Chapter 4

Results and discussion

4.1 Introduction

In Chapter 3 the focus was on the research design for this study. In this chapter the interpretive findings are presented and discussed. First I discuss the coding of the data and how the codes fit into the themes that emerged from the research questions and the tentative conceptual framework for this study. Then I reveal the personal ethnographies of each of the five participants. Ethnographic information includes the demographic data of participants, how they view themselves as teachers, and their perceived strengths and challenges of being a mathematics teacher. I proceed with an individual profile of each participant in relation to the themes. The six major themes of this study are understanding of reflection; content (level) of reflection; reflection-for-action; reflection-in-action; reflection-on-action and contextual factors influencing reflective practice. This is followed by an analysis of the participants' lesson study group reflections after lesson observation. Finally the participants' reflection on the lesson study group experience is revealed in a reflective interview with the group.

In the following section I describe how the data was coded (or categorised).

4.2 Coding the data

According to Dey (2005) data must always be considered in context. He argues that it is often essential to regard the researcher as part of the context being studied, which is obviously relevant in interviews, where the respondent is responding to some sort of stimulus on the part of the interviewer (Dey, 2005). I took this view into account when I started the process of coding (or categorising) the data for this study.

4.2.1 Coding the transcripts of the interviews with the participants

The data for this research study was obtained through two interviews with the five participants, document analysis (lesson plans and reflective writings) and three group reflections after lesson observation. During the initial interview I familiarised myself with the participants and explained the nature of my research study to them. I conducted a second interview with each participant after observing them teaching a lesson, to probe their reflections on their lesson, as well as to clarify their deviations from their lesson plans.

I transcribed these interviews *verbatim* and I read and reread these transcripts a number of times to familiarise myself with the participant's views on teaching mathematics, their planning and how they reflect on lessons.

I used the programme Atlas.ti 6 to code the transcripts. This programme allows the researcher to assign codes by selecting text in the transcripts considered to be relevant to the research focus. I used the *open coding* option to create a new code for a selected piece of text. While coding I read and reread selected sections of text and asked myself: *Does this code really capture the essence of this section?* I focused on meanings of sentences and not only on single words. The initial interviews were coded before the post-observation interviews. Although my interviews were open-ended, they were also structured in such a way as to gather information about participants' understanding of reflection, how and whether they reflect when they plan lessons, how and whether they reflect while teaching a lesson, and how they reflect on their lessons. The research questions and my conceptual framework were constantly in the back of my mind as I coded the data. However, I did not have a preset list of codes, but rather coded the text as I read through the transcripts. This means that although the themes that emerged were determined *a-priori* (in line with the conceptual framework for this study and the research questions guiding the study), the coding was done inductively, using detailed codes for each piece of selected text. I take cognisance of the fact that, *no matter how hard we try there are no purely inductive studies* (Bernard & Ryan, 2009, p. 107).

In Table 4.1 I provide a timeline of the data-gathering process. I have used pseudonyms to protect the identities of the participants.

Table 4.1 Timeline of the data gathering process

Data gathering instrument	**Participants (pseudonyms)**	**Date**
Initial interviews	Dianne, Mary, Vicky, Sipho	2010-07-29 2010-07-30
Classroom observation	Mary Morgan Vicky Dianne Sipho	2011-02-24 2011-03-04 2011-03-10 2011-03-11 2011-03-11
Post-observation interview	Mary Morgan Vicky Dianne Sipho	2011-02-24 2011-03-04 2011-03-10 2011-03-11 2011-03-11

Group reflection on observed lesson	Mary's lesson Morgan's lesson Vicky's lesson Dianne and Sipho's lesson	2011-02-24 2011-03-04 2011-03-10 2011-05-05
Final group interview	Mary, Morgan, Vicky, Dianne, Sipho	2011-05-05

The initial interviews took place in July 2010. The initial interview with Morgan was not taped (due to my nervousness I forgot to press the 'record button' on the tape recorder). The classroom observations could only be conducted in 2011 due to a national teachers' strike during the third term of 2010 and examinations during the fourth term. All the post-observation interviews were conducted immediately after the observation of each lesson. The lesson study group reflected the same afternoon on the lessons of Mary, Morgan and Vicky, but this was not possible in the case of Dianne and Sipho because of the start of the school holidays.

4.2.1.1 Inclusion criteria that determined the coding of the data

Keeping in mind the research questions that guide this study as well as the tentative conceptual framework for the study, I coded text in the transcripts that reveal the participant's

- thinking about his/her mathematics teaching in general (description of self as a teacher; perceived strengths, challenges and joys of being a teacher; teaching style, classroom management, time management, etc.);
- understanding of reflection (I considered the participant's verbal description of reflection during the initial interview and understanding of reflection as revealed in the example of reflective practice he/she provided during this interview);
- reflection-for-action (Before the initial interview I requested that each participant present a lesson plan for discussion. Before the observation lesson I received lesson plans from all the participants that I used during the lesson to determine the participant's reflection-for-action.);
- reflection-on-action (as revealed during the initial and post-observation interviews);
- reflection-in-action (as revealed by the deviations of the provided lesson plan);
- view of situational factors that may influence his/her reflective practice (time, class arrangement, interruptions while teaching, the presence of the researcher in his/her classroom, lesson study experience, etc.).

Table 4.2 summarises the inclusion criteria that determined the coding of the data.

Table 4.2 Inclusion criteria for coding the data

Inclusion criteria	Codes
Reflection on teaching in general as revealed during the two interviews and in the discussion of the lesson plan	Reflection on reason for becoming a mathematics teacher Description of self as a teacher Perceived strengths as teacher Perceived challenges Joys as a teacher Reflection on class management/arrangement Reflection on teaching in line with curriculum Reflection on teaching style Reflection on time management Language
Reflection on specific actions while teaching the lesson	Reflection on action: feelings about the lesson Reflection on action: external factors Reflection on aspects of the lesson that could change Reflection on challenges experienced in lesson taught Reflection on class management/arrangement Reflection on deviation of lesson plan Reflection on lesson plan: teacher's expectations of learners Reflection on other ways to teach the lesson Reflection on strengths of lesson taught Reflection on teaching in line with curriculum Reflection on teaching style Reflection on time management Reflection on unexpected happenings during lesson Language
Reflection on lesson planning	Discussion of lesson plan: perceived challenges Discussion of lesson plan: perceived strengths Discussion of the lesson plan: possible changes Reflection on deviation of lesson plan Reflection on lesson plan: teacher's expectations of learners
Reflection on learners' understanding of mathematics	Reflection on learners' understanding of concepts Reflection on challenges experienced in lesson taught Reflection on other ways to teach the lesson
Reflection on being a participant in this study	Reflection on lesson study experience
Reflection on contextual factors that influence being a reflective teacher	Reflection on action: external factors Reflection on class management/arrangement Reflection on time management Reflection on unexpected happenings during lesson Language

4.2.1.2 Exclusion criteria that determined the coding of the data

I excluded any text that did not provide answers to the interview questions or did not relate to the research questions that guide this study or to the tentative conceptual framework for the study. I also excluded any remarks by the participant that had no direct bearing on the focus of this study. I summarise the exclusion criteria for coding of data in Table 4.3.

Table 4.3 Exclusion criteria for coding data

Exclusion criteria	**Example of text excluded from coding**
Personal anecdotes not related to the focus of the study	*Because actually what happened I had to pay for my signature ...they did not send modules. They confirmed on the other side, we have sent you modules. I said to which post office ... because the first letter I received was from attorneys right away*[7]
Elaborations on their knowledge of mathematics not related to the focus of the study	*You've got mixed numbers here, the other one is just a mixed number and the other one is an ordinary whole number and then you see a fraction somewhere, this is an expression with three terms ... and then you can't add them or subtract them if they are like that, you have to make them to be the same, right, so they must all change. You have to change the mixed number to ... to an ordinary fraction*
Biographical detail not related to the focus of the study	*... then we went to the college because we wanted to alleviate this poverty and then uplift the background then with my youngest sister, all of us we are teachers at home*
Elaborations on past experiences not related to the focus of the study	*... poor backgrounds ... didn't allow us to get bursaries to university we did not have those opportunities in the Eastern Cape, especially the homelands*

The list of codes created for the two interviews are displayed in Table 4.4. During the initial interview I aimed to get acquainted with the participant and this interview probed the biographical background of each participant as a mathematics teacher.

[7] Language used by participants only slightly altered so as not to change the original meaning and nuance.

Table 4.4 List of codes created for the two interviews

Examples of questions during the initial interview	**Codes**
Why did you become a teacher?	Reflection on reason for becoming a mathematics teacher
How would you describe yourself as a teacher?	Description of self as a teacher
What are your strengths as a teacher?	Perceived strengths as teacher
What are the challenges you face as a maths teacher?	Perceived challenges
What are the joys you experience as a maths teacher?	Joys as a teacher
Do you know what reflection is?	Understanding of reflection
Can you give me an example of how you reflected in a lesson? (Discussion of lesson plan brought along)	Example of reflection Reflection on learners' understanding of concepts
Examples of questions during the post-observation interview	**Codes**
What are your feelings about the lesson?	Reflection on action: feelings about the lesson
What were the essential strengths of your lesson?	Reflection on action: external factors
Any challenges you experienced during the lesson?	Reflection on aspects of the lesson that could change
What were your expectations of your learners?	Reflection on challenges experienced in lesson taught
If you had to teach this lesson again what would you change?	Reflection on class management/arrangement
Can you think of any other way you might have taught the lesson?	Reflection on deviation of lesson plan
Do you think the content that was covered was meaningful to the learners?	Reflection on lesson plan: teacher's expectations of learners
(Discussion of deviations from the lesson plan)	Reflection on other ways to teach the lesson
(Discussion of what happened during the lesson)	Reflection on strengths of lesson taught
If you finally reflect on your lesson, how do you feel about it?	Reflection on teaching in line with curriculum
Is there anything else you want to add or say about your lesson?	Reflection on teaching style
	Reflection on time management
	Reflection on unexpected happenings during lesson
	Discussion of lesson plan: perceived challenges
	Discussion of lesson plan: perceived strengths
	Discussion of the lesson plan: possible changes
	Language

The codes in the second column display the categories I created by coding the text after the two interviews. When I coded the transcripts of the second interview, where the participants talked freely in response to a question, I found that more than one code could be associated with one interview question. In my selection of codes I tried to adhere to the following suggestions for categorisation (Dey, 2005):

- Become thoroughly familiar with the data: I read and reread the transcripts numerous times and watched the videos twice.
- Always be sensitive to the context of the data: I interpreted the meanings of phrases as an informed reader who knows the teacher and the context of that teacher's practice.
- Be flexible – extend, modify and discard categories: I located key phrases that speak to the phenomenon in question and discarded those that do not.
- Consider connections and avoid needless overlaps: I created networks of connections with Atlas.ti 6.
- Record the criteria on which category decisions are to be taken: I have provided inclusion and exclusion criteria for coding the transcripts.
- Consider alternative ways of categorising and interpreting data: I did not only rely on the codes that emerged using Atlas.ti 6, but also created matrices to categorise and interpret the data.

4.2.2 Deductive style of indentifying themes

In the next phase of the data analysis I used the programme Atlas.ti 6 to cluster the codes which I considered to be related to each other. These clusters are known as families, which can be broad collections of codes. To create coding families I selected codes from the non-member window in the code family manager in Atlas.ti 6 and made them members of a family by clicking in the member window. Families are not mutually exclusive, which means that one code can be found in more than one family. I used my research questions and my conceptual framework to name the families, which means that my themes were determined *a-priori*, in a deductive way. Six themes were created using Atlas.ti 6, illustrated in the following section with their code links. The themes are mentioned in the following order:

1) Understanding of reflection (as revealed by the participants during the initial interview);
2) Reflection-on-action (as revealed by the participants during the initial and post-observation interviews);
3) Reflection-for-action (as revealed by the participants in their lesson plans);
4) Reflection-in-action (as revealed by the participants during the observation lesson);
5) Content of reflection (revealed during both interviews); and
6) Contextual factors (revealed during both interviews).

4.2.2.1 Theme 1: Understanding of reflection

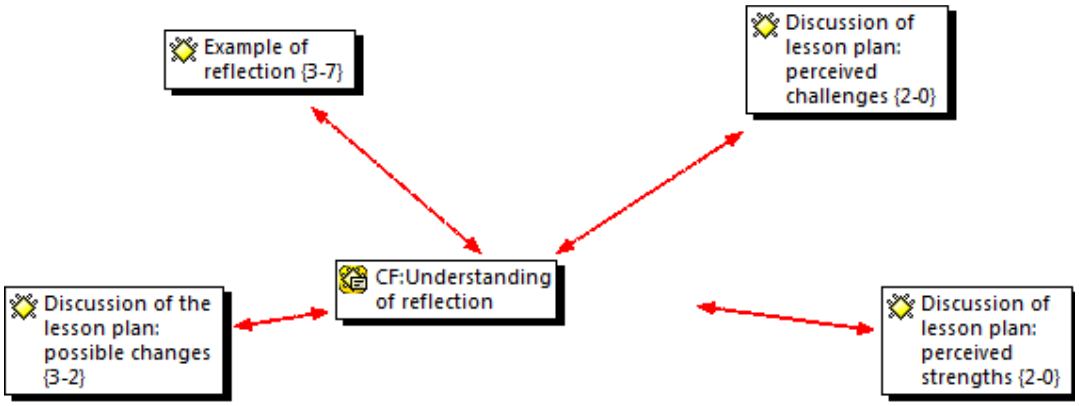


Figure 4.1 Theme: Understanding of reflection

Four codes are linked to the theme **understanding of reflection**. These codes are assigned to this theme based on the discussion of the lesson plan and the example of reflection in their teaching that participants provided during the initial interview.

Each code has a pair of numbers attached to it, for example, the code *example of reflection* has the set of numbers {3-7}. The 3 refers to the groundedness, which is the frequency with which the code was attached to quotations (three participants discussed an example of reflection in their classes). The 7 is the density. This is how many times a code has been linked to another code in the networks that were created. It can give an indication of how pivotal in the different interactions the code is (Archer, 2009). The code *example of reflection* was associated with seven other codes: perceived challenges, perceived strengths as a teacher, external factors, class management, strengths of a lesson taught, feelings about the lesson and aspects of the lesson that could change.

The theme **understanding of reflection** relates to the example of reflection that the participants described during the initial interview. In their discussion of their lesson plans the participants revealed perceived challenges, perceived strengths, and possible changes to the lesson. Through the example of reflective practice that they provided, they revealed their understanding of reflection.

4.2.2.2 Theme 2: Reflection-on-action

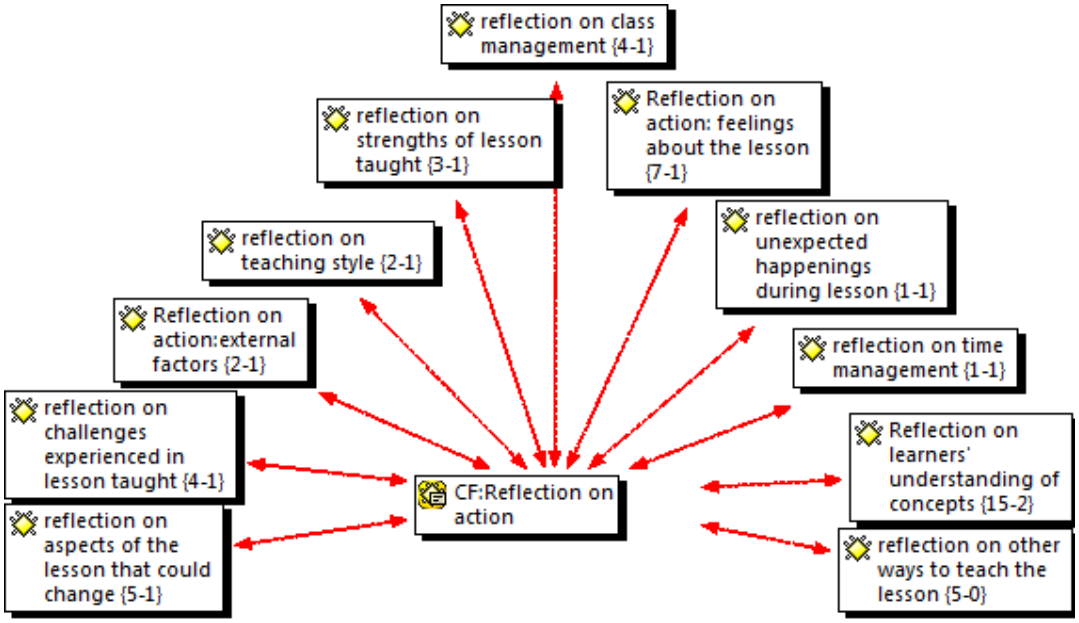


Figure 4.2 Theme: Reflection-on-action

The theme **reflection-on-action** emerged throughout the interviews. The participants reflected on their teaching during the initial interviews as well as during the post-observation interviews. They also reflected on their action during the group reflections on their lessons. They were concerned mainly with unexpected things that happened in their classes while teaching, their feelings regarding the lesson they taught and the fact that they could or could not relate the content to the real-world of the learners. They reflected on their classroom arrangement (working individually, in groups or pairing learners), their time management (they planned to do more examples and class work than possible within the period); most of them lamented their learners' lack of basic knowledge; and they reflected on the challenges they experienced while teaching the lesson (for example their own command of English as well as their learners' reading skills).

4.2.2.3 Theme 3: Reflection-for-action

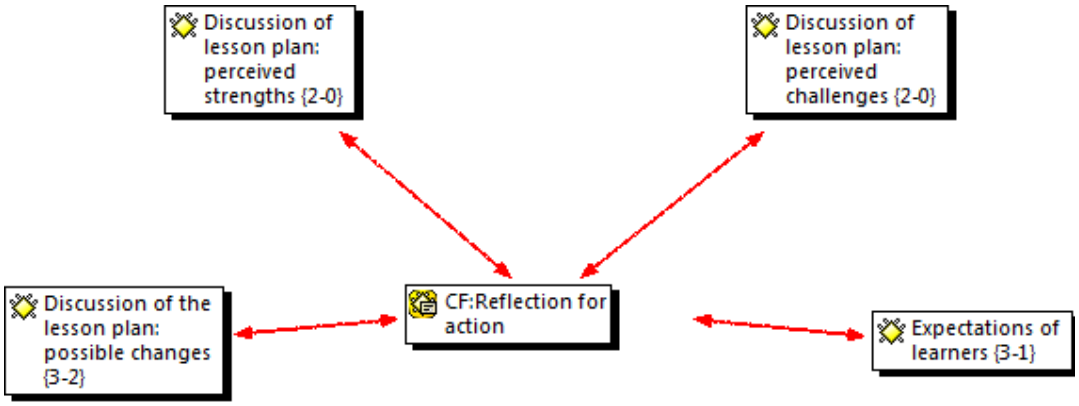


Figure 4.3 Theme: Reflection-for-action

The theme **reflection-for-action** emerged through discussions of the participants' planning of lessons. These lesson plans were discussed during the initial interviews, and also after each lesson observation. Furthermore the lesson study group cooperatively planned the first lesson on linear equations for a Grade 8 class. The lesson was taught by one participant, and after the first group reflection on the observed lesson, each participant had to adapt and change the lesson plan to the level of his/her class. During the interviews the lesson plans were discussed, revealing teachers' reflection-for-action.

4.2.2.4 Theme 4: Reflection-in-action

Figure 4.4 Theme: Reflection-in-action

I coded the participants' reflection on their deviations of their lesson plans for the observation lesson as relating to the theme **reflection-in-action**. Three teachers deviated from their original lesson plans while teaching the lesson, and I associate their deviations with the theme. In all three cases they revealed that they were thinking on their feet.

4.2.2.5 Theme 5: Content of reflection

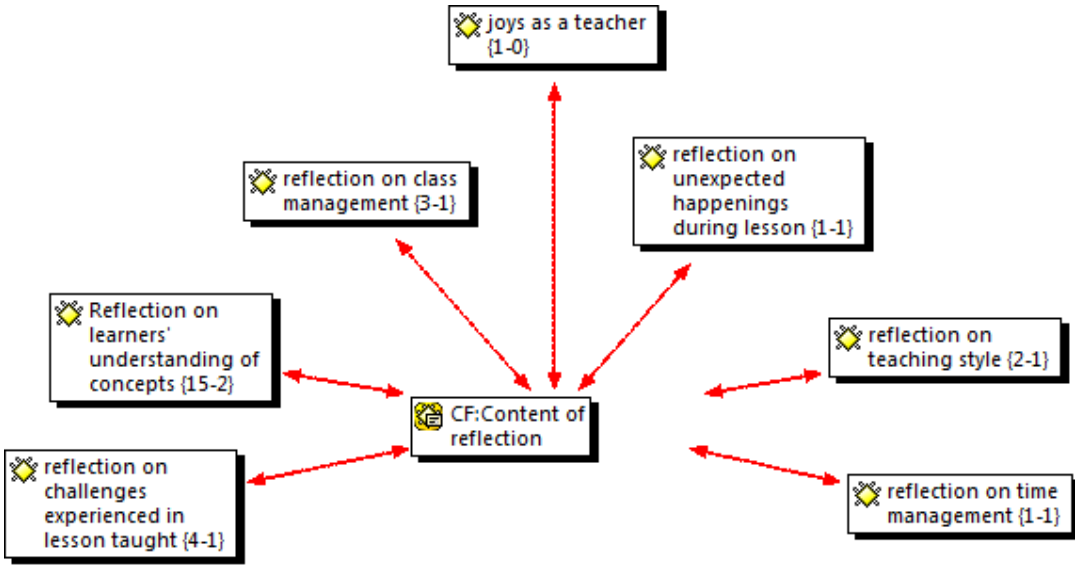


Figure 4.5 Theme: Content of reflection

The theme **content of reflection** basically deals with the content that the teacher reflected on and how deeply he/she reflected. The participants revealed that they reflect on their teaching styles, unexpected things that happen in class, their learners' understanding of concepts, their own time management and class management, the joys of being a teacher and the challenges of being a mathematics teacher.

4.2.2.6 Theme 6: Contextual factors

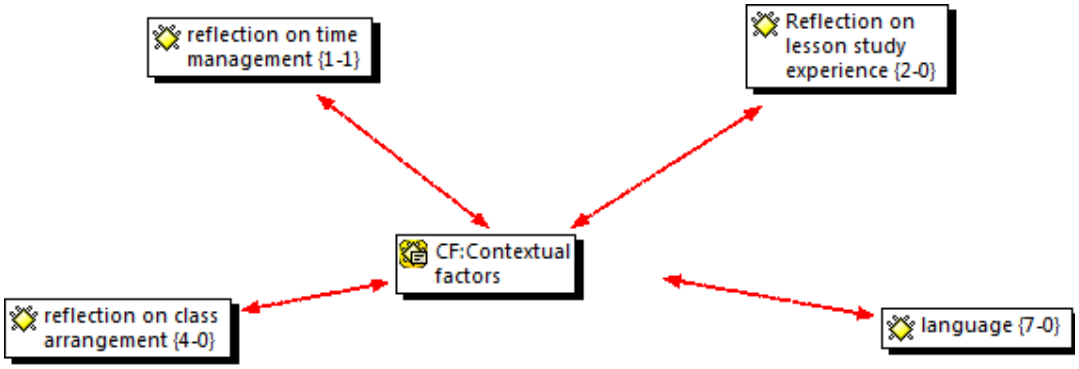


Figure 4.6 Theme: Contextual factors

The theme **contextual factors** reflects the participants' class arrangement, time management, their reflections on being part of the lesson study group and language issues. At first I did not assign the code *language* to this theme, but as I read and reread the transcripts I found that three of the participants repeatedly mentioned the fact that their

learners were struggling with language issues. One of the participants acknowledged that she was not fluent in English and frequently code-switched to Sesotho in her class.

In the next section I discuss the personal ethnographies of each of the five participants. I include demographic data as well as how the participants view themselves as teachers, and their perceived strengths and challenges as a mathematics teacher as reported during the interview.

4.3 Personal ethnographies of the participants

The biographical information of the five participants is provided in Table 4.5. I have used pseudonyms to protect the identities of the participants.

Table 4.5 Biographical information of participants

Participant	Dianne	Mary	Morgan	Sipho	Vicky
Age	32	44	39	48	44
Highest qualification	ACE at UFS	FDE at UP	BSc Ed at Uni QwaQwa	FDE at Uni QwaQwa	BEd Hons at Unisa
Number of years teaching	8	19	14	22	17
Mathematics Grades teaching	11,12 ML	8	10, 12	8, 9	9, 10, 11
Home language	Sesotho	Sesotho	Sesotho	Sesotho	Sesotho

From the table it is clear that these participants are all experienced teachers, with basic teaching qualifications and, except for Dianne, have all been teaching for 14 years or longer. They are all currently teaching in a rural township school where the pass rate for mathematics was 19% in 2010. The participants are pressurised by the school management and district office to improve the pass rate. The school building and grounds are neat and I used the boardroom as an office for the duration of the research. The language of instruction and learning (medium of instruction) at the school is English. Setati, Reed and Bapoo (2002) argue that in the remote rural areas of South Africa where access to English outside the classroom is severely limited, the classroom context is more appropriately described as a foreign language learning environment in which English is a foreign language. This finding has implications for my study, where the participants are teaching in a rural environment and they had to reflect on their practice through the medium of English. In addition, these participants all teach mathematics to learners who do not have textbooks.

4.3.1 Dianne

Dianne is a female teacher with an Advanced Certificate in Education (ACE) qualification obtained from the University of the Free State, QwaQwa Campus. She has been teaching mathematics for eight years and is now teaching Mathematical Literacy, which she claims is *much easier than maths*. When I asked her to describe herself as a teacher she replied:

> *Oh ... describe myself as a teacher, oh ... I am a role model to my learners, I work very hard and I want also them to work very hard, to not to be lazy and, jô ... as a teacher, hey, I do a lot of things, I'm helping also the people outside, not only the learners, like in church, in community with some ideas ... if they go to interviews, I help them ...*

She became a mathematics teacher because *I want to teach the learners maths and to show them mathematics is not a difficult subject*. According to Dianne her strengths as a mathematics teacher lie in the fact that *most of the time I'm not absent, I attend school well and work very hard during school time*. She claims:

> *I enjoy (laughs) ... what I'm enjoying as a teacher ... (laughs) ... Yes I'm enjoying to be with people, yes, I know every morning I'm going to meet the learners ... some are rich, some are poor, they are hungry ... I am enjoying helping them, giving money for break to eat something, I ... I love learners, yes ...*

The challenges she experiences teaching mathematics are in her own words:

> *Jô ... You taught to learners ... when you go out, you give them test ... they've got zero ... everything you taught them you ask as it is, but they got zero ... feeling that's very challenging, because ... Hey, they say when you talk ... they write class work ... they pass, after two weeks, test ... they fail, they say that it is easy when you talk to them or when you're still explaining ... when they are alone, they say they forget everything ...*

4.3.2 Mary

Mary is a female teacher who has a Primary Teaching Diploma (PTD) and a Further Diploma in Education obtained from the University of Pretoria. She has been teaching for 18 years and is currently teaching mathematics to Grade 8. She describes herself as a teacher as follows:

> *I'm very, very good ... I enjoy doing everything, explaining mathematics, also Life Sciences and I'm real-life centred, that's what makes my learners understand easily ...*

However, when asked about the challenges she experiences as a teacher, she replied:

Even if you can explain so many times, they say ma'am we understand, now we understand ... but just leave them like that and give them a task, the following day you find that when you are teaching ... the problem is that when you are teaching ... they can't take examples that you are writing. They don't write, they don't like to write ... They don't want to practise ...

4.3.3 Morgan

Morgan has a BSc (Ed) qualification obtained from the University of Free State QwaQwa campus. According to him he became a teacher because he saw there was a shortage of mathematics teachers. He enjoys working with the learners but feels challenged when they struggle.

I think the challenge one ... that I have is where you ask the learners basic questions like the LCM ... it becomes frustrated to me if you have two numbers, 5 and 2, and you ask them what is the lowest common multiple then the learners cannot give you the lowest common multiple ... to me it is very, very frustrating ... because I expected that one to be a basic one ...

4.3.4 Sipho

Sipho is a male teacher with a Further Diploma in Education from the University of Free State QwaQwa campus. He has been teaching mathematics for 20 years. According to him, he chose teaching as a career *because I love to work with kids and mathematics teaching because when I was at school I was a person who was loving mathematics*.

However, in our discussion of the lesson plan he brought with during the initial interview, he revealed that he felt challenged by learners' lack of reading skills. In his words:

you know that ... usually after I've done that, I try to bring about an application, that is the problem solving of this ... now what is challenging to the kids, usually I find that the interpretation of a question, the language, they cannot read the language ...

4.3.5 Vicky

Vicky is a female teacher with a BEd (Hons) obtained from Unisa. She has been teaching mathematics for 16 years. Vicky claims that she became a teacher because of her love of learners, but then she admits that

actually it was not ... for the first time it was not my intention but ... due to financial constraints that we had then I decided to take teaching as one of the things because I was able to ...

She mentions that the learners struggle with mathematics and regards that as her biggest challenge:

> *Jô. Here the challenge that I face, since I came here is ... the learners, I don't know, I really don't understand ... they don't have background of maths, they don't have the interest or the love of what they are doing. You can do whatever ... try to come with different methods and challenges but ... they don't cope, I don't know what's hindering them, those, like today I was presenting, we have done ... dealt with this for so long, equations ... with them, then today I come with a puzzle, so that we can do a puzzle on that one, jô, I am struggling ... because they have forgotten everything I have done (laughs) ...*

She describes herself as a teacher in the following way:

> *Sjoe, as a teacher, being a teacher you ... you are more than what you thought you are, you ... you become a guardian to them, or to many of them ... you become a preacher and a minister. I find myself most of the time being a social worker because when I was studying I deviated a little bit from maths and science. I do an honours of psychology of education, therefore I see that these learners, they need parental involvement through their lives. I want to help the learners therefore that is one of the things that mostly I do here at the school ... is more like counselling ... because we find that most of them, when you say why did you not do your homework, they will say that's because we don't have food at home ... because if you look at the background of the learners, most of them are suffering ...*

In the next section I portray the participants' reflections in relation to the six themes of the study. These themes characterise the similarities in the data but also reveal the subtle differences because of the individuality of each participant.

4.4 Participants' reflections in relation to the themes of the study

4.4.1 Theme 1: Participants' understanding of reflection

Only two of the five participants were able to verbally explain what the term reflection was and three of them were able to give an example of how they reflected in class (see Table 4.6). Although all the participants reflected during the interviews on their strengths as a teacher, the challenges they experienced when teaching mathematics, and their learners' understanding of mathematics concepts, they did not seem to realise that they were actually **reflecting** on their practice.

Table 4.6 Participants' understanding of reflection

Participant	Theme: Understanding of reflection
Dianne	Unable to explain what reflection and also unable to give an example of when she reflected in her class. When asked to give an example of reflection she said: *When I'm introducing a lesson, I gave them the explanation simple ... like mean, what is mean ... sum over ... and then after explanation, I do problems and examples, lots of examples ... I give them exercise too, like class work ...*
Mary	Unable to explain what reflection is and unable to give an example of when she reflected in her class
Sipho	Unable to explain what reflection is and unable to give an example of when he reflected in his class. I asked him: *When you taught this lesson was there any instance when you stopped and wondered ... shouldn't you do it differently ... because you can see the learners are struggling? Was there such an instance here?* He replied: *No ... no ...*
Morgan	Views reflection as follows: *Reflection is thinking back to last year's results, comparing last year's results to this year.* As an example he says: *I reflect in class when seeing learners misunderstanding something and then I think of another way to explain it.*
Vicky	Explains reflection as: *... how do I see myself or my learners ...* She reflects on her learners' poor backgrounds, for example: *Therefore I think that is through refection that I've changed the way of teaching. I have tried to come closer to them and see their own problem and how can I help them. What is it that they are lacking?*

Compared to the way reflection is defined in the literature[8], both Morgan and Vicky were able to explain what the term means. However, their explanations differed in the sense that Morgan focused on the mathematics results (which were very poor) and his concern about improving the results. In the literature Zeichner and Liston (1996, p. 11) believe that this type of reflection indicates a reflective teacher who is asking the broader question: *Are the results good, for whom and in what ways?* On the other hand Vicky focused on her view of herself and on her learners, taking her belief structure into account in her understanding of reflection. These two participants have different understandings of reflection. This finding mirrors results of Pedro's (2001) study where the participants provided different definitions of reflection. It seems that more than one perception of reflection is possible (Osterman & Kottkamp, 1993; Sparks-Langer, 1992; Zeichner & Liston, 1996).

[8] See Chapter 2, Section 2.4.1.1

To analyse the participants' example of reflection which they explained to me during the first interview, I have kept the four criteria for defining reflection[9] of Lee and Tan (2004) in mind. Measured against the first criterion, **examination of practice**, where reflection is not merely recalling a teaching incident in a general manner, but reflective thinking is seen as **focused and directed at particular issues or concerns about practice**, Dianne's example of reflection cannot be regarded as true reflective thinking because she is not reflecting about concerns that she has about her practice, but merely recalling the teaching incident in a general manner. (Lee & Tan, 2004). Morgan's example relates to his learners' understanding of mathematics, which he finds problematic and reflects on possible changes that he will have to make in order to meet his learners' needs, thereby demonstrating reflective thinking. Vicky's reflection on her learners' poor backgrounds might be considered to be critical reflection if one takes into account Liou's (2000, p. 199) definition of reflection: *Critical reflection is examining teaching experiences as a basis for evaluation and decision making and as a source for change.*

In the next section I discuss how the participants reflected on their classroom practice during the interviews.

4.4.2 Theme 2: Reflection-on-action

According to Schön (1987) reflection begins with the recognition that an educational dilemma or emotional discomfort exists in response to professional experiences. Not all the participants in this study reflected on their actions in the class, especially in relation to their learners' lack of understanding of concepts. However, they did reflect on events that had happened in class, but some of them failed to relate these events to their actions. All these reflections were prompted by the questions in both the interviews, as well as while they cooperatively watched the video recordings of their observed lessons. A discussion of each participant's reflection-on-action follows.

4.4.2.1 Dianne

During the two interviews Dianne reflected on the **needs of learners**, *some poor, some hungry*; the value of teaching mathematics related to real world, (for example teaching learners about BMI (body mass index) and data handling (how to gather information). She also reflected on her own **inability to use English fluently**:

> *the challenge is eh ... eish ... language ... I, I thought my English tongue is not so well ... that is the challenge ...*

[9] See Chapter 2, Section 2.4.1.1

She felt proud of her grouping of her learners (**class arrangement**) but concerned about her **time management**. She also reflected on other ways to teach her lesson on BMI:

> *Other way? Hmmm ... hey ... if they can come with the young graphs, what is this, clinic card, sometimes they can come with their baby clinic ... their own ... but I don't think they have ... and also to take the scale ... what is this ... is the scale, to make sure they know their weight, they stand there and you see your weight? ... Right, now from today you know your weight ... and then to take a tape for me to measure them, and then we can calculate the real BMI for each one. I can teach it that way again, it is practical too.*

4.4.2.2 Mary

In Mary's reflection on her action, she reflects on technical details only, for example blaming her **learners' lack of interest in mathematics** on their calculator usage and their obsession with their cell phones. In this instance she did not relate their lack of understanding to her teaching, but to external events.

> *I've given them some work to do, they will take out their cell phones and they would put in those earphones ... I don't know ... then they play music. When outside ... they are playing, they like playing, especially with the cell phones. When they get home it's TV time. Not homework time ...*

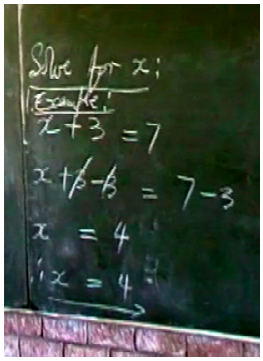
Like Dianne she was also concerned about her **time management** in class, and rationalised that she could not finish or wrap up a lesson because of **external factors**, such as the learning facilitator of Life Orientation who interrupted her class to get the work books of learners.

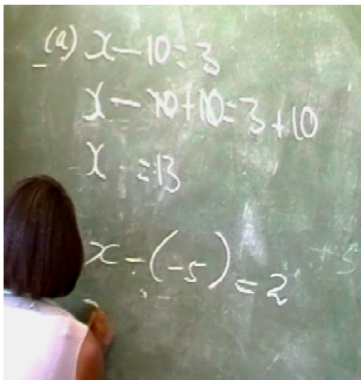
> *Yes, I taught them but ... I did not get ... eh ... did not really wrap up the lesson, maybe according to time that I allocated there, I said 40 minutes, OK strictly 40 minutes, OK, maybe I'll be on the body (*of the lesson*)10 minutes, 5 minutes interruption or 2 or less, and then get a child (unclear) ... I did not also give a full homework to say OK, I'm now applying my lesson ... I did not get a chance to apply my lesson, as if it was not planned ... I'll also blame what, though not negatively, the situations that emanated, the process to plan our own things, there are other things that are coming all of a sudden, now you have to step, now you have to open cupboards, now you have to take books, now you have to choose ... within this time that I was supposed to be teaching ... and now I have to cater for the learning facilitator of life sciences at the same time ...*

However, Mary reflected on the **content** she taught (e.g. the examples she selected for the class) and admitted that she did not do them from simple to complex (see Picture 4.1 below):

> *I would think of calculations ... it was more complex, because I ... I had just given them a fresh calculation that is very simple. Now all of a sudden the second example is more difficult, it's having brackets ... so there, I nearly ... killed them, that's why*

they struggled. I was also confused, I was now confused, I wanted ... I was having a feeling of say ... but now I have to catch up, hey, I've mentioned these things in my plan, I said I'm going to give them this rather than ... you know, I did not now think of them grasping gradually ... you see they were not suppose ... at least I should do about five calculations of the simple started form ...





Picture 4.1 Pictures portraying Mary's examples and class work for Grade 8

The first picture shows how Mary explained to her Grade 8 mathematics class how to use the additive inverse when solving linear equations, using a very basic example, $x + 3 = 7$. The second picture illustrates the equation that the learners struggled to do on their own: $x - (-5) = 2$, which is much more complicated than her first example, or even the second one, $x - 10 = 3$. In addition, she started her explanation of $x - (-5) = 2$ when the bell has already rung for break, and the class was not paying attention at that stage.

Mary referred to the **curriculum** when discussing the challenge of catering for all learners in her mathematics class as follows:

I look at what I give them in the form of activities, that at least my activities ... there must be those that are simple for learners with low levels of abilities and then, those who are moderate, but there should be those that are challenging also for very intelligent learners, likewise those who have low abilities ... they are forced now by the curriculum if you can see, they are forced to know, they have to know ... setting of question papers is so hard now, they have to know everything, they don't compromise when they set these papers, those even in Grade 12, for learners, they can't say, even in Grade 9, they can't say, now let's think for those who have low abilities, that at least they pass ... make 50% of the paper to be very simple, no, they don't do that ...

4.4.2.3 Morgan

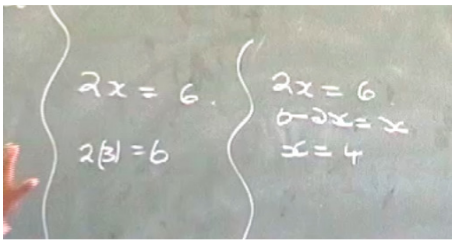
In the post-observation interview with Morgan he reflected constantly on his **learners' understanding of mathematics** concepts. Unlike Mary he reflected on how his actions

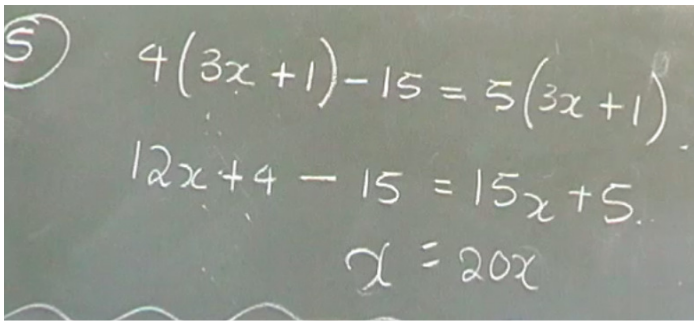
influence the learners' understanding of mathematics. He reflected on how to link new knowledge (solving linear equations in Grade 10) to learners' pre-knowledge (using the distributive law):

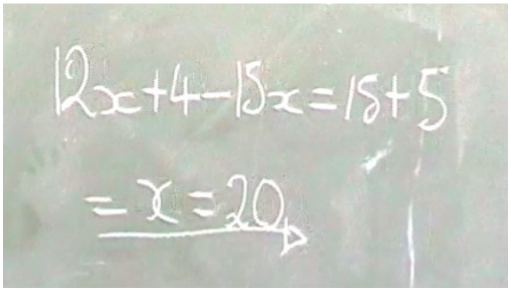
> *According to my understanding, if you are dealing with the learners, you do not need to frustrate them, you take them from the easiest one, eh ... from what do they know from other grades, then you take it step by step by taking the linear equation from Grade 8 then I take it to Grade 9, until I arrive at the Grade 10 where I expect them, where they have the brackets, so that they can apply what they learned in Grade 9, to apply the distributive law, from the distributive law ... eh ... we have equation where they have unknown on either side, where I expect them to discover from that they can be able to take the unknown from one side and the constant to the other side, and from thereafter when I see they are able to do that, I introduce the fractional equations ...*

Morgan asked his Grade 10 mathematics learners to clarify concepts and explain verbally how they would calculate a sum. He used questioning effectively and called on learners to do examples on the board (see Picture 4.2). When I asked him about not correcting the wrong examples on the board he said

> *I leave it to the learners so that the learners, they try to compare ... for them to make their own conclusion ... that this one is wrong, maybe it's wrong ... where ... what are the things that are wrong ...*







Picture 4.2 Examples of Morgan's Grade 10 learners' problematic work on the blackboard

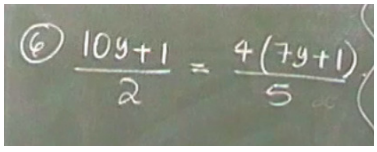
These examples portray some of the misconceptions of Morgan's Grade 10 learners, for example in the last picture one can see that the learner adds $12x$ to 4, gets $16x$ and then subtracts $15x$ from it to get x.

Reflecting on his **teaching style** (which he calls the discovery method) he said:

> *The most thing that I liked about the lesson is the discovery method where I invite the learners to come and show me what they are doing on the board, so that I can exactly know what they know and what they don't know.*

I asked Morgan what he would change if he had to teach the lesson again and once again he reflected on **learners' understanding of concepts**. In his lesson on linear equations it emerged that the learners did not understand how to obtain the lowest common multiple to solve fractional equations (see Picture 4.3 below), which he regarded as a challenge.

> *I think if I have to review the lesson, because I'm going to do it tomorrow, the things that I have to emphasise are the following: the important one is to make sure that all of them understand how to take the unknown to one side and the constant to the other side, and the other thing that I need to revisit is eh ... to find the lowest common multiple ... I need ... I need to go back to the algebraic fractions where they are dealing with the LCM so that all of them they can be on the same par ... so that they are not struggling ...*



Picture 4.3 Solving fractional equations

4.4.2.4 Sipho

Sipho reflected on **learners' lack of understanding English** during the discussion of the lesson plan in the initial interview:

> *you know that usually after I've done that I try to bring about an application, that is the problem solving of this ... now what is challenging to the kids usually, I find that interpretation of question ... the language, they cannot read the language ...*

In the post-observation interview he once again reflected on **learners' lack of understanding concepts** because of language issues:

> *sometimes the problem of English, when you say ascending order ... they don't understand ... ascending order ... what is that ... ascending ... to go up ... to start with the bigger exponent ... instead of starting with the smaller exponent*

However, Sipho not only reflected on his learners' understanding of mathematics concepts, but also on their **thinking**:

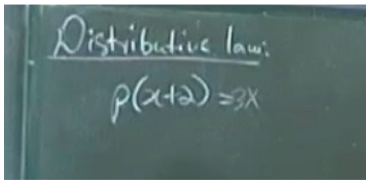
> *Sometimes when they struggle, sometimes it's important that, perhaps ... when someone stands up and come to the board and write something ... it's good to give him a chance perhaps to explain what he has written, to see how does he think, why he's writing it in that way, so that you can understand the way he thinks, because people think in different ways ...*

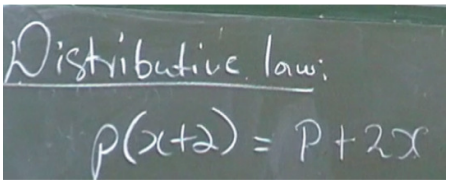
Sipho also reflected on **learners' lack of basic skills** and said *they got that intrinsic motivation but they don't have basic mathematical skills.* He was also, like Mary and Dianne, concerned about his **time management** in class:

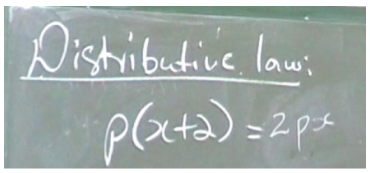
> *Sometimes I wanted to ask them questions, but due to time ... cause I realise that ... time ... eh ... I won't finish ... that is ... I won't be able to finish my lesson ...*

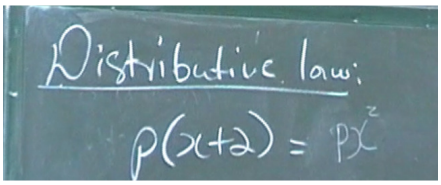
Sipho reflected on the **challenges** he experienced in his lesson (illustrated by the pictures below) on the product of the binomial as follows:

> *They amazed me because I expected them to be in a position to multiply ... you see, but I realised that they cannot ... they amazed me because I expected them to in the position to identify like terms and ... add them quickly but ... they struggled ... they amazed me with basic things you see ... hmm ...*









Picture 4.4 Examples of Sipho's Grade 9 learners' problematic work on the board

These pictures display some of the learners' misconceptions regarding the distributive law, for instance in the last picture one can see that the learner multiplied p by x and then confused the "+ 2 " with an exponent.

Sipho also reflected on his **learners' needs**:

> *but most ... the majority ... they are very weak ... they are very weak ... so they need one to give themselves time ... the motivation to show them that ... you know, sometimes if you show you care for them, if you try to give them that individual attention ... sometimes it helps them to be somehow independent ... to do things the way you do them ... they need that kind of consideration ...*

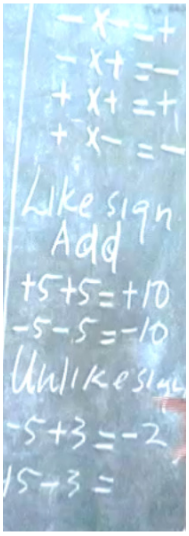
4.4.2.5 Vicky

Vicky reflected not only on the **needs of learners** but also on her own **shortcomings as a teacher** and her impatience with her Grade 9 learners' slow understanding of concepts.

> *How I speak, that is the first thing that I would change. I talk very quickly, that is ... I don't know how to change that one ... I expect them to understand quickly ... that is my problem ... I want them to ... I'll give them first problem, second problem, third problem, when we get to the fourth one ... Ai, ... I loose my temper sometimes (laughs) ... then I'll go to them straight away and usually I give ... eh ... a what ... twist their ears ... that is what I normally do ...*

She knew that her class was struggling with basic concepts and while she was teaching the lesson she wrote all the rules for integer computations down on the board and constantly referred the learners back to it when they made mistakes (see Picture 4.5). She reflected on her **teaching style** as follows:

> *but for this class, I have to repeat it two times before they understand. Even, like normally ... when I deal with them, I have to write negative multiplied by negative, all the formal things, the basics, that they must know from the previous Grade 8, Grade 9 ... normally I have to do it, because I know this particular class is having this kind of problem ...*



Picture 4.5 Vicky's rules for multiplication and addition of integers for Grade 9

The picture portrays Vicky's teaching of mathematics by using rules. This might be a reflection of her view of mathematics.

I summarise the participants' reflections on their actions in class in Table 4.7.

Table 4.7 Summary of participants' reflection-on-action

	Dianne	Mary	Morgan	Sipho	Vicky
Learners' needs	2		1	1	5
Learners' understanding	1	4	4	2	4
Language issues	2			1	1
Time management	1	1		1	
Classroom management	1			1	1
Teaching style		1	1		1
Learners' thinking				1	
Curriculum		2			
External factors		3			
Shortcomings as a teacher					2

In this table the quantity of each participant's reflection on certain issues is shown. For example, Mary, Morgan and Vicky constantly reflected on their learners' understanding of concepts, but only Sipho reflected on his learners' thinking. Although Mary reflected on her

learners' understanding, she did not think about how her actions might influence their lack of understanding. She was also the only participant concerned with external factors in explaining her actions (she reflected on three occasions during the various interviews on her learners' preoccupation with their cell phones and their need to use calculators for the most basic calculations, as well as blaming learning facilitators for her poor time management). Dianne, Sipho and Vicky reflected on learners' lack of understanding English, and Dianne also revealed her concerns about her own poor command of English during the post-observation interview.

According to Korthagen and Vasalos (2005) teachers usually reflect on aspects such as the classroom environment, learner behaviour, competencies of learners and beliefs about learners. The issues that the participants in my research study reflected on confirm the results of Korthagen and Vasalos (2005) and I categorised the content of their reflection-on-action as follows: 1) Reflections on pedagogical issues (classroom management, time management, teaching style, learners' understanding of mathematics) 2) Reflections on personal issues (language, shortcomings as a teacher) 3) Reflections on external factors (curriculum, interferences while teaching, class size) 4) Reflection on critical matters (learners' needs, learners' thinking).

Using these categories it appears that all the participants reflected on pedagogical issues and this finding is supported by a number of researchers (e.g. Butke, 2003; LaBoskey, 1994; Lee & Tan, 2004). Two participants, Dianne and Vicky, reflected on personal issues (Dianne's lack of fluency in English and Vicky's impatience with her learners and the knowledge that she speaks too fast). Unlike these participants' reflections, LaBoskey (1994) revealed that the participants in her study reflected on personal enjoyment and degree of enlightenment gained from the teaching experience. However, the participants in my study did reflect on the joys and challenges they experienced while teaching mathematics during the initial interview. Only Mary in my study reflected on curricular matters, unlike the four preservice teachers in Pedro's (2001) study. Three participants, Morgan, Sipho and Vicky, reflected on critical issues (their learners' needs, learners' thinking and addressing learners' lack of understanding of mathematics). This category is also addressed by Butke (2003) in her study of five choral teachers' reflective journeys. However, in contrast to my study, she found that her participants reflected on critical issues such as the importance of student citizenship, building a relational practice, issues of multicultural education, gender issues, and creating a sense of community.

In the literature consulted it is mentioned that teachers reflect on their actions when instigated to do so (García, Sánchez & Esquadero, 2006; Sowder, 2007) and this is also true for the participants of my research study who were required to reflect on their classroom practice in the lesson study group. What I found interesting is that none of the teachers reflected on their assessment of their learners. One reason for this might be because I did not specifically address this issue during the interviews or during the group reflections.

In the next section I discuss the participants' reflection-for-action.

4.4.3 Theme 3: Reflection-for-action

I used the participants' lesson plans to analyse their reflection-for-action. They were asked to bring a lesson plan along for discussion during the initial interview. For the observed lesson I provided them with a basic lesson plan template[10] which they used to cooperatively plan the first Grade 8 lesson on linear equations in the lesson study cycle. This template makes provision not only for reflection after the lesson, but also for reflection before the lesson is taught (in a column where the teacher reflects on his/her expectations of learner responses or understanding). None of the participants completed these reflection sections.

Each participant had to adapt this lesson plan to teach his/her observation lesson in the next lesson study cycle. The lesson plan was discussed and adapted after each group reflection on the lesson observed, and the aim was to try and improve the lesson plan in order to enhance learners' understanding of the concepts (which was the goal of the lesson study group).

The lesson plan for the observation lesson was analysed while the participant was teaching the lesson and any deviations that occurred were discussed during the post-observation interview.

4.4.3.1 Dianne's lesson planning

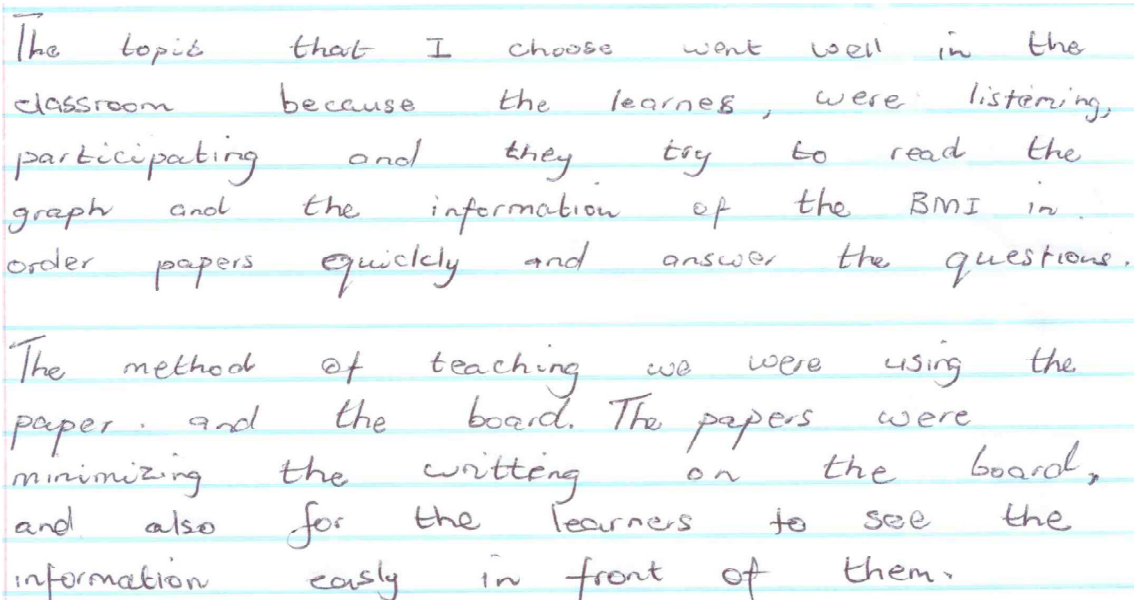
Dianne brought a one-page lesson plan template along during the initial interview. The template contained lesson plans for Grade 11 during the week 13 July to 26 July. Three data handling activities were provided with limited detail of the activity. Next to the teacher activity Dianne wrote *explain and give examples*; next to learner activity she wrote *do homework/class work*; next to expanded opportunities she wrote *more activities*; next to assessment instrument she wrote *memo*; her resource(s) was the *text book* and next to teacher reflection she wrote nothing. However, before the observation lesson she submitted

[10] See Appendix A

a detailed lesson plan on BMI for the Grade 11 Mathematical Literacy lesson. She admitted that she had learned a lot about lesson planning during the group reflection sessions we had after watching Mary and Morgan's lessons. In her teaching of the lesson Dianne adhered closely to her lesson plan and did not deviate from it, although she did not have enough time to complete the conversion of degrees Celsius to degrees Fahrenheit. In her lesson plan she made provision for learners' understanding of the content as follows: *I want learners to know how to substitute into a formula and to work with different formulas and use correct formula for a calculation also in life.*

She briefly mentioned their prior knowledge and future knowledge and her class arrangement and assessment. She provided two detailed examples as well as the activity the learners will be engaged in. However, she did not reveal her expectations of her learners or special needs that learners might have.

In her written reflection after the observation lesson she wrote: *It was easy for me to present the lesson because of the lesson plan Barbara designed for us.* She reflected on her learners' conduct in class, describing what happened in class.


The topic that I choose went well in the classroom because the learners, were listening, participating and they try to read the graph and the information of the BMI in order papers equickly and answer the questions.

The method of teaching we were using the paper. and the board. The papers were minimizing the writting on the board, and also for the learners to see the information easly in front of them.

4.4.3.2 Mary's lesson planning

During the initial interview Mary submitted a form with the date, learning outcome, assessment standard and content as an example of her planning. From this template one cannot picture how these lessons were taught. This template does not make provision for assessment, how the plan is linked to learners' learning of concepts and the ability of the

teacher to teach effectively. The needs of the learners are also not addressed. However, for the Grade 8 lesson on equations that I observed Mary provided a detailed lesson plan. In her lesson plan she reflected on her learners' understanding of equations as follows: *from their participation the teacher is able to draw feedback of their understanding*. I asked her what she meant with this statement and she replied:

> *As the one person is in front, is working on behalf of the class, and then ... I will see the level of the class ... of his understanding ... what ... through their participation, as you could see they participated more, and then they were trying to tell her how to do it, even though she was nervous, but they knew what should be done ...*

Although Mary explained to me in the post-observation interview that she tried to cater for the needs of all her learners there was no evidence of that in her lesson plan. However, in her written reflection on the lesson she reflected on the time she had wasted trying to mark all of the 54 learners' work and felt she should have rather given them a *fully-fleshed activity of maybe ten equations.*

4.4.3.3 Morgan's lesson planning

Morgan submitted a lesson plan template of Calculus lessons that he had taught for Grade 12 during the week of 21 June to 25 June. The lesson plan made provision for reflection, but he left that space open. The template did not make provision for teaching methodology or special needs of learners. From the template it was difficult to picture what had happened in the classroom during that week. Morgan's lesson plan for the observation lesson did not reveal much more than the template he submitted during the initial interview. However, he wrote out the examples he planned to do, as well as the class work in more detail. He provided no details of his expectations of his learners but in his final written reflection he reflected on their lack of understanding of solving equations and how he could help them:

> *I need to do everything in detail like writing in explanation each and every step because ... if ... I assume that the learner have pre-knowledge but they do stupid mistakes.*

Morgan's deviations from his lesson plan will be discussed when dealing with the theme *Reflection-in-action.*

4.4.3.4 Sipho's lesson planning

Sipho did not bring a lesson plan for discussion during the initial interview, but he provided a detailed lesson plan before the classroom observation. His lesson plan dealt with the product of two binomials. In his plan he provided an introduction to the lesson and three examples. During his teaching of the lesson he also deviated from his lesson plan and this will be discussed when dealing with the theme *Reflection-in-action.* His lesson plan did not make provision for special needs of learners and he did not explain his teaching methodology in his plan. As teacher activity he wrote *Facilitation.*

In his written reflection on his observation lesson he mentioned that he should have placed more emphasis on the application of the distributive law when finding the products of binomials, the addition and subtraction of like terms after multiplication of binomials, and the use of the number line for guiding the learners to add and subtract integers.

4.4.3.5 Vicky's lesson planning

During the initial interview Vicky provided me with a lesson plan template for six days, from 4 May to 11 May. No grade was written down and the content column revealed that the learners were doing revision of simple and compound interest, wrote a test, and then started with the Cartesian plane, drawing $y = mx + c$ and plotting points on the plane using the table method. Vicky's lesson plan for the observation lesson had a good introduction and her three examples were written down. However, the rest of the plan was done cryptically with no reflection on her expectations of her learners or how she would teach the content.

In her written reflection of her observation lesson Vicky wrote that she learned from her colleagues to involve her learners more in the lesson.

To sum up, it appears that hardly any reflection on planning to teach the content to increase learners' understanding of the concepts was evident in the participants' lesson plans. The lesson plans they submitted for the observation lessons were slightly more informative because they used a template that I provided, but none of them revealed any reflections on their expectations of the learners (although provision for this was made on the template). In their post-lesson written reflections the participants reflected only on Jay and Johnson's (2002) descriptive level (describing what happened in class). No evidence of critical reflection was found in the participants' lesson plans. This finding contrasts with the study by Luwango (2008) who investigated three mathematics teachers' critical reflective teaching in Namibia. She found evidence of reflection in the three teachers' lesson plans and concluded that critical reflection directs planning in terms of future actions (Luwango, 2008).

4.4.4 Theme 4: Reflection-in-action

Schön (1987) describes reflection-in-action as becoming surprised, interpreting it as a problem, and inventing procedures to solve the problem.

To determine each participant's reflection-in-action I used the lesson plan provided to me before the observation lesson and, during the observed lesson, I made notes on the lesson plan whenever the participant deviated from it. In the post-observation interview I asked each participant to explain the deviation and their explanations reflected that they were thinking on their feet. Reflection-in-action involves simultaneously reflecting and doing, and this implies that the professional has reached a level of competence, where he or she is able to think consciously about what is taking place, and modify actions instantaneously (Hatton & Smith, 2006).

Three of the participants in this study deviated from their lesson plans. Morgan planned to do eight examples but only did seven, including the eighth example as part of the homework. I asked him why and he said he was thinking of the time factor, and also that he needed to rather do one example that was on a higher level: $4(3x + 1) - 15 = 5(3x - 1)$, because he anticipated that the learners would not know what to do with the negative 15.

Sipho also deviated from his lesson plan. He introduced the product of two binomials on the board using a rectangle that was divided into four sections (a square and three rectangles) and explained to the learners how to find the area of the big rectangle by adding the areas of the four shapes. The learners struggled to find the correct area. He then deviated from his lesson plan and wrote the following on the board: If $p = x + 3$, find $p(x + 2)$. He explained this deviation as follows:

> *That is where ... I realised thereafter ... before I do this* (he refers to his planned examples)*, I should have got to show them the distributive, before I do this ... I should have done this after I have shown them this ... and that is when I realised that I've made a mistake ...*

Vicky deviated from her lesson plan by including the mathematical problem $(-3x + 2)(4x - 1)$ during the lesson while all the binomial products in her original lesson plan had positive x-coefficients. She explained this deviation to me by saying that she included it due to the common exam that all the Grade 9 learners would write the next week: *I decided let me challenge them and come with something that is different, that is why I have added this one with the negative.*

Although a number of theorists and researchers (Artzt, Armour-Thomas & Curcio, 2008; Butke, 2003; Jaworski, 2004; Nyaumwe, 2005; Pedro, 2001; Schön, 1983) believe that reflection-in-action is an active process in which doing and thinking are complementary, not all believe that reflection-in-action is possible[11] (e.g. Court, 1988; Van Manen, 1995). However, there is evidence in the literature that teachers do reflect-in-action (Artzt, Armour-Thomas & Curcio, 2008; Leikin & Dinur, 2003; Pedro, 2001; Ross & Bruce, 2005). Reed, Davis and Nyabanyaba (2003) argue that it is difficult to trace teachers' reflection-in-action if the researcher does not speak the main or primary language of the teacher whom she interviews and they stress that classroom observation is essential to capture these reflections. In my research study the teachers' reflection-in-action was captured using the teacher's lesson plan in conjunction with the classroom observation.

4.4.5 Theme 5: Content of reflection

The participants' content and depth of reflection relates to the level of their reflections. Different levels of reflection have been discussed in Chapter 2.3. Some researchers use the level of reflection interchangeably with depth of reflection (e.g. Lee, 2005; Jay & Johnson, 2002) and others relate the level of reflection to the content of reflection (e.g. Van Manen, 1977). In my study I considered both depth and content as the level of reflection, and I base my rationale to consider both on Lee's (2005, p. 712) argument that *one can reflect in depth on technical/practical issues and be considered at a lower level; as long as one considers moral and ethical issues even without justification, one can be considered reflecting at a high level*. In other words a teacher can be considered to reflect critically on a technical aspect of his/her teaching if there is a moral or ethical justification for it.

In Table 4.8 I summarise my view of the participants' levels of reflection, based on their revelations during the two interviews, also keeping in mind my observation of each participant. I used Lee's (2005) levels of reflections to determine the level of reflection of each participant[12]. Lee's (2005) levels of reflections consist of a recall level (R1), a rationalisation level (R2) and a reflective level (R3).

[11] See Sections 2.2.2.1
[12] See Section 2.3.5

Table 4.8 Participants' level (content) of reflection

Participants	Content of reflection	Level of reflection (Lee, 2005)
Dianne	Needs of learners; her poor command of English; relating mathematics to the real world; time management and her teaching style	R1 (recall level of reflection) R2 (rationalisation level of reflection)
Mary	Learners' lack of interest in mathematics, time management; teaching style and curriculum	R1 (Recall level of reflection)
Morgan	Learners' understanding of concepts; linking new knowledge to pre-knowledge; teaching style	R1 (recall level of reflection) R2 (rationalisation level of reflection)
Sipho	Learners' lack of language skills; learners' understanding of concepts; learners' lack of basic skills; learners thinking	R1 (recall level of reflection) R2 (rationalisation level of reflection)
Vicky	Needs of learners; own shortcomings as a teacher; impatience with learners' lack of understanding	R1 (recall level of reflection) R2 (rationalisation level of reflection)

From the table it appears as if none of the participants were able to reflect critically on their teaching. In my attempt to evaluate the level of each participant's reflection (during the interviews, in their lesson plans and reflective writings, and while watching the video recordings of their teaching) I had to consult the literature repeatedly, trying to capture the essence of what critical reflection is. According to Van Manen (1977) critical reflection entails the questioning of moral, ethical, and other types of normative criteria related directly and indirectly to the classroom. On Lee's (2005) reflectivity level one approaches experiences with the intention of changing/ improving in the future, analyses experiences from various perspectives, and is able to see the influence of cooperating teachers on students' values/behaviour/achievement. Critical reflection for Valli (1992) focuses on social, moral and political dimensions of education and involves making judgements based on ethical criteria. On Jay and Johnson's (2002) critical reflective level the teacher will consider all the different perspectives of a situation or problem and all the players involved: teachers, students, the school, and the community.

In contrast to my study's results, where none of the participants reflected on a critical level at this stage of the data analysis, Nyaumwe (2005) found that three of the four pre-service teachers' post-lesson reflective texts attained deliberate reflection (Level 2) and one of them reached the systematic reflection (Level 3) on the third visit. He used Hall's proposed three levels of reflection (Hall, cited in Nyaumwe, 2005): The first level (**fleeting**) involves random or everyday reflection (reflection at this level does not go deeper than thinking, remembering

or narrating one's practice); Level 2 (committed or **deliberate reflection**) involves an evaluation of the effectiveness of pedagogical decisions and actions without using the results to improve practice (reflection at this level is focused on action and it may or may not directly contribute to the improvement of practice); and programmatic, deliberate or systematic reflection at Level 3 (takes place when reflection results in **designing actions** that improve subsequent practice).

4.4.6 Theme 6: Contextual factors that influence reflection

Lee and Tan (2004) identified personal dispositions as a crucial contextual factor that influences student teachers' practice of reflection. If they are confident and competent they are more inclined to practice reflection in their classrooms. The other contextual factor that plays a role is, according to Lee and Tan (2004), interpersonal contexts (in the case of the student teachers the quality of the mentoring they received was crucial).

In this study the crucial contextual factor that emerged from the interviews with the participants was the opportunity that was created for reflection by the research project. Vicky reflected on the value her participation in the research project had on her classroom management:

> *Because everything was planned, (laughs) ... even if, I have changed, when you come, I decided I'm letting them sit in pairs, normally I use individual, and it was big class, when you enter my class from last term ... because, normally I don't resort to group lesson, because I want everybody to do it on their own, but this time I decided that, let me pair them in pairs, maybe they can help one another, and then, I think it works, because I could see that when I said ... do it for yourself ... then you come ... then the other turns to the one they know that could assist them, they do not turn to the neighbour, but they could turn to another one, which they know that they will understand better than themselves ...*

During the initial interview with Dianne when we discussed her lesson plan on data handling she said she would not change anything in the lesson if she had to teach it again. However, during the post-observation interview she was able to think of two alternative ways of teaching the lesson on BMI. She also reflected that she had learned to plan better because of the research project.

Morgan reflected on the value of being observed while teaching as follows:

> *I think ... what I maybe need to add is ... the sessions like this one are very important where you teach ... someone is watching you ... is giving you feedback because in that way you ... as a teacher you can be able to improve ... to be able to improve ... because the person who is observing you ... eh ... is maybe going to advise you,*

because in the session if you did something like this, like this ... then is going to improve your lessons ...

Another contextual factor that appeared to influence the reflections of the participants of this study was **language**. On numerous occasions the issue of language was raised by three of the participants (Dianne, Mary and Sipho), either complaining about their own command of English or referring to their learners' language proficiency. My findings provide some evidence in favour of Reed, Davis and Nyabanyaba (2003) in their investigations on teachers' reflective practice in under-resourced multilingual contexts. They suspected that those teachers who were more fluent in English found it easier to speak reflectively. However, the one researcher who was able to switch to the main language of some of the teachers in the least reflective band reported that switching to this language did not promote reflective discourse (Reed, Davis & Nyabanyaba, 2003). This finding suggests that in order to become a member of reflective practitioners, teachers may need to be apprenticed into reflective discourses, and further research is needed on this issue (Reed, Davis & Nyabanyaba, 2003).

The contextual factors that seem to influence the participants' reflections are summarised in Table 4.9.

Table 4.9 Contextual factors that influence participants' reflections

	Dianne	Mary	Morgan	Sipho	Vicky
Contextual factors	• Language • Lesson study experience		Lesson study experience	Language	Lesson study experience

From the table it seems as if Mary is the only participant who did not reveal any contextual factors that might influence her reflective practice, although she reflected on external factors that influence learners' understanding of mathematics. The rest of the participants mentioned the value of the lesson study experience and language as contextual factors influencing their reflective practice.

In the next section I discuss the interpretation of the lesson study group reflections and the final group reflection.

4.5 Results of lesson study group reflections

In this section I discuss the results of the lesson study group reflections.

4.5.1 Discussion of lesson study group reflections on lessons observed

After each classroom observation the lesson study group met in the afternoon, observed the video-recording of a lesson and then reflected on their observations. According to Taylor *et al.* (2005) observing a lesson enables teachers to shift their thinking from a teaching focus to a learning focus while puzzling over their learners' mathematical thinking. As observers, they are free to focus on the actual work the learners are doing and the learners' thought processes. During the lesson study group discussions I took fieldnotes and focused mainly on hearing the participants' individual voices while they were reflecting on the observed lesson as a group. I searched the literature for similar research but there seemed to be a lack thereof. Most of the research (e.g. Cerbin & Kopp, 2006; Coe, Carl & Frick, 2010; Fernandez, Cannon & Chokshi, 2003; Friedman, 2005; Hix, 2008) on lesson study report in general on the process and not in detail on the content of the individual teachers' reflections in the group (as I have done below) during the evaluation cycle.

4.5.1.1 Lesson study group reflection on Mary's lesson

Mary's lesson was the first that the group watched and discussed. Morgan, Mary and Dianne were present during the lesson discussion. Sipho and Vicky had to attend a labour meeting.

Morgan reflected on Mary's **introduction**, which he thought was *good because it relates to the learners' world*. He also reflected on her **lack of helping learners to understand** addition of integers and suggested that she should show learners how to add integers using the number line. He expressed **concern about treating the learners fairly** and catering for all learners' needs. Morgan's reflection on Mary's lessons is on a critical level (Jay & Johnson, 2002; Lee, 2005).

> *We should cater for all learners ... sometimes you plan a worksheet for your class, and after one or two examples you see they don't understand, and then only a few sums are done ...*

Dianne reflected on the **class size** (more than 50 learners in the class) and the fact that the learners do not have **textbooks**. Here she is still reflecting only on a technical level (Van Manen, 1977) or descriptive level/recall level (Jay & Johnson, 2002; Lee, 2005).

Mary reflected on the **time** she had wasted with the examples as well as the fact that she tried to mark every single learner's book. She is reflecting on her own actions while teaching

and thinking about what she could have changed to help her learners to gain the concepts, which, according to Jay and Johnson (2002), is on a descriptive and comparative level of reflection. However, she is not reflecting critically about how she should change her teaching to ensure that learners gain a deeper understanding of mathematics.

The group reflected on Mary's **lesson plan** and agreed that it could be improved. They suggested that in each lesson plan the grade should be mentioned and teachers should plan according to the level of their learners (e.g. Mary planned to divide or multiply by the coefficient of the variable, but this did not happen during the lesson because her learners struggled to transpose the constant term in an equation to the other side). The lesson plan should reflect the teacher's expectations of the learners and should include how the lesson would be wrapped up and what homework would be given.

4.5.1.2 Lesson study group reflection on Morgan's lesson

All the participants were present at the post-observation discussion. Dianne and Vicky criticised Morgan for not using the additive inverse to solve equations when he did the examples on the board (reflecting on his **teaching of the concepts**). They were reflecting on Level 2 of Jay and Johnson's (2002) taxonomy, in a comparative way (comparing Morgan's lesson with Mary's, who used the additive inverse in her examples of linear equations). Mary commented on his **teaching style**, which was learner-centred, also reflecting in a comparative way (her own lesson was not learner-centred). Vicky compared her own teaching style to Morgan's and reflected that she would have to prepare well for her observation lesson. The group reacted positively to the way Morgan conducted his class.

They reflected on Morgan's **lesson plan** and agreed that it could still be improved. They observed that the goals for the lesson should be clear. Morgan wrote as one of his goals that learners would be able to convert problems into linear equation form. This did not materialise in the lesson. Morgan deviated from his plan by omitting two examples. His reason was that the one example was easier than the previous one and he included that in the homework. He also asked the learners to do only one of the four planned activities, due to the fact that the learners did the examples on the board and that took up too much time.

4.5.1.3 Lesson study group reflection on Vicky's lesson

All the participants were present during the observation of the video and a fruitful reflection on her lesson was held afterwards. I found that the group was getting more fluent in their discussions. They seemed to reflect more openly and talk more freely during the

discussions. They were also less careful of each other's feelings and as a result they criticised some aspects of the lesson but also praised where this was due.

The group reflected mainly on how to **help learners to gain basic concepts**, like adding and multiplying integers. Vicky addressed the basics while doing the examples by writing the rules for addition and multiplication of integers down. Morgan suggested that she should use the number line to help learners to understand addition of negative and positive numbers, Sipho suggested that all learners should have the multiplication tables in the back of their books and Mary showed the group how to use their fingers when multiplying 7 by 7. Dianne said:

> *What I liked, she knew that they are going to struggle with the signs and the first 3 examples she gives them everything, how to multiply, after that she gives them the more difficult examples ...*

The group also reflected on her **class arrangement and discipline**. She paired the learners according to their performance, so that they could help each other. Vicky admitted that she became impatient with the learners when they struggled to understand the content. Morgan stressed the **importance of being patient with learners**, reflecting on a critical level (Lee, 2005):

> *We need to be very patient with the learners. When you teach them, we need to make sure that you motivate the learners.*

The group discussed Vicky's **lesson plan** and concluded that it could still be improved by writing down the teacher's expectations of her learners.

4.5.1.4 Lesson study group reflection on Sipho's lesson

Sipho's lesson was observed by all the participants and the lesson was discussed briefly because Morgan and Sipho had other obligations. The group reflected on his **introduction**, which they felt was good and they also felt positively about his **interaction with his learners** and the way he conducted his class. Once again, they all reflected on the **learners' lack of understanding of basic concepts**, for example, the learners struggled to add $3x$ to $6x$.

4.5.1.5 Lesson study group reflection on Dianne's lesson

Only Vicky and Mary were present to watch Dianne's lesson on video. The rest of the lesson study group were in a meeting with the principal and Sipho had to attend to his soccer team.

Vicky reflected on Dianne's **teaching style**, which she believed was too teacher-centred with little learner involvement. Mary reflected on Dianne's **topic** which she considered to be very interesting and also commented on the fact that **Mathematical Literacy learners** were actually using mathematics formula and doing mathematical calculations.

Dianne reflected on her own **poor command of English** and her nervousness being video-taped. She also commented on the fact that she could see on the video that the learners actually understood English well. She said that she was going to do less code-switching in future.

In Table 4.10 I summarise the content and level of reflection revealed in the group discussions on each lesson.

Table 4.10 Summary of content and level of reflection revealed during the lesson study group reflections after each lesson

Lesson study group reflections	**Mary's lesson on 2011-02-24**	**Morgan's lesson on 2011-03-04**	**Vicky's lesson on 2011-03-10**	**Sipho's lesson on 2011-05-05**	**Dianne's lesson on 2011-05-05**
Content of reflection	The introduction; her teaching style; learners' understanding ; class size and lack of textbooks; her lesson plan	Teaching of the content; teaching style (learner-centred); lesson plan	Her methodology; learners' understanding of concepts; her expectations of her learners; teaching style; class arrangement and management; learners' needs	His introduction; his teaching style; learners' understanding of concepts	Her teaching style; the topic; language
Level of lesson study group reflection (Jay & Johnson, 2002; Lee, 2005)	R3 (Critical reflection / Reflective level: Considering the implications of her teaching for learners)	R2 (Comparative level / Rationalisation level: Thinking about his teaching from different perspectives)	R3 (Critical reflection / Reflective level: Considering the implications of her teaching for learners)	R1 (Descriptive reflection / Recall level: Describing his actions in class)	R2 (Comparative level / Rationalisation level: Thinking about her teaching from different perspectives)

Table 4.10 illustrates two dimensions of this research study, namely content of reflection and level of reflection. The content of the group reflections was measured using Jay and

Johnson's (2002) and Lee's (2005) levels of reflection (see Section 2.3). From the table it seems that, during the group reflections, the individual participants reflected on all three levels: Descriptive/Recall (describing the actions of the teacher observed), Comparative/Rationalisation level (comparing individual reflections on the lesson with each other's perceptions) and Critical reflection/Reflective level (considering the implications of the teacher's actions on learners' understanding of mathematics). This was in contrast with the individual participant's reflections during the two interviews, in which none of them revealed critical reflectivity on their practice. However, during the group reflections, while reflecting cooperatively on a lesson that they observed, they reflected critically (R3) on Mary and Vicky's lessons, considering the implications of each teacher's actions on their learners' understanding of mathematics. This finding is mirrored in the literature by Yoon and Kim (2009) who found that when reflection was done at a collaborative level by their participants, the dynamics of reflection among group members was greater than individual reflection.

4.5.2 Final group reflection on being part of the lesson study group

Initially I planned a focus group interview to determine how the participants experienced being part of the lesson study group. Due to unforeseen circumstances at the school the scheduled focus group interview could not take place. One of the participants was called for a meeting with the school management just before the start of the focus group interview and another participant excused himself in order to attend to his soccer team. Only three participants remained and I conducted a general discussion with the three participants and asked them to talk freely and openly about their experiences in the lesson study group. Dianne and Mary conversed in their home language (Sesotho) and Vicky translated their conversation for me. Afterwards I asked each participant individually to tell me about their experiences and to elaborate on Vicky's translation of their conversation. During the same afternoon I conducted a telephonic interview with Morgan and Sipho to ascertain their opinions on being part of the lesson study group.

The participants reported that they had gained a lot from being part of the lesson study group. A summary of their reflections appear in Figure 4.7. They mentioned the following aspects:

4.5.2.1 Lesson planning

Dianne and Mary discussed the influence of the lesson study group on their planning as follows: *Previously we did not spend much time on lesson plans, and now, because of what we have done, it is much easier for us ...*

4.5.2.2 Teaching mathematics

Dianne and Mary felt that their learners had also gained from their teachers' being in the lesson study group because

> *I was lazy and slow ... now I'm more determined to ... whatever we have learned, to transfer it to the learners. I see learners as differently from the first ... we gained that when you are teaching you must start from simple to complex, and we gained that you must question the learners a lot and involve the learners ... yes, we gained a lot and we have improved a lot ...*

Dianne also reflected that she would, after the lesson study group experience, use more English in her class: *I now realise that the learners are able to do the work in English. I thought that learners do not understand but now I want to uplift the learners ...*

4.5.2.3 Self-observation

The participants all reflected on the value of self-observation. Mary said:

> *You can see yourself and what you are doing now ... you take yourself out, out, and you are looking at yourself as if you are looking at another person who is performing ... you see another part of you that you haven't noticed, then you feel very bad when you see I'm not doing what I think I'm doing ...*

Vicky said:

> *After seeing myself in the video, it was as if I was researching myself, it was research that was done for me. I gained a lot, and everybody has gained a lot from this, because after seeing yourself you could see the mistakes that you are doing and you are able to rectify them, therefore I'm not looking at this as your research, we are looking at this as comprehensive maths research ...*

Morgan said he appreciated the opportunity that the lesson study group provided to watch his colleagues and himself and saw how he dealt with the learners. *This leads to introspection so that you can improve when you go back into the class.*

4.5.2.4 Observation of colleagues

Morgan reflected that he had learned a lot from the classroom observations. Watching his other colleagues helped him to make his own lessons more learner-centred and to focus more on learners and their needs rather than on finishing the syllabus. He also realised that he had to be more patient with the learners and their lack of understanding and help them to master the basics so that they did not become discouraged. Vicky said:

> *We have learned of so many approaches for teaching, each one of the educators here, and really that benefits the school a lot, even you yourself, it's not only the school that will benefit but also the learners, but even yourself is going to benefit so much, the approach, the style ...*

Dianne reflected on the value of observation her colleagues as follows:

> *We learned from each other, like in Morgan's lesson. Most of the time he talk to the learners, ask them questions, give learners time to think and ask them to write answers on the board. From Mary I learned that she gives learners examples first and then let them solve ... and then, they waste time but learners understand, they understand. From Sipho I learned that he facilitates, not facilitating but checking every learner's book, and give learners chance to write on the board ... from Vicky ... she gives learners lots of examples for them to understand ...*

4.5.2.5 Group discussions

Sipho appreciated the positive feedback that he received from his colleagues in the lesson study group. Morgan also commented on the fact that during the group discussions, criticism was done in a positive way, indicating the teacher's strong points and providing suggestions for improvement. Mary reflected that from the group discussions

> *I learned more about our educators as teachers because when we are here ... we talk about ourselves and how we experience the learners.*

I summarise the benefits of lesson study reported by the participants in Section 4.5.2 in the Figure4.7. I use a circular diagram to illustrate the influence of the lesson study cycle on the participants' reflective journeys. They reported that they improved their lesson planning as a result of the lesson study group planning sessions. They were more confident about their teaching after seeing themselves on video. They expressed a deeper awareness of their learners' needs. They learned from watching their fellow participants on video to change their teaching to become more learner-centred; and they felt as if they were doing self-research by being part of this research study.

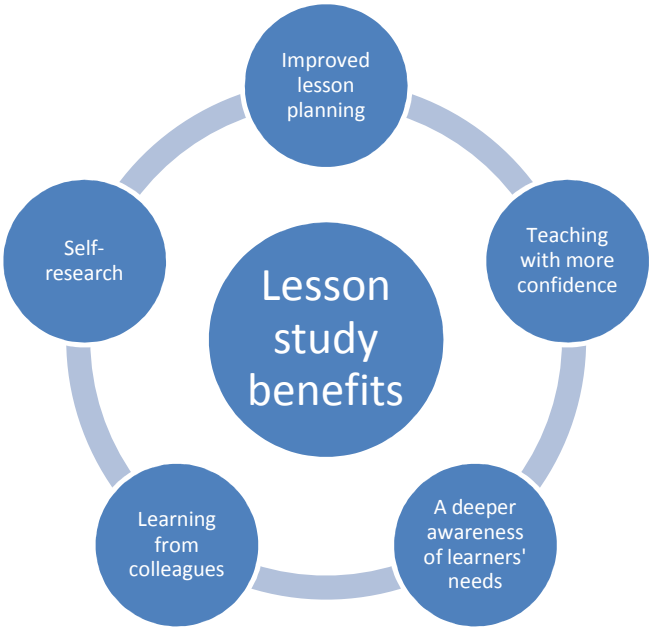


Figure 4.7 Benefits of lesson study reported by the participants

In the literature there is confirmation of the benefits of lesson study as reported by my research study's participants. Lewis (2000) mentions that research lessons impact on teachers' individual professional development, their view of learners (they *learn to see children*), new content and approaches are acquired, competing views of teaching emerge, and a demand for improvement is created. Hix (2008) confirms that the sum of planning collaboratively, anticipating student responses, creating evaluation questions for observers, observing the public teaching, and discussing and reflecting on the observations are beneficial to teachers' reflective practice. Friedman (2005) reports that the major advantage of lesson study for teachers is the collaboration factor which supports the findings of this study.

4.6 The reflective journey of each individual participant

The developmental process of the participants' reflective practice was analysed with a focus on the content, moment and the depth of their reflection. In this section I discuss the reflective journey of each of the five participants from the initial interviews up to the last group reflections. This journey is illustrated in Figure 4.8.

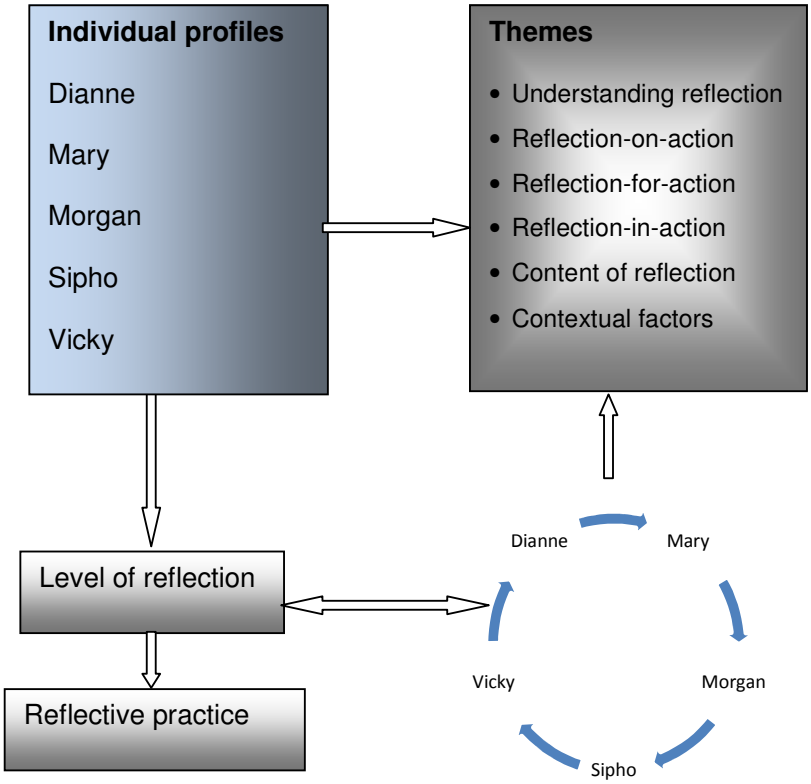


Figure 4.8 The reflective journey of individual participants

In the figure the individual profiles of the five participants are linked to the six themes of this research study. The participants' levels of reflection were established during the interviews and in their lesson study group reflections (the circular diagram). The arrows in the figure indicate a possible relationship between the individual participant's level of reflection and his/her reflective practice. A possible relationship between the lesson study group and the individual participant's reflection is also portrayed in the figure.

4.6.1 Dianne

During the initial interview Dianne could not explain her understanding of the term reflection, and she was unable to give an example of how she reflected in her classroom. She told me about a lesson on data handling that she taught to Grade 10 mathematics learners and said she experienced no problems in class. She could not think of any other way to teach the lesson she was telling me about in the interview, saying *Change? ... nothing ... nothing to change.* Her lesson plan for this lesson did not contain any evidence of reflection. However, during the post-observation interview she reflected on what she liked about her lesson, her

own inability to use English fluently, as well as on her misinterpretation of her learners' command of English. She was also able to provide two alternative ways of teaching her lesson, and expressed surprise that her learners were eager to work on the board during this lesson.

During the lesson study group reflections Dianne (who was the youngest participant and teaching Mathematical Literacy, unlike the rest of the group who were all mathematics teachers) talked freely about what she considered worthy aspects of the lessons observed (for example Vicky's class arrangement and her examples that were structured from simple to complex). She also criticised Morgan for teaching the learners to solve linear equations without formally transferring the constant term to the right-hand side of the equation. During the final group reflection she admitted that her view of learners had changed because of the lesson study experience. She revealed that she was using questioning more effectively and tried to involve the learners more in her lessons.

In my view Dianne has grown as a reflective practitioner. Although she was unable to reveal her understanding of reflection, she reflected-on-action and her reflections most often occurred at Level R1 (recall level) and then slowly extended to the R2 level (rationalisation level) (Lee, 2005). She is not yet reflecting critically on the impact of her teaching on her learners' understanding of mathematics and how she should change to achieve this, but I believe that the lesson study experience helped her to view her own teaching from a different angle (through the eyes of her colleagues). The contextual factor that seems to influence her reflections is language.

4.6.2 Mary

During the initial interview Mary could not explain her understanding of the term reflection, and she was unable to give an example of how she reflected in her classroom. However, Mary regarded herself highly as a mathematics teacher during this interview, explaining to me in detail how she related mathematics to the learners' real-life experiences. When asked whether she would teach the lesson she was describing in any other way, she replied: *I ... I ... I would, but I did it this way, I also give them other strategies, but I think this one was the simplest to them.* This reply indicated that she was not thinking of changing her teaching method to develop her learners' understanding of the concepts, and her reflections during this interview were only on a recall level (R1 level of reflection) (Lee, 2005).

During the post-observation interview Mary was able to reflect on how to introduce linear equations to Grade 8 learners:

> *but when you are breaking the ice ... you want to talk about ... maybe twins ... how am I going to ... you want to create that set-up where the left-hand side and the right-hand side are being balanced, you see ...*

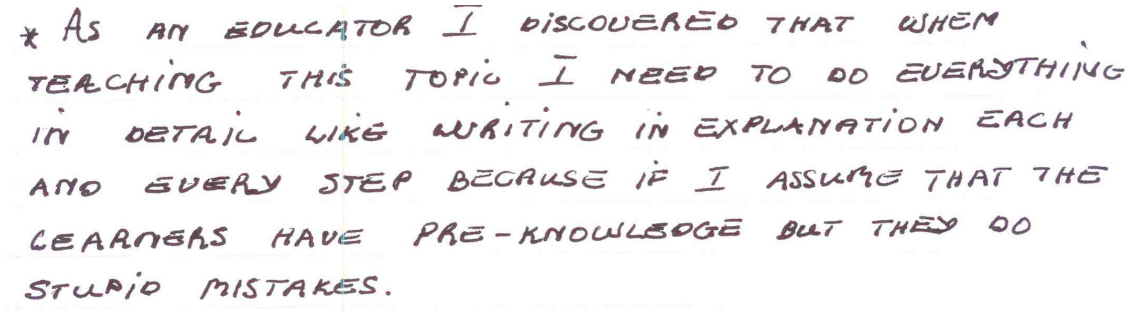
She reflected more deeply on her own actions during this interview, thinking back on her time management and the fact that she was unable to wrap-up her lesson or give the learners homework to do. However, during the interview she still blamed external factors for her lack of time management, revealing that she was only reflecting on a technical level (Level R1, recall level) (Lee, 2005). During the group reflections Mary's reflections were still only on Level R1 (recall) (Lee, 2005). She reflected on Dianne's topic, Morgan and Sipho's learner-centred teaching style, and Vicky's examples, ordered from simple to complex.

However, in her written reflection on her observation lesson, she attributed her poor time management to her own actions (the fact that she tried to mark all the learners' class work during the lesson, and the time wasted by calling one learner to the board who wasted time doing the example). When asked what she would change about the observation lesson, she admitted that she had not planned the lesson with her learners in mind: *you know, I did not now think of them ... grasping gradually* ... To me, this acknowledgement as well as her final reflective writing revealed that she was reflecting on a deeper level than during the initial interview, progressing to Level R2 (rationalisation level of reflection) (Lee, 2005).

4.6.3 Morgan

Morgan explained the term "reflection" as *looking back* on actions taken in class. During the post-observation interview Morgan revealed his knowledge about his learners' level of mathematics when he explained to me why he clarified terminology before he started with his Grade 10 lesson on linear equations: *you do not need to frustrate them ... you take them from the easiest one, eh ... from what do they know from other grades, then you take it step by step ...* Morgan knew his learners and his teaching approach actively involved the learners in the lesson. Based on the interview I had with him I considered him to reflect on Level R2 of Lee's (2005) reflection levels (a rationalising level), but during the group reflections on each other's lessons, I realised that he was reflecting on a critical level (Level R3 of Lee's (2005) reflection levels), thinking about how each teacher could change their lesson in order to improve the learners' understanding of mathematics.

In his final reflection on his observation lesson he wrote:


* As an educator I discovered that when teaching this topic I need to do everything in detail like writing in explanation each and every step because if I assume that the learners have pre-knowledge but they do stupid mistakes.

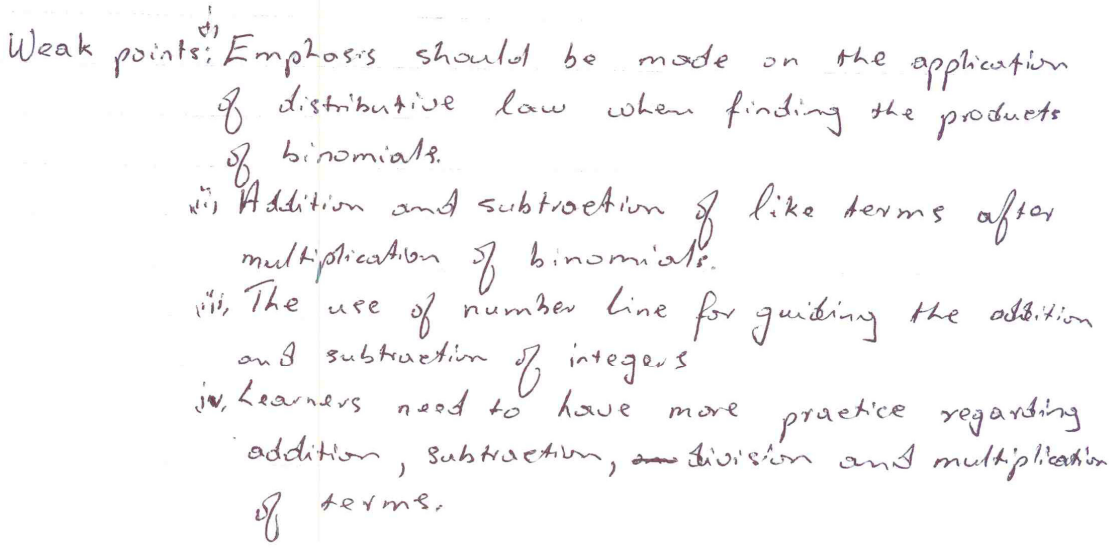
I consider his reflective writing to be only on a rationalisation level of reflection (Level R2) (Lee, 2005).

4.6.4 Sipho

Sipho could not explain his understanding of the term “reflection” to me during the initial interview. However, during this interview he said he would change the way he taught a lesson depending on the challenges he experienced emanating from the learners. He was concerned about the learners’ understanding of trigonometric problems due to their poor command of English. During this interview he reflected on his actions in relation to the learners’ lack of basic knowledge: *it seems as if you are not doing enough ... or something like that ... but as you can see they lack background ... that is, they lack foundation, that is the basic knowledge ...* At this stage Sipho was still reflecting on Level R2 of Lee’s (2005) levels of reflection, rationalising about his learners’ lack of understanding, but not with the intention of changing his actions in the future.

Sipho attended only two group reflections during the course of the research project. He reflected on learners’ lack of basic computational skills during the discussion on Vicky’s lesson, but his reflections were on a technical level only, (Level R1) of Lee’s (2005) reflection levels.

In his final reflective writing he wrote the following, which indicated that he was reflecting on his learners’ understanding of the concepts, as well as his presentation of the content, once again not reflecting on a critical level of reflection (Level R3, reflective level) (Lee, 2005).


Weak points: i) Emphasis should be made on the application of distributive law when finding the products of binomials.
ii) Addition and subtraction of like terms after multiplication of binomials.
iii) The use of number line for guiding the addition and subtraction of integers
iv) Learners need to have more practice regarding addition, subtraction, ~~and~~ division and multiplication of terms.

4.6.5 Vicky

Vicky revealed her understanding of the term "reflection" as *looking forward.* She reflected on her concern for her learners during both interviews, describing herself as a counsellor in the initial interview. However, during the second interview she revealed that through reflection she was able to change the way she was teaching. She was reflecting on a critical level (Level R3 reflective level) (Lee, 2005):

> *I think that is through reflection that I've changed the way of teaching. I have tried to come closer to them and see their own problem and how can I help them. What is it that they are lacking? Like I said, they don't have anything. Financial background is allowing them that they cannot participate* ...

However, Vicky's written reflection after her observation lesson was only on a R1 level (recall level) (Lee, 2005). It seems as if she was able to reflect verbally on a deeper level than with written reflections. This finding supports Lee's (2005) observation that each participant in his study indicated different preferences and abilities in the various communication modes: written reflections and oral format.

4.7 Conclusion

In this chapter I discussed the coding of the data, which was done inductively using the programme Atlas.ti 6. Twenty-six codes were created from the *verbatim* transcriptions of the two interviews with participants of this study. These codes were assigned to the six themes that were created deductively from the research questions and conceptual framework for this study, namely, 1) understanding of reflection; 2) reflection-on-action; 3) reflection-for-action;

4) reflection-in-action; 5) content of reflection; and 6) contextual factors influencing participants' reflective practice.

I then gave the ethnographic profiles of each of the five participants of the study, followed by each participant's reflection in relation to the six themes of the study (see the summary in the Table 4.11).

Table 4.11 Participants' reflections in relation to the themes of this study

Themes	Dianne	Mary	Morgan	Sipho	Vicky
Understanding of reflection			*		*
Reflection-on-action	*	*	*	*	*
Reflection-for-action					
Reflection-in-action			*	*	*
Content of reflection	*	*	*	*	*
Contextual factors	*		*	*	*

From the table it appears that two participants seem to understand the concept of reflection; all reflected-on-action during the interviews; none of the participants reflected-for-action in their lesson plans or in their reflective writings after the observation lesson; three participants reflected-in-action by explaining their deviations from their lesson plans; all the participants revealed the content of their reflections during the interviews and four participants revealed contextual factors that influenced their reflective abilities, namely language and the value of being in the lesson study group.

In this chapter I also reported the results of the lesson study group reflections on each participant's observation lesson. In the lesson study group the individual participants reflected on Level 3 of Jay and Johnson's (2002) and Lee's (2005) levels of reflection, which means that their reflections were on a critical reflective level. This is in contrast to the individual participant's reflections during the initial and post-observation interviews, where none of them seem to be able to reflect critically on their practice.

Finally I reported the benefits of the lesson study experience that the participants revealed in the final group reflection. These are: 1) improved lesson planning; 2) gaining confidence in

their teaching of mathematics; 3) obtaining a deeper awareness of their learners' needs; 4) reporting learning from their colleagues; 5) doing self-research.

In the next chapter I provide the final conclusions and implications of this study.