lower socio-economic backgrounds, like learners at Umhlanga, tend to select a ‘non-specialized recognition rule which in turn regulates their selection of non-specializing recognition context” (Bernstein, 1990: 104). In selecting the non-specialized recognition rule, learners tend not to be aware of the special purpose for which the everyday is used in a mathematics classroom. Therefore, they are more likely to view the everyday as an object to be engaged with rather than a vehicle towards the mathematics.

Regulative discourse

Social values, in this case, refer to that which constitutes acceptable character and conduct. It thus falls within Bernstein’s notion of a regulative discourse as a moral discourse. Social values are subject-independent. Within the new South African education system, critical outcomes resonate with these values because they (critical outcomes) are cross-curricular and generic. In particular, critical outcome 2 stipulates that a learner should be able to work effectively with others as a member of a team, group, organization, community (DoE, 1997). Bulelwa seemed keen to inculcate this notion of collective participation among learners. During the course of Lesson 2, for example, she noticed that a presenter from Group 3 could not respond to questions posed by other learners, she apportioned blame on all members of Group 3.

T: Class, I must say that I am very much disappointed about the group members. It looks like if a person is coming to present in front, we are just setting up the person; we are not helping out our group mate. (She then chats with another pupil and then continues). We are not helping out that person. We just keep quiet. You must remember that the person is also getting marks for you. Not for themselves. Continue Group 6.

[Lesson 2, line 42, Umhlanga]
I have so far reflected on the pedagogic practice in the classroom with particular reference to the way in which the teacher transmitted mathematical skills and social values. The connection between teaching (what Bulelwa foregrounded in class) and learning (the sense learners make of the lesson) is not a simplistic cause-and-effect relationship. Learners’ interpretation of the lesson may thus not be taken for granted on account of the teacher’s actions. From a constructivist’s position, Jaworski argues, “What the learner creates is her own perspective” (Jaworski, 1982:22). Translated to this lesson, learners create their own perspective of what is legitimate. The following section focuses on the learners’ perspective of the lesson.

**Learners’ sense of the Lessons 1 and 2**

In order to gain learners’ perspectives of the lesson, I have compiled a list of all questions or issues that learners and the teacher raised during the presentations. I have classified these questions or concerns into: (a) mathematical concerns, (b) non-mathematical content concerns and (c) classroom social norms concerns. Non-mathematical concerns are those which do not require mathematical knowledge in order to be engaged. For this lesson, such concerns would be in relation to:

- The year in which a particular number system was developed
- Materials used by a particular society for writing
- Whether a particular symbol was used

Though these questions may be about mathematics, answering them does not necessarily require a mathematics background per se. Mathematical concerns are those which can only be responded to on the basis of appealing to mathematics content. Content, in this regard, is used metaphorically to highlight that “mathematics is placed in a container” (Cobb, 1998:43) which brackets out any non-mathematical aspects. These would include an account of why division by zero yields an undefined value or why a number such as seven is not considered a perfect number. Social norms concerns “the participation
structure that the teacher and students establish in the course of their ongoing interactions” (Cobb, 1998:33). For this study, these norms include

- The audibility of the presenter
- The presenter’s posture and confidence

Table 5.5 Category of concerns raised during Lessons 1 and 2 by learners and the teacher

<table>
<thead>
<tr>
<th>CONCERN</th>
<th>GROUP ASKED</th>
<th>CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaker’s voice was too low</td>
<td>1</td>
<td>Social norm</td>
</tr>
<tr>
<td>The year the Greeks developed their number system</td>
<td>1</td>
<td>Historical</td>
</tr>
<tr>
<td>Did the Greeks use %</td>
<td>1</td>
<td>Historical</td>
</tr>
<tr>
<td>Write one of the numbers</td>
<td>2</td>
<td>Mathematical</td>
</tr>
<tr>
<td>Why the Egyptians wrote on Papyrus</td>
<td>2</td>
<td>Historical</td>
</tr>
<tr>
<td>What does the picture representing a million look like</td>
<td>2</td>
<td>Social knowledge</td>
</tr>
<tr>
<td>When did the Babylonians invent their number system</td>
<td>7</td>
<td>Social knowledge</td>
</tr>
<tr>
<td>Learners could not understand because they could not hear</td>
<td>7</td>
<td>Classroom social norms</td>
</tr>
<tr>
<td>Why two symbols were used (by Egyptians) to represent a million</td>
<td>5</td>
<td>Mathematical</td>
</tr>
<tr>
<td>What is the value of $\theta$</td>
<td>4</td>
<td>Mathematical</td>
</tr>
<tr>
<td>Where did Chinese and Indians write</td>
<td>3</td>
<td>Historical knowledge</td>
</tr>
<tr>
<td>The period when maths was developed in China and India</td>
<td>3</td>
<td>Historical knowledge</td>
</tr>
<tr>
<td>Why 6 was considered a perfect number</td>
<td>3</td>
<td>Mathematical</td>
</tr>
<tr>
<td>Whether Chinese and Indians had zero in their number system</td>
<td>3</td>
<td>Social Knowledge</td>
</tr>
</tbody>
</table>
5.2.3 An account of Lesson 7 and Lesson 8: Number patterns, AIDS and population growth

Lesson 7

The focus group for this lesson was an all-boys group of six: Mafika (M), Patrice (P), Nkanzi (Nka), Lungile (L), Snambethi (S) and Nkunzi (Nku). Bulelwa started the Lesson 7 by rounding up Lesson 6. She showed learners a booklet (three-figure table) that she used as a student and highlighted the convenience of using calculators. She then introduced activity 7 (Figure 4.8) by outlining the relationship between mathematics and AIDS. She particularly recruited AIDS because she felt it was close to the learners’ experience and she regarded the mathematical knowledge of number patterns to be a weapon to ‘combat’ the escalation of AIDS.

T:... We are still looking at the number patterns… but now we are trying to relate what is happening in mathematics classes to real life situations. We are actually trying to see whether what you learn in mathematics classes is actually relevant. These number patterns …are they relevant?... do they help mathematicians to figure out what is happening in real life? So I picked that one where mathematicians are trying to use mathematics to solve real life problems. Problem which is actually epidemic, which is big for South Africa (pause). We are having so many people dying of AIDS. We want to use it and see how we can actually use mathematics to prevent the escalation in the number [of people] that are dying of AIDS. I even said it is most unlikely that no one has ever heard of an AIDS victim in our communities or society, you must know someone that actually died of AIDS: Whether they are not a member of your family, your neighbour or in the communities.

[Lesson 7, line 7 Umhlanga]
Having set the scene, Bulelwa explained the worksheet to the learners, drawing learners’ attention to the two tables in the worksheet. Her presentations suggested that responding to this task would have a bearing on the reduced infection rate in real life.

T: You’ve got two tables that are given to you. You must study both those tables. Can you have a look at that particular table? We’ve got two tables, you must study both those tables. The first one has the number of years, dating from 1960 to 2001..(pause) 2120 years…you are in 2001 so that means it’s about 119 years from now. We are trying to predict so that we can help the future generations to try and solve this problem of AIDS before it actually wipes out the whole generation… the next generation. So the first table shows the number of years and the world population growth. You have a certain growth rate, which you actually look at… where they’ve actually given us that 1960 the population growth was actually 3000 million. In 2000 it is estimated to be 6000 million and in 2040 it is estimated to be 12000 million and now all you need to do is to predict. (emphasizes) Look at the table and predict the next two spaces that are given in question marks. What do you think the population size will be in 2080 and 2120. You’ve got to fill those spaces. And also you’ve got a certain table which has the number of increasing AIDS sufferers.

[Lesson 7, Line 8, Umhlanga]

Having set the scene and explained the worksheet, Bulelwa advised learners to work in groups whilst she walked around to check progress in each of the groups. The focus group’s discussion was mainly on the causes of AIDS transmission. After sometime, Bulelwa noticed that some groups had not responded to items d and e. She registered her concern to the class.

T: ‘Cause there’s two major questions which most students are trying to avoid. Number (e)…most people are trying to avoid number (e). Number (e) says… if I could just explain to the rest of the class. Number (e) says the world population in the year 2000 is 600 (sic) million.

Patrice: 6000 million

T: 6000 million. Then in which year will the number of AIDS sufferers be more than 6000 million? Some of the groups have worked it out. They are only giving the year but they didn’t continue with the rest of the question. Now which year is that that the number of AIDS sufferers will reach that particular figure?

[Lesson 7, line 58 – 60, Umhlanga]

It would seem that some learners had not attempted these items because they did not know how to engage them. For example, note the way in which Mafika justifies the focus group’s answer (2040) to the question asked in line 60 above.

T: 2040? Is that…this group says it’s 2040.

M: No, mam, we were estimating.

T: You estimated. You’ve got to estimate wisely in mathematics. You don’t just estimate just like
that, that is why you are studying patterns, Mafika. You’ve got to study patterns and then estimate. The other groups, what did you get?

[Lesson 7, lines 64 -66, Umhlanga]

The group had completed items $a$ and $b$. When Bulelwa arrived and interacted with the group, she approved of their written responses to these two items and went over the items, $a$, $b$, $c$, $f$ and $g$ with them. After she had left, the group continued the discussion on items $f$ and $g$. The discussion was on the transmission of HIV/AIDS (item $f$) and the way AIDS can be prevented (item $g$). Bulelwa noted that most groups were not engaging items $d$ and $e$. She thus drew learners’ attention to item $e$. She first interpreted and explained the question in isiZulu and then engaged learners in a whole class discussion. During this discussion, she drew learners’ (whole class) attention to the different rates at which AIDS sufferers and the world population increase.

T: Now, let’s look at this particular question. Because the first part you are given the number of years. Then the second part you need to discuss what this means. (She repeats in isiZulu). Now how long does it take for the world population growth to double itself? How long does it take?  

Learners: 40 years 

T: That is if you are in 2000, it will only be in 2040 that the world population growth will be 12 000 million. Now how long does it take, if you look at the second table, for the number of AIDS sufferers to double itself? How long does it take?  

Learners: One year 

T: It’s only a year, that the number of AIDS sufferers are increasing. This is the crucial part where I need your discussion, which I need you to write. Don’t just write the year… what does it mean? If it takes the world population 40 years to double itself, not only in South Africa but the whole world, and the number of AIDS sufferers it takes one year. What does it mean? Now let me ask you another question so that you can have it in your discussion as well (pause) Is AIDS a curable disease? (Siren whales to signal end of period).  

[Lesson 7, lines 67 – 71, Umhlanga]  

The teacher drew learners to the mathematical significance of the answer (line 69) as well as the social implications of a higher growth rate in the number of AIDS sufferers. The period ended as Bulelwa went through item $e$ with learners. She indicated that she
would introduce an additional task on percentages and reminded learners to bring flowers for Lesson 8*.

**Lesson 8**

In this lesson, the teacher brought ‘closure’ to the activity (Figure 4.8) she introduced in Lesson 7. A focus group for this lesson consisted of six members: Bongani (B); Nomakula (N), Hlupi (H), Mbali (M), Hellen (Hl) and Khanyiso (K). All the learners except Khanyiso are female. For this particular lesson, a number of learners had brought flowers. The teacher, Bulelwa, had anticipated that she would conclude this lesson before the end of the period and then start a new section which would require flowers. As she had promised learners in Lesson 7, she introduced an additional item which she wrote on the board: “What is the percentage of people suffering from AIDS related diseases around the world in the year 2000?” She then gave learners an opportunity to discuss the worksheet in their groups.

The actual discussion amongst learners in the focus group was not audible. However, Bulelwa seemed happy with the groups’ written response as she assessed it as ‘excellent’.

It was not clear to her, though, how the group engaged and justified their response to item (e). As evidenced in the following excerpt of the lesson transcript, the group could not explain how they obtained 2000 as the answer.

T: ... And the next one (she reads out ‘e’) ‘The world population in the year 2000 is said to be 6 000 million. In which year will the number of AIDS sufferers be greater than 6 000 million if this trend continues?’ (pauses)... Ok; in which year?
B: We said 2000.
T: Now, how did you get 2000? How did you arrive at 2000?
FG: (No conclusive answer)
T: How did you work it out?
FG: (response inaudible)

*[Lesson 8, lines 12 – 17, Umhlanga]*

* Bulelwa thought she would complete the worksheet (for lesson 7) midway through lesson 8 upon which she would commence with another worksheet in which flowers would be required.*
Bulelwa then left the group to continue the discussion. After about three minutes she goes over the whole worksheet with the whole class. Items a, b and c, in which learners were to complete the pattern, did not seem particularly problematic for learners. During this discussion, she emphasized the need for learners to justify their answers. For example, when one learner offered 2 200 (a correct answer) as a year in which the population will be 192 000 million, Bulelwa offered the following challenge:

T:  (She writes it on the board) Now, we just don’t simply take people’s answers, we need to understand how they came to get their answer, not only whether the answers are right or wrong. We need to understand their way of thinking. Now (calls a learner’s name) tell us how you got the answer?
Learner:  (Explanation inaudible)
T: (She writes 2200 on the board and asks) And 96 000 times two?
L’s:  192 000.
T: (To the learner who gave 3 000 initially) Do you still think that the answer is 3000?
L:  No.

[Lesson 8, lines 29 – 34, Umhlanga]

She then discussed item (e), for which the answer is 1068, 8 million, with the whole class. At this point Bulelwa drew the learners’ attention to the significance of the results, namely, that the number of AIDS sufferers may catch up with the world population size.

T:  Siya says 40 years. Now we predicted that in 2040 the world population will be 12 000 million. How does this figure compare with 1068,8?
Sipho:  Not very close.
T:  Not very close? But is it not scary that it takes 40 years for the world population to double itself and when it comes to AIDS it takes three years to reach almost a figure that is close to 12 000 million.*

[Lesson 8, lines 35 – 37, Umhlanga]

Items f and g elicited a variety of responses from learners. Some responses regarding the cause of AIDS transmission were general, for example engaging in unprotected sex. Some responses were, specific, such as the use of razors by Inyangas (traditional healers). Item (h) was responded to with ease.

* It is not possible to show that the number of AIDS sufferers is catching up as 1 68,8 million and 12 000 million are far apart. Seemingly, 1068.8 million was mistaken for 10 068.8 million.
In concluding the lesson, Bulelwa showed her awareness that AIDS and mathematics were two different discourses which had the potential to elicit different responses from learners.

T: Thank you for the discussion we have had on activity 7. I just hope that in the end it will help you and your communities. Please spread the message; write those posters. Most unfortunately, I thought we would have sometime to discuss patterns and nature. Now did you enjoy the lesson?

L’s: Yes.

T: What did you enjoy most, the AIDS part or the maths part?

L’s: AIDS.

T: (laughs) So AIDS is more interesting than the Maths.

[Lesson 8, lines 102 – 106, Umhlanga]

5.2.4 Reflecting on Lesson 7 and Lesson 8

Instructional discourse: managing the ‘everyday’

The everyday that Bulelwa makes reference to is the one she considers to be close to learners’ lived realities. However, she uses this context in two ways: as a platform to engage data and as a reality to be reflected on. This point is revealed in the following excerpt, which took place in Lesson 7.

T: It’s only a year, that the number of AIDS sufferers are increasing. This is the crucial part where I need your discussion, which I need you to write. Don’t just write the year, what does it mean? If it takes the world population 40 years to double itself, not only in South Africa but the whole world, and the number of AIDS sufferers it takes one year. What does it mean? Now let me ask you another question so that you can have it in your discussion as well. Is AIDS a curable disease? (Siren signals end of period). (my emphasis)

[Lesson 7, line 72, Umhlanga]

In the section above I have referred to two types of AIDS. The transformed AIDS was seemingly meant to provide a dose of realism for the exponential function f(x)=16.7 (2\(^{x-1997}\)) where f(x) denote the population size (in millions) and x the year in which the population is observed, starting from 1997. This is the AIDS which leads to the doubling of AIDS sufferers in ‘one year’. In this way it was used as a close and inauthentic context. The untransformed AIDS, however, played a different role. It was introduced in
order to raise the level of learner awareness of the unfortunate effects of AIDS. It is the AIDS which is ‘not curable’ and is thus used as a close and authentic context.

In changing untransformed AIDS to fit in with mathematical data (figures in the table), a transformation took place. As Bernstein (1996:34) suggests, “As a discourse moves from one position to the other, it is ideologically transformed, it is not the same any longer.” Bulelwa is thus managing a link between two types of AIDS which need different rules of engagements. Untransformed AIDS requires learners to reflect on their everyday considerations such as drawing of posters. On the otherhand, transformed AIDS requires learners to reflect on the mathematical considerations such as the exponential increase in the number of AIDS sufferers.

With respect to mathematics content, Bulelwa often emphasized the need for learners to explain their answers. Thus, what legitimized a response is not only a numerical value but an account of how the value was obtained as well. In her discussion with the focus group in Lesson 8 over item $d$ of the worksheet, Bulelwa noticed that the answer 2 200 was correct and yet, she needed learners to explain how it was obtained:

T: Now, how did you get the answer? How did you work it out?
M: (She points out to the sheet)
T: (Reading out a written answer) We first plus 40 in every year, finally we got to the year 2200, after that we times 48 000 million by two and the answer become 98 000 million and times 98 000 million again and the answer become 192 000 million. That’s excellent, that’s correct (she marks it).

[Lesson 8, lines 9 – 11, Umhlanga]

**Regulative discourse -Inculcating social values: Lessons 7 and 8**

Besides teaching mathematics, Bulelwa had an additional task of creating an environment in which learners would be ready to receive information. Such responsibility falls within Bernstein’s notion of a regulative discourse as it pertains to creating order (1996:42). Of interest though, is the way in which Bulelwa held groups responsible for any unacceptable behaviour of one of the group members. In one
instance, Bulelwa found Nku asleep whilst other members were discussing. This is how she handled the situation:

T:  Let me see what you have done. Who is sleeping now..hey.
N:  Waky waky
Nku:  (he lifts his heard) No I am thinking.
T:  You thinking when you are sleeping..ohh don’t be clever. Please, make it a point that you work together. How can you work when somebody is sleeping? Don’t you need his input?
M:  We need it
T:  So wake him up, tell him to wake up. Last time it was David who was sleeping. (Looks at the response and reads out the question and the answer). You multiply a number by itself?

[Lesson 7, lines 73 – 78, Umhlanga]

What Bulelwa was inculcating in this regard is the notion of collective responsibility amongst learners. Working together as a member of a team is embraced in the revised National Curriculum Statement (2001:11) as a Critical outcome.

**Learners’ engagements of tasks in Lessons 7 and 8**

The move between untransformed AIDS and transformed AIDS is characterized by a change in the framing values. Transformed AIDS required strong framing because it called for the bracketing off of learners’ everyday and thus a selection of specialized recognition rules. Learners’ written responses suggest they were able to select appropriate recognition rules.

**Written responses for items a, b and c submitted by focus Group 3 (Lesson 7)**

Study the tables given and answer the questions that follow.

<table>
<thead>
<tr>
<th>Year</th>
<th>1990</th>
<th>2000</th>
<th>2040</th>
<th>2080</th>
<th>2120</th>
</tr>
</thead>
<tbody>
<tr>
<td>World population growth</td>
<td>3,000 million</td>
<td>6,000 million</td>
<td>12,000 million</td>
<td>24,000 million</td>
<td>48,000 million</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>World increase in the number of AIDS sufferers</td>
<td>16.7 million</td>
<td>33.4 million</td>
<td>66.8 million</td>
<td>133.6 million</td>
<td>267.2 million</td>
</tr>
</tbody>
</table>

From the tables, you can see that the AIDS and population figures follow trends, which can be seen, from the number patterns. These patterns allow researchers to predict what these figures will be for the future.

(a) Describe the pattern of population increase every 40 years as shown in the first table.

We multiply a number by itself, to get the next number.

(b) Describe the pattern of the increasing number of AIDS sufferers as shown in the second table.

You add a number, by itself, to get the next.

(c) Fill in the missing numbers in each table.
For Lesson 7 (i.e. Group 3) I have chosen to use Patrice’s worksheet and responses because he led the group discussion and thus his responses would probably provide a fair reflection of the groups’ responses. Focus Group 4 also managed to offer appropriate responses for the first three items in the worksheet, as shown below by a written response that the group submitted.

Written responses for items a, b and c submitted by focus Group 4 (Lesson 8)

Study the tables given and answer the questions that follow.

<table>
<thead>
<tr>
<th>Year</th>
<th>1960</th>
<th>2000</th>
<th>2040</th>
<th>2080</th>
<th>2120</th>
</tr>
</thead>
<tbody>
<tr>
<td>World population growth</td>
<td>3 000 million</td>
<td>6 000 million</td>
<td>12 000 million</td>
<td>24 000 million</td>
<td>68 000 million</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>World increase in the number of AIDS sufferers</td>
<td>16.7 million</td>
<td>33.4 million</td>
<td>66.8 million</td>
<td>133.6 million</td>
<td>267.2 million</td>
</tr>
</tbody>
</table>

From the tables, you can see that the AIDS and population figures follow trends, which can be seen, from the number patterns. These patterns allow researchers to predict what these figures will be for the future.

(a) Describe the pattern of population increase every 40 years as shown in the first table.

(b) Describe the pattern of the increasing number of AIDS sufferers as shown in the second table.

(c) Fill in the missing numbers in each table.

Dealing with untransformed AIDS, on the other hand, required weak framing which in turn leads to the selection of non-specialized recognition rules. In other words, in dealing with this AIDS, learners had to draw from their everyday, practical and out-of-school experiences. Learners’ written responses suggest they were able to select...
appropriate recognition rules for dealing with items on authentic AIDS as illustrated by written responses from both groups, to items f and g.

Focus Group 3 response to items f and g (Lesson 7)

(f) How is the HIV virus/ AIDS transmitted? Explain

- HIV virus / AIDS is transmitted by
  - liquid fluids: eg. sperm, blood

(g) What can we do as a society to break the pattern of the increasing number of AIDS sufferers? (i.e. decrease the number of AIDS sufferers)

- We can make a drama about AIDS and warn people
- We can show that how danger AIDS is with posters
- We can organise an awareness day
- Be faithful to your partner.

Focus Group 4 response to items f and g (Lesson 8)

(f) How is the HIV virus/ AIDS transmitted? Explain

(hiv virus / aids is transmitted by)

(g) What can we do as a society to break the pattern of the increasing number of AIDS sufferers? (i.e. decrease the number of AIDS sufferers)

- By abstaining sex,
- Exercising,
- Eating health food and
- By phoning in AIDS help line or to talk to someone who can advise you

The two items, d and e, which attempt to open up a dialogue between AIDS and mathematics were responded to differently by the two groups. All members of Group 3, including Patrice, did not offer any written responses to items d and e. These are the two
items most learners were not able to offer responses to during Lesson 7 (lesson during which we collected Group 3 written responses). However, members of the group had made attempts to discuss the item e. The discussion proceeded as follows:

M: (He reads out the question from the worksheet)
S: They say the second table
M: I think they are talking of this one (points to the first table)

[Lesson 8, lines 79 – 81, Umhlanga]

There is no agreement between learners on how the task should be approached; ultimately they seem to give up. Group 4, however, provided some written responses to both items d and e

Responses by Group 4 to items d and e

(d) Researchers believe the earth cannot support a population approaching 192 000 million people. If the population continues to double every 40 years, then in which year will it be 192 000 million? Explain how you worked out your answer. WE FIRST PLUS 192 000 MILLION 2000 = 2200 40 IN EVERY YEAR FINALLY WE GET TO THE YEAR 2200, AFTER THAT WE TIMES 192 000 MILLION BY TWO AND THE ANSWER BECAME 96 000 AND TIMES 96 000 MILLION AGAIN AND THE ANSWER BECAME 192 000 MILLION THAT IS HOW WE GET THE ANSWER 192 000 MILLION.

(e) The world population in the year 2000 is said to be 6 000 million. In which year will the number of AIDS sufferers be greater than 6 000 million if the trend in the second table continues? Discuss what you think this means.

The written response to item (d) is correct. The learners have managed to provide a correct answer and to offer a procedure they used to obtain the answer. Though the question made reference to the population size, learners were not required to use this
information or context in responding to the question. Item (e) was also responded to in accordance with the way it was discussed in the class. As far as that discussion went, it was correct. (In fact, the correct answer is the year 2006 and not 2003 as provided in class, seemingly the figure 600 million was confused with 6 000 million or 1068.8 million was confused with 10 068.8 million). The second part of the question required learners to comment on the implication of the answer. In this regard, the learners suggested that “We think that the number of AIDS sufferers is increasing each year and this disease is coming fast”. This response characterizes a selection of non-specialized recognition rules because learners recruit their social knowledge about AIDS. They do not link the increase in the rate of the disease with the data in the table. There seems to be little awareness that the AIDS they are supposed to refer to is the transformed AIDS.

**Summing up Lessons 7 and 8**

In Lessons 7 and 8 Bulelwa encouraged learners to work collectively and, as described in Chapter 4, had the furniture arrangement which communicated this intention. At an instructional level, she had two identities. At one level, she operated as a mathematics teacher whose concern it was for learners to make sense of and describe number patterns; at another level, she foregrounded the social concerns about AIDS and advised learners to be cautious. Whilst foregrounding the social weakened the framing value, learners were able to choose appropriate rules for questions that needed the selection of specialized recognition rules for those which required the selection of non-specialized recognition rules.

In spite of the unannounced and implicit movement between and reference to what I have termed transformed AIDS and untransformed AIDS, learners seemed to sense or detect the type of rules that were at play in order to engage each.
5.2.5 Lesson 9 events: Counting the flower petals

Lesson 9

The context summoned in Lesson 9 is a set of flowers that Bulelwa had been requesting learners to bring to class. She started the lesson by greeting learners, asking why the class is dirty and enquiring whether learners had brought flowers. The focus group for this lesson was the one we had interacted with before during Lesson 1 (Group 2). However, Linda Masondo was not in class on this particular day. So the discussion took place among the following learners, all of whom were girls: Linda Zondi (LZ), Leah (L), Mpumi (M), Thulani (T) and Xolani (X). Though Bulelwa was upset with learners who did not bring flowers, she allowed them, as the lesson progressed, to use flowers she and the other learners had brought. For this particular day Bulelwa had two activities: The first activity involved counting flower petals and writing these numbers in ascending order. Another activity involved the drawing of a family tree. The first activity involved the counting of petals in each flower.

In relation to the second activity, she said:

T: So what happens is that we’ve got one root. If you can just imagine the root and the stem being just one, the giving… branches that is your family… you start off… you can actually look at your… like she…either great grand parents or your grand parents. Then you actually move to a certain number of children, they also give birth to…(demonstrating a tree model using hands)… it ends up looking like a tree…Then as part of the homework it means that you are going to take time because you should contact your family members sometimes.

[Lesson 9, line 39, Umhlanga]

Bulelwa drew learners’ attention to the possibility of no pattern emerging from drawing a family tree. She, however, highlighted that learners should look for trends to observe whether at some stage, the number of family members decreased as a result of, for example, family planning.

The focus group struggled to begin with the task involving the flower petals as they had brought no flowers. Mpumi improvised by ‘recalling’ that some flowers have four
petals. This type of guesswork did not impress Bulelwa, as evidenced during a conversation she had with the group.

T: …(looking at M) The Rose has four petals? No, no, no,… no is not true. You see now you are not doing the right thing, you are now guessing. Here, I’ve got you, here is the Rose, only the colour that changes. I want you to count the petals, the number of petals, but now you…it is difficult for you to count the petals. Sometimes you might have to pull it apart, because you see, you might not know where you have started off. This is an old one (referring to the Rose), so you can just put off the petals then you know how many they are. Once you have finished, you can lend it to the other group that don’t have that rose. (Learners are counting petals pulling them off)

[Lesson 9, line 74, Umhlanga]

Having borrowed a flower from a neighbouring group, learners counted and recorded the number of petals. Their discussion then switched over to AIDS. In particular, some group members enquired on what ‘semen’ is and there was some discussion on the transmission of the HIV virus. The switch to the AIDS discussion was very sudden, provoked by Lenah.

L: We will fail, we know we copied [With reference to the flower petals task], Aids is the most… dangerous disease…I think that Aids is the most… recent…disease many people are dying from Aids than the other diseases. So did you hear when mam explained yesterday.

[Lesson 9, line 70, Umhlanga]

Bulelwa then led a whole class discussion about the activity, writing down the various number of petals obtained from all the groups. The following sequence emerged 1,3,5,6,7,8,13,14,16,30,45,270,287 (which is authentic but not Fibonacci). She suggested that if they had brought fresh flowers (with all petals intact), then they would be able to observe and test the Fibonacci sequence. She highlighted to learners that even if they observed no particular pattern from the flower petals they had, their answers are correct in the light of their data being genuine. She engaged learners further on the Fibonacci sequence and then concluded the lesson by asking them whether they believe patterns occur in nature, to which she received no definite response.

5.2.6 Reflections on Lesson 9

For this lesson, Bulelwa makes reference to attributes of real, tangible and untransformed flowers: the number of petals. She also reflects on the attributes of
imaginary flowers whose number of petals obey the Fibonacci sequence. I refer to the latter as transformed flowers.

In reflecting on this lesson I firstly focus on how the teacher manages a movement from the everyday context of untransformed flowers to that of transformed flowers. Secondly, I reflect on the way in which the teacher encourages particular social norms.

**Instructional discourse - movement from the everyday context to mathematics**

The untransformed flowers context that Bulelwa draws on does not yield the expected desired mathematical outcome, the Fibonacci sequence. A movement from the everyday to the mathematics implied managing this disparity. In so doing, Bulelwa had to be cautious, on the one hand, to not undermine the observed pattern (obtained from real flowers) and, on the other, ensure that the Fibonacci sequence is learned. She manages a movement from untransformed flowers to transformed flowers as follows:

T:  
If we had actually brought fresh flowers knowing that all the petals are still there, it is believed that the number of petals do follow a certain sequence which was invented by a Mathematician who lived in the 14th, no the 13th century, his name is Fibonacci. Now I also want us to check whether is it true or does it actually still happen, is it true for certain parts of the country where he lives... or the time where he lived or is it still applicable nowadays.  

[Lesson 9, line 170, Umhlanga]

She, thus, ‘transforms’ (Bernstein, 1996: 35) untransformed flowers into ‘fresh flowers’. The fresh flowers Bulelwa is referring to are ‘imaginary’ (Bernstein, 1996:35). It is from these ‘fresh’ or transformed flowers that learners would be able to observe the Fibonacci sequence. Secondly, Bulelwa finds it difficult to sustain the authenticity of the results obtained in class. For example, she suggested that the lesson was also somehow aimed at verifying whether the Fibonacci sequence is observable ‘nowadays’. The logic, on the basis of classroom events, suggests that the Fibonacci sequence does not hold for this particular lesson and period. Perhaps it even suggests that the Fibonacci sequence was a once off event which could only be observed during the 13th century at a place where Fibonacci stayed. However, following this logic would make it difficult to justify the teaching of the Fibonacci sequence. So Bulelwa had to surrender her dependence on the ‘real’ data.
For Bulelwa’s lesson to proceed, she had to treat the data obtained from an authentic and near context (untransformed flowers) as if it were inauthentic. She managed to do this by suggesting a practical possibility: some petals might have fallen off. Similar to the case of AIDS in the previous lesson, Bulelwa moves from the real context of untransformed flowers, via an imaginary and transformed context of ‘fresh flowers’ to the Fibonacci sequence. She is ‘forced’ to use transformed flowers because they are immune to practical settings: like the accidental drying out and falling off of petals.

A related challenge involved the extent to which the everyday was to be included in this lesson. There were certain aspects of the everyday that Bulelwa was prepared to surrender, for example, the names of flowers. In this regard, she advised learners:

T: What you need to do as well is to write the name of the flower. If you do not know the name you can give the…(inaud) you can actually give me that particular flower, but make it the point that at some stage later on you do find the real name. Ask your biology teachers… other people that can help you know what flowers they, or you can even ask the florists, they can help you know what is the name of the flowers or you can just call them either (a), (b) or (c), or whatever that you feel…. (inaudible). Be creative and write… give the name of the flower

[Lesson 9, line 13, Umhlanga]

Though these flowers were real and untransformed, their authentic names were not a subject of concern for this mathematics classroom. Instead learners could be ‘creative’. Such ‘creativity’ it would seem, was not to be extended to the number of petals. Thus, the number of petals could not be guessed but the names of flowers could be.

**Regulative discourse - inculcating the social norms**

The teachers’ challenge, as observed in the other lessons, was not only limited to the transmission of mathematical skills. She also encouraged learners to be socially responsible. For example, she showed some concern over the conditions of the class, upon which she challenged learners and reminded them that:

T: You know a healthy mind needs a healthy body in a healthy environment, you cannot learn if the environment is so dirty. Eh… yesterday we looked at the patterns that are ...(inaudible)... in everyday life, where we actually… (inaudible)... the pattern of AIDS epidemic. We had a
In this case Bulelwa shows concern towards the learners’ health. She, in the process, brings in another non-mathematical aspect: the bringing of flowers. Whilst bringing flowers to class is not strictly a mathematical task, the teacher considered it seriously. She was particularly disappointed with Group 2, the focus group. During the course of the lesson, she approached them and highlighted that bringing flowers was part of their responsibility:

T: I just want the flowers (inaud)... but next time please participate in the lesson... it is you who have to... take charge of your own learning... the Rose has four petals (looking at L3).  

[Lesson 9, line 70, Umhlanga]

In sum, Bulelwa plays the role of both a mathematics teacher and an experienced adult. As a mathematics teacher, she attempts to move from the non-mathematics to the mathematics. As a concerned adult, Bulelwa inculcates norms that are not necessarily mathematical, but social. In the next section I focus on the way in which learners made sense of these classroom events.
Learners’ response towards lesson 9

Using flowers from other groups, the focus group produced the following answers in response to the worksheet.

<table>
<thead>
<tr>
<th>NO. OF PETALS</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE OF FLOWER</td>
<td>Rose</td>
<td>Pink</td>
<td>...</td>
<td>Yellow</td>
<td>Pink</td>
</tr>
</tbody>
</table>

(3) Arrange the number of petals of the flowers in an ascending order.

3, 5, 5, 5...

(4) Is there a pattern in the number of petals of the flowers? If yes; describe it.

No, there is no number pattern of petals of the flower.

(5) What is this number pattern called?

None.

This was followed by a sudden switch to a discussion about AIDS. This discussion was most probably informed by the previous two lessons. The following interaction highlights some of the issues learners discussed.

M: Ok, you heard when Mam yesterday asked if, what did the question mean, when...by which year will the people...population will be infected (probably refers to item e of Worksheet 4) because...(other group members laugh)

M: (She continues) Serious...eish...I want to tell you what I know about AIDS...you know what I know about AIDS, I know that it is...(laugh takes rose from the table, they keep on laughing)

M: (goes on to discuss). A sexually transmitted...during the sexual intercourse, ...During the sexual intercourse period (other learners listen attentively, eager) the man transfer a fluid into...(inaudible)

L: Semen

[Lesson 9, lines 81-84, Umhlanga]
So serious and intense was the discussion that no interference, particularly from other learners, was welcomed. A learner from another group was told, when he tried to appeal for the group’s attention that he was ‘disturbing’.

Learners in this group had completed the task for the day, in other words, they had provided the written responses as was required. For them there was no sequence emanating from the ascending order of the number of petals. However, when Bulelwa introduced the Fibonacci sequence, the majority of learners seemed to follow the pattern that made up the sequence.

L: three plus five equals to eight.
T: Now generate the pattern, don’t mention the numbers. (pause) If you add two numbers you also get the next numbers and two previous you also get the next number, is it true?
L’s: Yes Mam.
T: Three plus five.
L: Eight.
T: Five plus eight?
L: Thirteen.
T: So that is… figure out what could be the next one… say eight plus thirteen gives us?
L: Twenty-one.
T: Then what will be the next number?
L: Thirty-four.
T: Thirty.
L’s: Thirty-four.

[Lesson 9, lines 180 – 192, Umhlanga]

From these responses, it would seem that the majority of learners were able to follow the rule which generated numbers in the Fibonacci sequence. As a separate activity, learners were also able to count the flower petals and put them in ascending order. The connection between the two activities was not evident.

**Summing up lesson 9**

Bulelwa struggled to tease out the Fibonacci sequence on the basis of the real flowers which learners had brought to the classroom. She resorted to an ‘imagined’ situation in which ‘fresh flowers’ would have produced the desired sequence. This seemed a way out of a situation where authentic data did not yield expected data. Whilst learners successfully negotiate the task in the worksheet and the Fibonacci sequence, it is not
clear that they would have observed the connection between the two tasks without the teachers’ intervention.

CONCLUSION

In this chapter I have analysed two aspects of the lessons which incorporated the everyday: the activities used and the classroom events. In analyzing the worksheets, the need to highlight the distinctions between the everyday became important since different contexts evoke different responses amongst learners. Bernstein’s classification construct, as pointed out in Chapter 2, did not provide a language concrete enough for this purpose.

Learners engaged activities in a classroom environment where both the mathematical and the non-mathematical aspects were legitimized. Bulelwa also encouraged certain moral values (like cleanliness and staying away from drugs). The picture emerging is that the classroom environment addressed more than the mathematics content. Such blurring of the boundary between the mathematics and the everyday challenged her to move between the authentic in order to position and reflect on the everyday and the inauthentic in order draw learners to mathematical aspects of the lesson. In this regard, she would allow non-mathematical discussions about flowers or AIDS but she would also inauthenticate this context by drawing in false data (in the case of AIDS) or introducing Fibonacci sequence (in the case of flowers petals).

The environment in which learners engaged the tasks was weakly classified and weakly framed, a -C-F environment, using Bernstein’s codes. In other words, what counted as legitimate was ‘open’. Given the socio-economic background, it was interesting to observe whether –C-F setting would be transformed into +C+F. For Lessons 1 and 2 and some activities in Lesson 7 and 8 (tasks d and e) the non-mathematical aspects were privileged by learners. In such cases, there was no movement from +C+F to –C-F. However, in Lessons 7 and 8, the context recruited did not prevent learners from selecting appropriate recognition rules. In other words, learners knew when to recruit the mathematical considerations and when to background them and foreground the everyday
considerations. The privileging of the non-mathematics in Lesson 1 and Lesson 2 could be attributed to weak framing value or openness of the criteria used to evaluate presentations.

With the benefit of the background in which learners engaged the activities, the type of activities they engaged and how they responded to these activities, the following chapter explores learners’ views about the role of the everyday in mathematics.