# EXPLORING PRE-SERVICE TEACHERS REFLECTIVE PRACTICE IN THE CONTEXT OF VIDEO-BASED LESSON ANALYSIS

A thesis submitted in fulfilment of the requirements for the degree

Of

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(Faculty of Education)

By

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## DECLARATION OF ORIGINALITY

I, ***Samukeliso Chikiwa*** (Student number ***g15c0002*)**, declare that this doctoral thesis is my own work, and that all other sources used or quoted have been fully acknowledged and referenced in the manner required by the Rhodes University Department of Education Guide to referencing. It is being submitted for the Degree of Philosophy at Rhodes University, and has not been submitted for a degree or examination at any other university.

Samukeliso Chikiwa

30 April 2020

(Signature) (Date)

# ABSTRACT

This study explored the development of reflective practice in foundation phase pre-service teachers in the context of video-based lesson analysis at a university in South Africa. The study was conducted in the field of mathematics education, responding to the urgent need to equip pre-service South African teachers with the knowledge and skills for effective mathematics teaching. The research is foregrounded by the continuing poor performance of South African learners in mathematics at all levels of education in the country, which has been linked to the inadequate knowledge and skills of mathematics teachers. Pre-service teacher education is putting considerable effort into improving the preparation of mathematics teachers and developing their ability to reflect on their teaching practice is one of the strategies being employed for this purpose. Research has demonstrated the importance of reflective practice (RP) in both developing and extending teachers' mathematical knowledge for teaching. This study therefore contributes to current research that supports the development of RP as a professional skill for promoting the acquisition of knowledge for teaching in pre-service teacher education.

The study adopted a qualitative case study approach with two phases of data collection. In Phase 1 I collected and analysed three sets of 19 pre-service teachers' written reflections to establish the nature of the reflections that they developed when analysing video-recorded mathematics lessons of experienced teachers' practice. Phase 2 was conducted with four PSTs who reflected on video-recorded mathematics lessons of their own practice, and similarly sought to investigate the nature of the reflections they developed when reflecting on practice. The four PSTs wrote one set of reflections on their own lessons, went through three sessions of facilitator-guided reflections, then wrote another set of reflections to establish if the support provided in small group facilitator-guided sessions improved their reflections.

Iterative content analysis was employed to analyse the PSTs' written reflections, using an analytic tool that I developed for this purpose through merging Lee's (2007) and Muir and Beswick's (2007) levels of reflection frameworks. My model had four levels of reflection: description, explanation, suggestion and reflectivity. The names of each of the levels connect to the key indicator for that level. PSTs' written reflections were coded and analysed according to these levels.

The study found that PSTs' initial reflections were mostly description of general classroom events with little reflection at the levels of explanation and suggestion, and an absence of reflectivity. Most reflections focused on general events in the lesson rather than mathematical events, even though the six lens framework they were given to guide their reflections prompted them to steer their attention towards mathematical events. The second and third sets of reflections, although mostly still at level 1, showed some shifts towards explanation and suggestion, although an increased focus on mathematical events though reflectivity was still largely absent. No PST reached the fourth level of reflectivity in Phase 1. However, in Phase 2, the PSTs' reflections after the three small group facilitator-guided sessions included some evidence of reflectivity. The findings suggest the need for pre-service teacher educators to make a concerted effort to teach PSTs what reflection is and how to reflect on their practice. The findings also showed the need for small group facilitator-guided support in the development of PSTs' reflective practice.

# DEDICATION

This thesis is dedicated to my mother, Ms C. O. Dube, who have always believed in me and wanted the best for me, and to my late father Mr Clement Alfred Majahana, who did not live to see this achievement.

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# Table of Contents

# LIST OF TABLES

# LIST OF FIGURES

# ACRONYMS AND TERMS USED IN THIS THESIS

| | |
|---|---|
| **ANAs** | Annual National Assessments |
| **BEd** | Bachelor of Education |
| **CAPS** | Curriculum Assessment Policy Statements |
| **CCK** | Common content knowledge |
| **DDM** | Dilemmas and decision making |
| **DHET** | Department of Higher Education and Training |
| **EC** | Eastern Cape |
| **FLRM** | Four levels of reflection model |
| **FP** | Foundation phase |
| **GD** | General description |
| **GE** | General explanation |
| **GR** | General reflectivity |
| **GS** | General suggestion |
| **HCK** | Horizonal content knowledge |
| **KCC** | Knowledge of content and curriculum |
| **KCS** | Knowledge of content and students |
| **KCT** | Knowledge of content and teaching |
| **MD** | Mathematical description |
| **ME** | Mathematical explanation |
| **MKfT** | Mathematical knowledge for teaching |
| **MKO** | More knowledgeable other |
| **MMI** | Mathematical and meta mathematical ideas |
| **MR** | Mathematical reflectivity |
| **MS** | Mathematical suggestion |
| **NSC** | National Senior Certificate |
| **PCK** | pedagogical content knowledge |
| **PGCE** | Post Graduate Diploma in Education |
| **PST** | Pre-service teacher |
| **PSTs** | Pre-service teachers |
| **RP** | Reflective practice |
| **SANCP** | South African Numeracy Chair Project |

| | |
|---|---|
| **SCK** | Specialised content knowledge |
| **SLF** | Six Lens Framework |
| **SMK** | Subject matter knowledge |
| **TE** | Teacher education |
| **TP** | Teaching Practice |
| **TTIC** | Theory of Teaching in Context |
| **ZDB** | Zone of proximal development |

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

This study explores the reflections of pre-service Foundation Phase teacher trainees as they analyse video recordings of mathematics lessons in the process of developing their reflective and teaching practice. The present chapter sets the scene for the research. I begin by discussing the widespread concern about mathematics education in South Africa that constitutes the background of and rationale for the study. I identify the research goals and questions that guided the study, before highlighting its significance and outlining its design. The chapter ends with a brief account of subsequent chapters to provide the reader with an overview of the study as a whole.

## 1.2 BACKGROUND OF THE STUDY

South Africa has a long history of poor learner performance in mathematics, extensively reported both locally and internationally (Reddy, 2006; Fleisch, 2008; Spaull & Kotze, 2015). According to the Centre for Development and Enterprise (CDE) (2013) "the teaching of mathematics in South African schools is amongst the worst in the world. Mounting indicators on school performance and teaching reveal largely unacknowledged poor teaching of mathematics in the great majority of schools" (p. 2). As indicated above, research points to several factors behind this problem, including teachers' lack of adequate content and pedagogical knowledge to teach mathematics effectively (Fleisch, 2008; Spaull & Kotze, 2015). The South African Department of Basic Education (DBE) (2009) is increasingly concerned about the deficits in teachers' knowledge for teaching, as evidenced by learners' continuous poor performance in both science subjects and general literacy. There is therefore an urgent need for transformation both in how mathematics is taught and how mathematics teachers are being prepared to meet the demands of teaching mathematics. To contribute to this process of transformation in South Africa, this research explored the reflections of Foundation Phase (FP) pre-service teachers (PSTs) as they analyse video-recorded mathematics lessons in order to develop their reflective practice (RP) and mathematical knowledge for teaching. I particularly chose FP because the trajectory of poor performance in mathematics begins at this early stage (Spaull & Kotze, 2015).

While most teachers found in South African classrooms are professionally qualified (Spaull, 2008), mathematics teachers are said to lack adequate knowledge of content and pedagogy to teach mathematics in ways that enhance conceptual understanding (Carnoy, 2008). The CDE (2013) states that South African "teachers [are] not able to answer questions in the curriculum they are teaching" (p. i). Various small-scale studies conducted in South Africa have confirmed that the majority of primary school teachers generally employ poor pedagogical practices, which results in poor learner performance (Hoadley, 2012).

Research that seeks to understand the challenges faced by teacher education regarding the development of mathematical knowledge for teaching (MKfT) suggests that not enough is known about what is needed to prepare teachers adequately, and that there is little coherence and integration between theory taught at universities and the actual work done in the classroom (Adler, 2005; Darling-Hammond, 2006; Department of Basic Education (DBE), 2009; Green 2010). Beginner teachers are said often to suffer 'practice shock' as they find it difficult to apply what they have learned in their teacher education programmes (Santagata & Yeh, 2014). They tend to revert to intuitive theories of teaching and learning that correspond with their own experience in school rather than with the research-based knowledge from their teacher education programme (DBE, 2009). Hence there is a need to develop approaches that help pre-service teachers (PSTs) to learn in contextualised ways, where quality mathematics teaching practice is made visible and learnable. According to Green (2010), "teachers need better training" (p. 5). This research contributes to the search for knowledge of how to develop teachers who can reflect and learn from their practice. Reflective practice (RP) has gained popularity in research for its ability to help pre-service teachers (PSTs) to both construct and extend teacher knowledge that enables them to teach effectively. However, there is not enough knowledge on how RP develops in PSTs. In the next section I elaborate on the mathematics education crisis in South Africa.

## 1.3 MATHEMATICS EDUCATION IN SOUTH AFRICA

South African education has often been described in alarming terms, such as: a crisis, a national disaster, being in tatters, inefficient, making ineffective use of resources and essentially dysfunctional (Letseka, 2013). Such terminology is often used with particular reference to mathematics education (Reddy, 2006; Fleisch, 2008; Spaull, 2013; Bansilal, Brijlall & Mkhwananzi, 2014; Spaull & Kotze, 2015). Mathematics education in South Africa is facing challenges of extremely poor learner performance that begins in the early years of schooling.

Spaull and Kotze (2015) claim that by the time learners reach Grade 3, only 16% will be performing at a Grade 3 level in mathematics. Learner performance in mathematics continues to worsen as learners climb the ladder of education. (Spaull & Kotze, 2015; Graven & Venkat, 2017). According to Spaull and Kotze (2015), by Grade 4 the majority of learners will be performing two to three grades behind the ostensible grade, the extent of backwardness seemingly dependent on their socio-economic background. Unfortunately, national, regional and international research studies confirm the accuracy of these diagnoses.

South Africa has participated in a number of international educational achievement studies over the past two decades, to monitor and evaluate the quality of schooling in specific subjects such as mathematics, science and literacy. Studies such as the Trends in International Mathematics and Science Studies (TIMSS) (Spaull, 2013; Reddy, 2006), South and East African Consortium for Monitoring Educational Quality (SACMEQ) (Fleisch, 2008; Spaull, 2013) and the Monitoring Learning Achievement (MLA) have shown that South Africa has one of the lowest achievement rates in mathematics internationally (Fleisch, 2008). In each of these comparative studies South Africa's performance has been towards the bottom of the table.

The Monitoring Learning Achievement was designed in 1995 to track and monitor the quality of primary school education in the countries that participated. South Africa joined in 1998, four years after the attainment of democratic government. Of the twelve countries that participated in 1998, the South African participants came out last in mathematics, behind poorer SADC countries such as Zambia, Malawi and Botswana (Fleisch, 2008).

TIMSS assesses the educational quality of mathematics and science education worldwide. TIMSS administers assessments of Grades 4 and 8 every four years. South Africa joined in 1995, with Grade 8 participating in the evaluations. According to Reddy (2018), our learners performed worse than all the countries that participated, to the extent that from 1999 onwards South African Grade 9s wrote the assessments written by Grade 8s from other countries. However, even with South African Grade 9s writing a grade 8 assessment, and Grade 5s writing the Grade 4 assessment, South Africa remained at the bottom. Reddy (2018) notes that in the 2015 TIMSS evaluations, South Africa came forty-eighth out forty-nine participating countries for the Grade 4 evaluations (written by Grade 5 in South Africa), and forty-seventh out forty-eight countries for the Grade 8 evaluations, again finishing behind poorer SADC counties such as Botswana (Clerkin, Perkins & Cunningham, 2016).

The SACMEQ studies similarly confirm the predicament of mathematics education in South Africa. The advantage of these studies is that they compare our learner performance to that of other countries in the region with similar post-colonial challenges. Our Grade 6 learners participated in SACMEQ II (2000) and III (2007) and were ranked towards the bottom of the participating countries in both studies. Commenting on SACMEQ III, Van der Berg, Taylor, Gustafsson, Spaull and Armstrong (2011) claim that "an alarmingly high proportion of Grade 6 learners have clearly not mastered even the most basic reading and numeracy skills" (p. 1). They maintain that of the fifteen countries that participated in the study, South Africa has the fifth highest proportion of functionally innumerate learners. Although there was great improvement in the SACMEQ IV evaluations, where South Africa ranked sixth of the fourteen countries that participated, it is notable that it was still behind some countries with considerably smaller economies, like Zimbabwe and Swaziland (DBE, 2016b).

The results of the various national benchmarking tests confirm the problem of poor learner performance in mathematics. The National Senior Certificate [NSC] and the Annual National Assessments [ANAs] are the key indicators of learner achievement in South Africa. Analysis of the NSC examination results written at the end of Grade 12 reflect a problem in South African mathematics education. In Grade 12 examinations, mathematics is the most poorly performed of all university gateway subjects and is marked by a downward trend from year to year, as seen in Table 1.1, below. The Table 1.1 show the overall Grade 12 results from 2015 to 2019, with achieved percentages of 30% and above.

*Table 1. 1: NCS Students' performance in gateway subjects (adapted from DBE, 2020a, 8)*

| Subject | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Accounting | 69.5 | 59.6 | 66.1 | 72.5 | 78.4 |
| Business Studies | 75.7 | 73.7 | 68.0 | 64.9 | 71.0 |
| Economics | 68.2 | 65.3 | 71.0 | 73.3 | 69.3 |
| Geography | 77.0 | 76.5 | 76.9 | 74.2 | 80.5 |
| History | 84.0 | 84.0 | 86.0 | 89.7 | 90.0 |
| Life Sciences | 70.4 | 70.5 | 74.4 | 76.3 | 72.3 |
| Mathematical Literacy | 71.4 | 71.3 | 73.9 | 72.5 | 80.6 |
| Mathematics | 49.1 | 51.1 | 51.9 | 58.0 | 54.6 |
| Physical Science | 58.6 | 62.0 | 65.1 | 74.2 | 75.5 |

As seen in Table 1.1, above, mathematics is the most poorly performed subject year after year. Adler and Pillay (2017) argue that the majority of Grade 12 learners now opt to write mathematical literacy, which is believed to be much easier. This is evidenced by the declining number of learners who register to write mathematics year after year. This trend can be seen in Table 1.2, below, that presents the Grade 12 overall achievement rates in mathematics from 2015 to 2019, as well as the rates for the Eastern Cape Province (EC) in particular.

*Table 1.2: NCS overall achievement rates in Mathematics 2015-2019 (adopted from DBE, 2020, p.177)*

| Year | No. wrote | | No. achieved at 30% and above | | % achieved at 30% and above | | No. achieved at 40% and above | | % achieved at 40% and above | |
|---|---|---|---|---|---|---|---|---|---|---|
| | National | EC | National | EC | National | EC | National | EC | National | EC |
| 2015 | 263 903 | | 129 481 | | 49,1 | | 84 297 | | 31,9 | |
| 2016 | 265 912 | | 136 011 | | 51,1 | | 89 119 | | 33,5 | |
| 2017 | 245 103 | 35 994 | 127 197 | 15 221 | 51,9 | 42.3 | 86 096 | 9 541 | 35,1 | 26.5 |
| 2018 | 233 858 | 36 449 | 135 638 | 16 576 | 58,0 | 45.5 | 86 874 | 9 438 | 37,1 | 25.9 |
| 2019 | 222 034 | 35 270 | 121 179 | 14 747 | 54,6 | 41.8 | 77 751 | 8 354 | 35,0 | 23.7 |

Table 1.2, above, shows the matric results for mathematics in South Africa for the past five years. While the pass rate seems to have risen between 2015 and 2018, the number of candidates writing mathematics has been going down since 2016, with 11 824 fewer candidates writing mathematics in 2019 than in 2018. Despite that decrease in numbers, there was still a drop in the 2019 pass rate of 3.4%. The pass rate of candidates who scored 40% and above is considerably lower than that of those who passed at 30% and above. For example, in 2019 54.5% were said to have passed matric, but only 35% qualified for university entry. The problem is worse in the Eastern Cape, where my research was conducted, and these are the students expected to enrol in PTE at the university where this research was conducted. As seen in Table 1.2 above, the EC results for 2017, 2018 and 2019 are below the national average, suggesting the intensity of the crisis in this province.

The ANAs also relay the same predicament. The ANAs were introduced in 2011 to enable the DBE to track learner performance in the system on an annual basis, to be able to identify key problems in the teaching and learning of mathematics. Table 1.3, below, portrays the results for mathematics between 2011 and 2014[1].

*Table 1.3: Average percentage marks in mathematics by grade for ANA (2011-2014) adapted from Robertson & Graven, 2015, p. 13)*

| Grade | 2011 | 2012 | 2013 | 2014 | Grade averages across 2011-2014 | Eastern Cape 2014 |
|---|---|---|---|---|---|---|
| 1 | 63 | 68 | 60 | 68 | 64,75 | 65 |
| 2 | 55 | 57 | 59 | 62 | 58,25 | 58 |
| 3 | 28 | 41 | 53 | 56 | 44,5 | 52 |
| 4 | 28 | 37 | 37 | 37 | 34,75 | |
| 5 | 28 | 30 | 33 | 37 | 32 | |
| 6 | 30 | 27 | 39 | 43 | 34,75 | |
| 9 | n/a | 13 | 14 | 11 | 12.6 (2012-2014) | |

The ANA results reveal the extent of the learning deficits in South African primary schools (Graven, 2016). The National Education Evaluation and Development Unit (NEEDU) (2013) reports that the ANAs mirror "dismal performance across the country in mathematics" (p. 55). As noted in Table 1.3, the general downward trend in the ANA results is evidence of the poor mathematics skills among South African learners across the grades. The FP results of the ANAs in the Eastern Cape are of particular significance, as this study specifically addresses the foundation phase in this province. The DBE's (2016a) report on the 2014 ANA results by province indicates that the FP in the Eastern Cape was the second worst performing. As seen in Table 1.3, Grade 1 learners in the EC scored below the national averages. Like the NCS results, this suggests that the effects of poor teaching and learning are worse in the Eastern Cape than the other eight provinces in South Africa. A significant quantity of research has been conducted in order to attempt to explain why learners are consistently performing below expectation. This is the topic of the next section.

[1] No ANAs were administered after 2014

## 1.4. REASONS FOR POOR LEARNER PERFORMANCE IN MATHEMATICS IN SOUTH AFRICA

Continuing low learner performance in mathematics in South Africa has led to an increase in research that seeks to understand the reasons for the crisis. Findings that are most common among these studies relate to the presence of large numbers of South African mathematics teachers who lack a fundamental understanding of mathematics and employ poor quality teaching strategies (Venkat & Spaull, 2014; Carnoy, 2008; CDE, 2011). In the next section, I share research that has investigated the MKfT of teachers.

### 1.4.1 Investigating teachers' mathematical knowledge for teaching

The Grade 6 teachers whose learners took part in the SACMEQ III evaluations were given the same test as their learners. Drawing on the test results, Venkat and Spaull (2014) report that 79% of Grade 6 mathematics teachers showed content knowledge competence below the Grade 6 and 7 levels, and only 17% of those tested in the Eastern Cape Province had adequate content knowledge to teach Grade 6. Venkat and Spaull (2014) report that most teachers in the Eastern Cape refused to write the test, clearly implying a lack of confidence in their own content knowledge levels. This situation suggests a positive correlation among the teacher's content knowledge, the quality of their teaching and their learners' achievements.

Mabogoane and Pereira (2008) report on the Integrated Education Project that measured Grade 4 to 6 teachers' content knowledge using Grade 4 to 7 content items in four South African provinces: KwaZulu Natal [KZN], Eastern Cape, Limpopo and Northern Cape. The teachers tested performed poorly, scoring an average of 32%. Similarly, the Khanyisa Education Support programme conducted a baseline study with 24 rural primary schools in the Limpopo province (Taylor & Moyana, 2005). The study tested a sample of 39 Grade 3 teachers on Grade 6-level mathematics and literacy items and found that the majority of teachers scored between 29% and 50%, with a lowest score of 21, 7% and only one teacher who scored higher than 75%.

As seen from this range of small-scale studies, the majority of teachers who participated had low content knowledge levels. As Venkat and Spaull (2014) assert, "primary school mathematics teachers should, at the most basic level, have mastery of the content knowledge that they are required to teach" (p. 2). Another factor identified as contributory to poor learner performance in mathematics is the lack of teaching skills among mathematics teachers.

Ensor, Hoadley, Jacklin, Kuhne, Schmitt & Lombard (2009) conducted the Count One Count All (COCA) study to investigate how South African FP teachers developed number sense in learners. They found that most teachers did not possess pedagogic skills adequate to the task. Instead they employed poor teaching strategies that engaged learners in very concrete methods for solving problems rather than exposing them to more abstract problem-solving procedures. Hoadley (2012) analysed several small-scale studies conducted in South Africa and confirmed that most primary school teachers generally employ poor pedagogical practices, which results in poor learner performance. Teachers' practice evinced low levels of cognitive demand, the dominance of concrete over abstract meanings, slow pacing, collectivised as opposed to individualised learning, a lack of explicit feedback to learners, a lack of coherence, and the erosion of instructional time (Adler, 2005; Schollar, 2008; Ensor et al., 2009; Venkat & Naidoo, 2012).

According to Venkat and Spaull (2014), the problem of the teachers' content knowledge relates more to the ways in which they acquired their mathematics knowledge than to the knowledge components. Mathematics teaching centres on enacting mathematics, and mathematical modes of enquiry are fundamental to this enactment. The mathematics content teachers know cannot therefore be divorced from the ways in which they know mathematics. Watson and Barton (2011) affirm that "it is not just a question of what teachers know, but how they know it, how they are aware of it, how they use it and how they exemplify it" (p. 67). Hence Taylor's (2008) remark that "teachers cannot teach what they do not know" (p. 24).

The quality of education positively correlates with the quality of teachers (Wolhuter 2006), while the quality of teachers in turn reflects the quality of pre-service teacher education (PTE) Green (2010). In her inaugural lecture Professor Wilmot confirmed:

> There are many factors contributing to and sustaining a crisis in education in South Africa and globally, however, the findings of international and national research widely acknowledge that the single most important factor influencing the quality of education is the quality of teachers and that quality of teaching and learning cannot rise above the ceiling imposed by low teacher capacity; and the cause of poor teaching lies not with teachers but with the teacher education system that produced them. (Wilmot, 2017, p. 3)

Thus Wilmot (2017) suggests that PTE is ultimately responsible for poor learner performance. In the next section I discuss PTE in South Africa.

## 1.5 TEACHER EDUCATION IN SOUTH AFRICA

According to Wolhuter (2006), “any education system stands or falls by the quality of its teaching profession, and therefore, by implication, the quality of its teacher training programmes” (p. 124). Thus, as Wilmot (2017) alleges, the problem of poor learner performance in South Africa is rooted in the way teachers are being prepared for service. In this section I first describe teacher education in South Africa and its history, then ponder on the challenges faced by teacher education today and how apartheid contributed to these challenges. I end the section by discussing how the challenges are being addressed and how my research fits into this larger picture.

In South Africa teacher education is categorised into PTE and in-service teacher education (INTE). INTE pertains to the further development of teachers who already hold teaching qualifications and are already serving as teachers. This can serve to improve the teacher’s qualification (for example, teachers who hold a Diploma/Certificate in Education and desire to have a degree), or take the form of seasonal professional development sessions, to update teachers on changes in the curriculum or to address topics that seem difficult to teach successfully. The INTE degree is done on a part-time basis, through block release.

PTE on the other hand pertains to providing initial teacher training to aspirant teachers. In South Africa there are basically two entrances into teaching. One is through a four-year Bachelor of Education degree (BEd) that is offered to individuals who do not have any degree and wish to become teachers. The other entrance is through a Postgraduate Diploma in Education (PGCE), which is offered to individuals who already have at least a bachelor’s degree but now want to join teaching. These candidates do a one-year course where they are introduced to the theories of teaching and learning. While my discussion may be general to PTE, my particular interest is in the BEd programme because my research was done with BEd PSTs. Before I discuss the challenges that South African teacher education is facing, I provide a brief background to PTE that may help to explain the problems currently being experienced.

### 1.5.1 The history of education in South Africa

The history of education in South Africa is significant to any attempt to give reasons for the dearth of MKfT among the majority of teachers. The changes and challenges in this history are inseparable from the political history of the country. According to Oginniyi and Mushayikwa (2015), the division between blacks and whites under the National Party's apartheid policies from the 1950s led to blacks being educationally disadvantaged. The black schools' curriculum was designed to prepare children for menial jobs and therefore had inferior facilities, teachers, and other teaching and learning resources. As Oginniyi and Mushayikwa (2015) observe, "Most white teachers received pre- and in-service training at well-resourced urban universities, while most black teachers started teaching without even completing their own secondary schooling" (p. 73). Thus, whereas 96% of the teachers in white schools had teaching certificates, only 15% of teachers in black schools were certified (Oginniyi & Mushayikwa, 2015).

Black South African teachers were trained in Bantustan-based teacher colleges which focused on the mass production of teachers, while universities and technikons were mainly for white, coloured and Indian teachers (Oginniyi & Mushayikwa, 2015). There was a remarkable difference between the university and college qualifications as the curriculum, entrance requirements and length of training all differed, resulting "in unevenness in quality which was racially defined" (Wilmot, 2017, p. 6).

The new post-1994 democracy brought with it a lot of hope and expectations for change, as the new government was determined to make changes in the teacher education systems and eradicate the inequalities born of the apartheid era. According to Wilmot (2017), a lot of policies were made and implemented to restructure and reorganise teacher education, and simultaneously, prepare teachers to implement South Africa's changing national school curriculum. For example, the teacher training colleges were closed, and teacher education was incorporated into universities to ensure a unified teacher training system. Teacher education continues to attempt to redress inequality issues.

### 1.5.2 Challenges and reforms in teacher education in South Africa

Teacher education in South Africa is still facing multi-faceted challenges, some of which are the legacy of apartheid (Adler, 2005; Van der Berg et al., 2011; Wilmot, 2017). One of these challenges is the lack of adequate knowledge about what is needed to prepare competent mathematics teachers (Adler, 2005; Van der Berg et al., 2011). Reporting on the conceptions of teaching underpinning the BEd and PGCE curricula at five South African universities, Bowie and Reed (2016) confirm that "there is no agreement among mathematics teacher educators on exactly which types of courses are likely to best meet teachers' needs" (p. 105). The debates about which mathematics education courses are most appropriate for PTE continue (Department of Higher Education and Training [DHET], 2015).

Adler and Davis (2006) claim that PTE struggles to embrace the content and pedagogical knowledge necessary to teach mathematics in the wake of apartheid, because most students who enrol as mathematics PSTs have inadequate mathematics content knowledge as a result of being exposed to poor teaching by inadequately qualified teachers (Department of Education [DoE], 2004). The DoE (2004) is concerned that if these students have not received adequate training to make good their knowledge deficits, they may continue to perpetuate poor teaching practices leading to an ongoing vicious cycle of poor achievement. This sets a challenge for PTE to help break the deficit cycle by training teachers to have adequate MKfT (Chikiwa, 2017). The CDE (2017) report asserts that "getting South African schooling out of this 'vicious' schooling cycle and fostering a more 'virtuous' cycle will be difficult but not impossible" (p. 1). PTE has somehow to create time to cover all the content gaps that PSTs should have brought with them to training within its already tightly scheduled programmes.

Adler (2005) also observes that universities face the challenge of providing a large number of adequately and appropriately prepared mathematics teachers at a time when there are fewer people taking up the advanced study of mathematics, and very few people choosing teaching as a profession. This is evidenced in a study by Kyriacou and Stephens (1999) that explored undergraduates' views of teaching as a career choice and found that only 13% of the students who qualified for university entrance considered taking teaching as a career. As indicated earlier in the chapter, fewer and fewer learners take mathematics at matric level, and even fewer pass sufficiently well to enrol at a university in South Africa. For example, in 2019 only 35% qualify be admitted into university, imagine how many students would be interested in pursuing a career in teaching if only about 13% of those who qualify are the only ones interested. The problem is worsened by that PTE must compete for the small number of students who passed mathematics against science faculties that train personnel for high-status jobs. Lumandi (2008) acknowledges that in South Africa, teaching is a low-status and relatively low-paying job and therefore attracts few people (Adler, 2005).

Even though PTE is faced with such challenges, there have been significant developments in the field since 2007. These include funding for scholars to do more research into the knowledge required for the development of teachers; the involvement of education chairs such as the South African Numeracy Chair Project (which is funding my studies through National Research Funding); and expanding PTE through state funded Funza Lushaka merit bursaries, which are meant to attract (1) more students to teacher education to address the teacher shortage and (2) high quality students into teaching to address the quality of teaching problems in the country. The DHET has commissioned projects to ensure the production of enough teachers for the national schooling system until 2025 (Wilmot, 2017). According to Wilmot (2017), "The shape of the PTE system is being addressed to ensure that we produce enough teachers for all school phases and subjects, especially mother-tongue African Language teachers in the Foundation Phase (Reception Year to Year 3)" (p. 9). While this could be a good move, if not well monitored there is always the danger of compromising quality for the sake of quantity.

Deacon (2016) notes that our PTE system is still very uneven in terms of the quality of PTE programmes, and Wilmot (2017) confirms that "it is characterised by high rates of attrition and slow through-put rates; on average it takes six years to complete a four-year degree" (p. 9). Although positive results with regard to the supply of teachers have been noted since 2008, concern remains about the quality of teachers produced, hence the focus of teacher education is now on quality (Wilmot, 2017).

The South African government is taking measures to address the issue of the quality of teachers and teaching. For example, in 2011 the DHET and DBE launched the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa, 2011-2025 [ISPFTED], (DBE & DHET, 2011). According to Wilmot (2017) the steady but slower than anticipated progress in the implementation of the plan resulted in the development of a Master Teacher Development Plan, released in May 2017, which sets out specific targets and deliverables and the strategies to achieve these.

There have also been initiatives aimed at PSTs' mastery of the mathematics of the grades they will teach, including some with a specific focus on the types of mathematical thinking a teacher need (Chikiwa, 2017). For example, on the agenda of the 2017 Human Resources Development Committee (HRDC) and the Mathematics and Science Standing Committee (MSSC) workshop was to define guidelines for the breadth and depth of the maths and science content that must be covered in Maths and Science PTE programmes at each of the various phases (R. Human, email communication, 31 May 2017).

In an effort to ensure the output of good quality teachers, the DHET (2015) established the Minimum Requirements for Teacher Education Qualifications (MRTEQ). The MRTEQ clearly describes the specific requirements for the development of learning programmes, as well as guidelines regarding practical and work-integrated learning (WIL) structures. DHET (2015) invited all the universities involved in PTE to take an active part in the redress of apartheid legacies by integrating situational and contextual elements that will assist teachers in developing competencies that will enable them to deal with diversity and transformation.

In the sphere of primary school reform, where this research is situated, the DHET recently introduced the Primary Teacher Education project (PrimTEd). This is a four-year project that forms a part of a suite of projects in the Teaching and Learning Development Capacity Improvement Programme (TLDCIP) that covers the areas of primary teacher education, technical and vocational education and training (TVET) and Community College lecturer education, inclusive education and early childhood care and education. Thus, PTE and its various stakeholders are still in the process of reforming and transforming teacher education in South Africa. Wilmot (2017) claims that:

> Universities are in various stages of re-curriculating all their teacher education qualifications which must be approved by the DHET and accredited by the CHE and SAQA before 2019. The process has been slow with bottlenecks and contestations about the appropriateness of the specified discipline knowledge for primary school teaching. Colleagues in my faculty are coordinating inter-university working groups researching the appropriate knowledge standards for mathematics in primary schooling. (p.9)

As we have seen, the various departments of education, policymakers and researchers are all working together to improve the quality of teachers in South Africa. The basic question behind all the efforts is: “So, what must teachers know and be able to do if they are to fulfil their role in enabling systematic learning?” (Pendlebury, 2009, p. 27). In response to this question Pendlebury (2009) suggests:

> First, because school knowledge is complex, teachers must understand the ‘design’ of each learning area they teach, so that they can arrange what is to be learnt in a meaningful sequence. Second, they need a clear conceptual structure for the content to be learned. Finally, they need to think about what learners will do during lessons.

> Learning happens through children's engagement with cognitive tasks related to the main concepts of the learning area or subject. (p. 27)

The three factors at the heart of Pendlebury's response are that teachers need conceptual understanding of the content they teach, they need pedagogical knowledge to be able to teach the content in understandable ways, and lastly "they need to think" about their practice. In other words, they need to reflect on their practice and see what is going to work in their lesson and what is not going to work and figure out how to improve instruction. Thus, as Schon (1987) and Ghaye, (2010) suggest, teachers need to reflect for action, in action and on action for effective learning to take place. Thus, the ability to reflect on practice is a golden strand that still needs to be woven into PTE to better prepare PSTs for their careers as teachers. This study forms part of ongoing research that seeks to contribute to knowledge about how to develop reflective practice (RP) in PTE.

The importance of developing RP in teacher education cannot be underestimated (Ward & McCotter, 2004; Darling-Hammond, 2006; Muir & Beswick (2007); Poom-Valickis & Mathews, 2013; Arslan, 2019, to mention just a few). Darling-Hammond (2006) argues that RP is essential in bringing together theory learnt at the university and practice in the teacher's classroom. Thus, RP helps the teacher to remodel the theories learnt during PTE to fit into the context of his/her classroom. According to Tomlinson (1999), "[a] reflective teacher can test many principles from everyday interaction in the classroom. In other words, philosophy is derived in action" (p. 2). Oginniyi and Mushayikwa (2015) concur:

> To produce high quality teachers for the education system in South Africa and perhaps elsewhere, [needs] moving beyond the rhetoric of education reforms … It certainly warrants a closer consideration by teacher training institutions and other stakeholders. It is a well-known fact that the quality of teachers at basic education level, to a large extent, is determined by the quality of training they received at higher education institutions. The new curriculum in South Africa certainly demands new instructional strategies that go beyond the chalk-and-talk approach within which most teachers have been groomed. (p. 86)

As Ogimniyi and Mushayikwa (2015) suggest, to prepare teachers effectively, PTE needs to employ new strategies that promote tight coherence and integration among courses and between coursework and teaching practice in schools. Darling-Hammond (2006) suggests that pedagogies that model good teaching should be prioritised as they close the gap between theory and practice. She claims these create experiences of learning to teach that are more lasting and authentic. Thus, teacher educators need to focus on the details of instructional practice, and design professional education programmes that offer PSTs multiple opportunities to learn, practise and fine-tune their skills. The use of video to stimulate reflective practice in teacher development seem to fit well into the description of this desired strategy.

Video lesson analysis has been recommended as a process of learning in context (Dewey, 1933; Schon, 1983; Sherin & Van Es, 2009; Santagata & Yeh, 2014). Santagata and Yeh (2014) claim that videos of teaching provide PSTs with a 'window' into teaching without the pressure of having to interact in the classroom situation. Drawing on this research, my study explored the nature of reflections PSTs develop as they analyse video-recorded mathematics lessons. The lecturer employed video-recorded lessons analysis to develop PSTs' RP and MKfT in the comfort of their lecture rooms, where she would have control of RP development process. This study explored the process of RP development to inform PTE practice. In the next section I share my research goals and questions.

## 1.6 RESEARCH GOALS AND RESEARCH QUESTIONS

### 1.6.1 Research goals

The aim of my research was to explore the nature of reflections of Foundation Phase teacher trainees engaged as they analyse video-recorded mathematics lessons to develop reflective practice. While the PSTs' lecturer's aim was to develop both reflective practice and mathematical knowledge for teaching, the focus of my research rested solely on the development of reflective practice. Through this research I sought to contribute to knowledge of how PTE can develop reflective practice in meaningful ways to prepare PSTs to meet the demands of the complex and dynamic work of teaching. My research establishes the levels of reflection that PSTs possibly go through as they develop reflective practice. This will be of help to PSTs' educators as they plan and implement RP development lessons.

### 1.6.2 Research Questions

To carry out this study, I was guided by the following questions:

1. What is the nature of the reflections that PSTs develop as they engage in video-recorded lesson analysis?
2. How does the nature of these reflections change over time, if at all?
3. What role is played by the Six Lens Framework as the reflective tool used to guide pre-service teachers' reflective practice?

4. (a) How do PSTs reflect on video of their own teaching? (b) Are these reflections any different from their reflections on video of other teachers' lessons?
5. What is the nature of PST reflections after receiving guidance from a skilled facilitator in small group sessions?
6. How did their reflections on their own practice change following skilled facilitation, if at all?

## 1.7 RESEARCH ORIENTATION AND METHODS

My study is situated in the interpretive research orientation defined by Cohen, Manion and Morrison (2005) as an approach that endeavours to "understand and interpret the world in terms of its actors" (p. 28). My research emphasises experience and interpretation (Henning, 2004), with the aim of establishing the nature of the reflections in which PSTs engage as they reflect on video-recorded mathematics lessons. Because of the explorative nature of my study, I employed a qualitative case study to generate an in-depth understanding of the phenomenon under investigation. The qualitative case study helped me to "catch unique features that may otherwise be lost in larger scale studies … these features might hold the key to understanding the situation" (Nisbet & Watts, 1994, in Cohen, Mannion & Morrison, 2011, p. 293). The qualitative case study allowed me to use naturalistic data collection methods such as observation, interviews and analysis of written reflections from my participants. Content analysis was used to analyse the participants' written reflections.

## 1.8 THE SIGNIFICANCE OF THE STUDY

As stated earlier, poor learner performance in mathematics in South Africa begins in the primary years of schooling. Research that seeks to understand this problem recognises several contributing factors, among which is the inadequacy of teachers' mathematics content and pedagogical knowledge, knowledge that might enable them to teach mathematics in ways that enhance conceptual understanding (Fleisch, 2008; Spaull, 2013). PTE is held responsible for teachers' knowledge deficits and is therefore making reforms to improve the quality of teachers.

There are a number of concerns with regard to preparation of teachers. Firstly, Adler (2005) claims that PTE just does not know how best to prepare teachers for teaching mathematics., Secondly, there is concern that most PSTs' learning about classroom practice is left largely to chance (Ball, Sleep, Boerst & Bass, 2009), as teacher educators have no control over the knowledge and skills that PSTs acquire during teaching practice (TP). This is essentially in the hands of the mentor teachers, the majority of whom themselves, lack adequate content and pedagogy knowledge as discussed earlier (Darling-Hammond, 2006). How can these teachers be expected to mentor what they cannot do themselves? As Darling-Hammond and Richardson (2009) affirm, PTE needs sophisticated education systems that can offer more effective professional learning than has traditionally been available. These systems should promote developing teacher knowledge within the context of teaching, exposing PSTs to the practice of teaching, observation, and reflection (Green, 2010). Some studies recommend the use of practice-based approaches, such as watching and reflecting on video-recorded lessons during PTE, to afford PSTs classroom experience without the pressure of being in the actual classroom (Sherin & Van Es, 2009; Santagata & Yeh, 2014).

There is agreement in the literature about the significance of reflective practice in developing teacher knowledge and aiding teachers to practice adaptive teaching. The problem, as Ward and McCotter (2004) point out, is that PSTs do not initially do not know how to reflect, nor even understand what reflection is. Teacher education is still evolving strategies for developing PSTs' RP (Poom-Valickis & Mathews, 2013). This research explores the nature of the reflections PSTs engage as they analyse video-recorded mathematics lessons to develop RP. This is done to inform PTE of the stages of RP development as PSTs analyse video-recorded lessons. While international research has explored the development of RP in both in-service and PTE, to my knowledge, little attention has been focused on foundation phase pre-service teaching in the South African context. This research, though conducted on too small a scale for its findings to be generalised, is important insofar as it reveals the process that PSTs undergo as they develop RP through analysing video-recorded mathematics lessons. This in turn provides insight into the ways in which RP might feed into PSTs' understanding of mathematical pedagogy. While it is not my aim to generalise the results of my study, other institutions that deal with FP pre-service teacher education may gain insight from its findings to bring to bear in related situations (Yin, 2009). The next section provides an overview of this research.

## 1.9 OVERVIEW OF CHAPTERS

This study is divided into seven chapters. In this section I present a summary of each chapter to provide the reader with a brief overview of the study.

Chapter 1 introduces the study. It contains the research title, describes the background and context of the research, foregrounding the problem of poor learner performance as a result of poor teaching and learning practices. I establish with reference to the literature how the teacher education legacy of apartheid contributes to current teachers' paucity of content and pedagogical knowledge, and I describe the reforms that South Africa has initiated to redress the situation. The chapter introduces reflective practice as the 'missing paradigm' in current teacher learning environments. I highlight my research goals and guiding questions before adumbrating the significance of the study.

In Chapter 2 introduced the three premises of this study to contextualise my choice of theoretical frames. I discussed the broad learning theories that frame this study. I introduce Vygotsky's (1978) social constructivism and how its premises help to account for how PSTs construct their knowledge of reflective practice as they analyse video-recorded mathematics lessons. Schoenfeld's (1998) theory of teaching in context is also discussed propounding that teaching is something performed in and shaped by a context and thus, teaching teachers about teaching should be done in the context of teaching.

In Chapter 3 I review literature in relation to the premises informing the study and the frameworks that support them. The first premise is that there is knowledge that is specific to the work of teaching, and that PTE should therefore incorporate the development of that kind of knowledge. I identify Ball, Thames and Phelps's (2008) mathematical knowledge for teaching as the basis for this thinking. The second premise is that PSTs training for teaching mathematics need to develop the ability to reflect in the practice of teaching mathematics. I reviewed literature relating to what reflection is and why it is important in education. I pay particular attention to literature that discusses reflective practice in relation to PTE. Karsenty, Arcavi and Nurick's (2015) six lens framework was discussed both as the popular model for guiding mathematical reflections in the context of video-recorded lesson analysis and as a tool my lecturer chose for her class.

In Chapter 4 I discuss my research orientation and methodology. I identify interpretivism as the paradigm that frames the study, and the case study as the particular approach adopted. I then describe the data collection instruments and how the data was analysed.

In Chapter 5 I present and analyse the reflections written by the 18/19 PSTs who participated in my study in order to respond to my first three research questions. These reflected on the practice of experienced teachers.

In Chapter 6 I present and analyse the reflections written by the four PSTs based on the video-recorded lessons of their own practice to explore the area of my last three research questions.

In Chapter 7 I summarise the study, discuss its findings, draw conclusions and deliberate on the implications and limitations of the study.

## 1.10 CONCLUSION

In this chapter I introduced the study, noting that it sought to explore the nature of the reflections which PSTs engage as they analyse video-recorded lessons to develop their reflective practice. I discussed the background of the study as relating to how mathematics is poorly performed in South Africa as a result of most teachers' inadequate knowledge of both content and pedagogy and ventured some reasons for this. I described some of the measures taken to redress the situation, while noting the challenges still faced by the South African teacher education system in the provision of effective mathematics teachers. This study comes as part of strategies to reform PTE. The research goals and questions were formulated, the research design outlined, and the significance of the study summarised. A general, chapter-by-chapter outline of the study as a whole concluded the chapter.

# CHAPTER 2

# THEORETICAL FRAMING OF THE STUDY

## 2.1 INTRODUCTION

My study sought to explore the process of RP development in PTE. This chapter discusses the broad theories of learning that frame this study. Vygotsky's (1978) social constructivism and Schoenfeld's theory of learning in context are discussed as theories that offer a useful guide to how effective learning occurs. I begin by briefly outlining the basic premises of this study's approach to teaching and learning in the context of pre-service teacher education.

## 2.2 BASIC PREMISES

I endorse Mathew, Mathew and Peechattu's (2017) claim that "teacher education plays a vital role in reforming and strengthening the education system of any country…. The quality of education depends on the quality of teachers and teaching. The way teachers are trained is an important aspect to improve quality" (p. 126). In this section I discuss the three premises that constitute the basis for my understanding of how teachers should be trained to be competent and thereby ensure quality education.

Teaching is both demanding and very complex. Like any other profession or trade, to practise it efficiently and effectively requires knowledge that is specific to it. Shandomo (2011) argues that while teaching demands a lot of energy, stamina and fortitude, it also requires that one remains focused on its more intellectual aspects. The first premise for this study is that there is knowledge that is specific to the work of teaching. Each subject requires the teacher to have some unique knowledge of its content and of the processes that result in learners' acquisition of conceptual understanding. Thus, teaching mathematics requires knowledge that is specific to the teaching of mathematics. Inspired by Shulman's (1986, 1987) idea of pedagogical content knowledge (PCK), Ball et al. (2008) distinguish six knowledge domains that they maintain are specific to the teaching of mathematics. They call this mathematical knowledge for teaching (MKfT). This knowledge is neither purely pedagogical nor exclusively knowledge of mathematics content, but an amalgamation of the two (Shulman, 1987). More details about this knowledge is provided in Chapter 3.

The second premise is that the practice of effective teaching requires the skill of critical reflection. Dewey (1933) claimed that "it is impossible to become, and continue to be, an effective teacher without a personal commitment to reflective practice" (p. 9). Schon (1983, 1987) explains the significance of reflection in the work of teaching. He proposes that the process of reflection-in-practice is a means by which "professionals engage in a continuing dialogue with the permanently changing situation of their practice, and in so doing draw on both their knowledge-in and their knowledge-of practice; that is their own and others' reflections on and enquiries into practice" (p. 509). Loughran (2002) adds: "It is not surprising, then, that reflection continually emerges as a suggested way of helping practitioners better understand what they know and do as they develop their knowledge of practice through reconsidering what they learn in practice" (p. 34). Even more directly, Kelly (2006) states that without developing RP it is impossible to gain expertise. I therefore maintain that learning about the practice of teaching is not complete without developing in PSTs the ability to reflect. I discuss reflective practice in detail in Chapter 3.

My third and final premise is supported by Schoenfeld's (1988) theory of teaching in context. It is a claim that PSTs can best learn about the practice of teaching within the context of teaching itself. In support of this notion, Kelly (2006) argues,

> Thus, expertise is situated, that is, tied to the circumstances to which it pertains; not to precise situations, but to the particular ways of doing things (their working practices) and their associated ways of thinking which help define social circumstances. The pathway to expertise is through engagement in practices, moving towards full participation in tasks of increasing accountability; expertise is reciprocally and interpretatively constructed through this engagement. Over time, participants acquire the facility to engage successfully in the discourse, norms and practices of a particular social context. (p. 511)

As mentioned above, I provide more detail about my first and second premises in Chapter 3, while the third premise is canvassed in this chapter. In the next section I introduce constructivism as the broad theory of learning that frames this study.

## 2.3 UNDERSTANDING CONSTRUCTIVISM

Education has long been driven by theories of teaching and learning that have influenced both educational research and educational practice. According to Ary, Jacobs and Sorensen (2010), theories of learning enlighten educators about the practice of teaching and the science behind learning. They remark, "How can we teach students if we do not know how they learn? How can we improve the performance … if we do not know … how we ourselves learn or how to enhance their learning?” (p. 1). Although there are many different approaches to learning, the literature suggests that these can be grouped in three general categories: behaviourism, cognitivism and constructivism. In this research I followed the precepts of constructivism, with an inclination towards social constructivism because it aligns with my belief about how learning occurs.

Schcolnik, Kol and Abarbanel (2006) describe constructivism as a theory of learning which posits that students learn by actively constructing their own knowledge. There are two areas of emphasis in constructivism: cognitive constructivism and social constructivism (e.g. Von Glasersfeld, 1995; Schcolnik et al., 2006; Powell & Kalina, 2009). These two are not mutually exclusive as both are underpinned by the belief that people learn by constructing their own knowledge. Powell and Kalina (2009) assert that both theories believe in inquiry teaching methods and students creating concepts by building on existing knowledge that is relevant and meaningful. The two theories differ in language development theory. With the cognitive constructivism, thinking precedes language, while social constructivism holds that language precedes thinking (Powell & Kalina, 2009).

I chose social constructivism as the learning theory to inform my study because its principles provided a rationale for my intuitive beliefs about effective teaching and learning. Social constructivism offers a well-researched set of principles that sheds light on and provides some explanation of how PSTs acquire, process and retain new skills, insights, knowledge and experiences during the process of learning (Ary et al., 2010). De Houwer, Barnes-Holmes and Moors (2013) describes learning as “the acquisition of habits, knowledge and attitudes… involves new ways of doing things” (p.631). De Houwer et al. (2013) further claims that “when learning occurs, a more-or-less permanent change is experienced in the learner’s behaviour” (p. 631). Thus, the theory helped me as a researcher to understand the learning process, to respect both observable facts and an established body of knowledge. It provided the means for verification, stimulated new discoveries and identified areas that need further investigation (Coffield, Mosely, Hall & Ecclestone, 2004). The next subsection discusses social constructivism.

### 2.3.1 Understanding social constructivism

According to Powell and Kalina (2009), Vygotsky, the originator of social constructivism, studied learning and development to improve his own teaching, but in the process came to question and reject the assumption made by cognitivists such as Piaget and Perry that it was possible to separate learning from its social context. All cognitive functions, he realised, originate in social interaction: people's knowledge and understanding can be traced to their encounters with others, so language lies at the centre of knowledge construction (Vygotsky, 1978). For Vygotsky (1978) learning was not simply the accommodation and assimilation of new knowledge by learners, but a process in which learners were integrated into a knowledge community. According to Vygotsky,

> Every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals. (1978, p. 57)

Social constructivism therefore recognises knowledge construction as a social cognitive process an individual cognitive process that has been socially mediated. In a social constructivist environment, PSTs construct knowledge as they "explore the world around them, observe and interact with phenomena, converse and engage with others, and make connections between new ideas and prior understandings" (The Berkeley Centre of Teaching and Learning [BCTL], 2018, p. 1). Learning for PTSs is thus an interactive process that requires them to engage with a phenomenon and learn from each other through discussion, negotiation and the sharing of information (Powell & Kalina, 2009). PSTs then internalise the outcomes produced by working together. Doolittle (2001) notes that these outcomes can include new strategies, new skills and new knowledge. In his social constructivist theory Vygotsky therefore emphasises the collaborative nature of learning and recognises the importance of cultural and social context. In support for my choice of theoretical framework, Kelly (2006) claims that teachers learn better in a constructivist environment. Kelly (2006) describes teacher learning as an outcome of a dynamic relationship between teachers' "conceptual resources, the physical resources available, and the affordances and constraints of their classroom" (p. 510). Thus, PSTs can best learn to reflect on practice when provided with a learning environment that encourages collaborative learning, the sharing of ideas and physical resources that foster learning with understanding (Kelly, 2006). In my research, social constructivism offered a useful account of an effective method for developing PSTs' reflective practice (RP) through collaboration and social interaction.

Among the elements of social constructivism that I found useful for PTE are Vygotsky's (1978) notions of the zone of proximal development (ZPD) and scaffolding. These account for how learners learn more effectively when they have others to support them.

## 2.4 UNDERSTANDING THE ZONE OF PROXIMAL DEVELOPMENT IN PTE

Vygotsky's social constructivist theory is incomplete without making mention of scaffolding and the zone of proximal development (ZDB) because these two play a significant role in the construction of knowledge. Vygotsky (1962) developed the concept of ZPD which he described as a zone where learning occurs after a person is helped towards understanding a concept. Schunk (2012) defines the ZDP as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 243). Thus, the ZPD measures the amount of learning a PST can attain if given additional instructional support. In the context of this study, ZDP is the difference between the nature of reflections PSTs can engage on their own without help, and how they can reflect with the aid of a reflective tool and guidance from a facilitator. Figure 2.1, below, illustrates the ZPD.

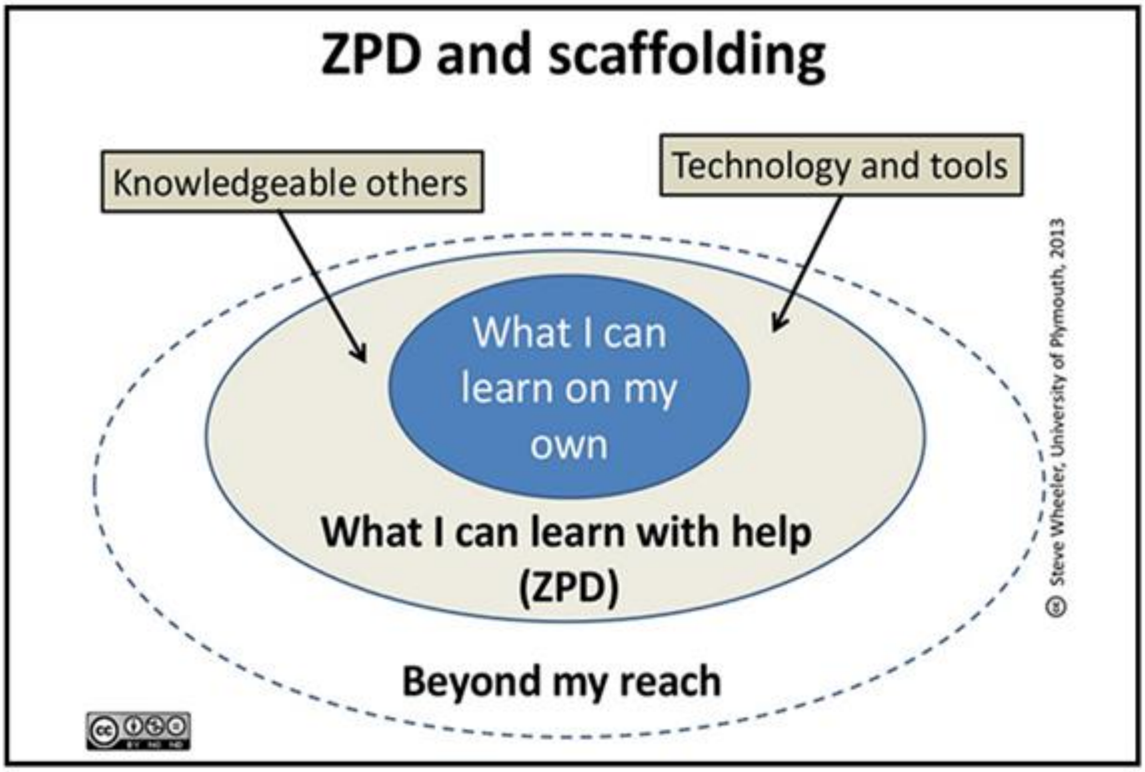



*Figure 2. 1: Zone of proximal development and scaffolding (adopted from Wheeler, 2013)*

According to Vygotsky, a student moves from what they know to their ZPD through scaffolding. Scaffolding is the help given to accelerate a student through to his or her ZPD. Vygotsky (1978) defines scaffolding as a "process through which an adult or more competent peer assists the student in her/his ZPD as much as necessary, and tapers off this aid as it becomes unnecessary, much as a scaffold is removed from a building during construction" (p. 86). Thus, scaffolding is the aid that PSTs obtain from teachers, peers or others to push them to the next level of understanding. Although Vygotsky never used the term scaffolding, his ideas were employed in the coining of the word (Adam, 2017). Adam (2017) claims that the theory behind instructional scaffolding is that students learn better when collaborating with others who are more knowledgeable than them, than when learning independently. This notion echoes Vygotsky's social constructivist ideas. In teacher preparation, the lecturer or peers provide scaffolding that help the PSTs expand their learning boundaries and learn more than they would if learning on their own. As they analyse and discuss the video-recorded mathematics lesson, both their understanding of the practice of mathematics teaching and RP improves beyond what they had gained from their experience as mathematics students. Scaffolding helps them to develop new insights into practice. The instructions given by the lecturer about analysing the video-based lesson together with the framework provided to guide their reflections and the peer discussions about the lesson help the PSTs to reflect better. Since RP is not an inborn skill, McGregor and Cartwright (2011) assert that PSTs can develop RP with the guidance of more knowledgeable others. In the next section I discuss the implications of social constructivism for education.

## 2.5 IMPLICATIONS OF SOCIAL CONSTRUCTIVIST THEORIES FOR TEACHER LEARNING

Amineh and Asl (2015) advise that when considering pedagogical implications, we must always remember that: (1) learning depends on what individuals already know; (2) new ideas are grasped as individuals adapt and change their old ideas; (3) learning involves inventing ideas rather than mechanically accumulating a series of facts; (4) meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas that conflict with our old ideas.

In the social constructivist approach, instructors are recognised as facilitators rather than "teachers" because being a teacher suggests a teapot and cup relationship between the teacher and the students. The teacher acts all knowledgeable and gives a lecture that covers everything she wants the students to learn while the students sit and ‘receive’ the lesson (Amineh & Asl, 2015). In social constructivist learning, the facilitator provides the environment, resources and instruction that help the students to engage with the phenomenon and construct their own knowledge and understanding of the content (Amineh & Asl, 2015). According to Amineh and Asl (2015), the student plays a passive role when the teacher just teaches, but an active role when the instructor facilitates the learning process. Below I present seven principles, derived from Schcolnik et al. (2006), that PTE should consider when developing PSTs’ teacher knowledge using a social constructivist approach.

1. *Learning is an active process of knowledge construction; the learning environment should therefore not be for imparting knowledge but rather support the learners’ construction of knowledge.* (p.13)

Social constructivists believe learning takes place in authentic and real-world environments Thus teaching PSTs about the practice of teaching should occur in a natural setting for teaching and learning such as a classroom (Schcolnik et al., 2006). It is therefore of paramount importance that the teacher educators provide learning environments that accurately represent real-life teaching and learning environments so as to engender real-life experiences. Doolittle (2001) claim such environments provide PSTs a ground for their minds to operate on. PSTs need to observe teachers teaching and derive their own interpretations that will help them to construct knowledge about the practice of effective mathematics teaching. PSTs should be exposed to materials, experiences, and situations from which they can inductively build their own knowledge (Schcolnik et al., 2006). If PSTs cannot be taken to schools to observe, then these authentic learning environments should be brought to where PSTs are studying. According to Doolittle (2001) “knowledge construction is enhanced when the experience is authentic” (p. 4). The use of video has made it possible to bring the classroom to the lecture room for PST learning. Screening video-recorded lessons expose PSTs to the real-life classroom environment on which they can reflect on real teaching and learning and thus develop RP.

2. *Learning should involve social negotiation and mediation*.

Social constructivism emphasises social interaction as the basis for knowledge construction. According to Doolittle (1999), social interaction facilitates the development of socially relevant skills and knowledge, as well as providing a mechanism for dealing with issues that may require individual adaptation. He claims that cultural knowledge is usually attained only through social contacts. Vygotsky regards language as an integral component of social mediation and the medium through which knowledge and understanding are constructed in social settings. Educators are therefore urged to create learning environments that permit PSTs to learn from each other through activities such as group and class discussions. Discussing the lessons, they have observed in a group serves to develop not only PSTs' mathematical language but also a culture of mathematics teaching. Teacher preparation curriculum should therefore be designed to promote interaction between PSTs and their learning tasks (Adam, 2017).

3. *Content and skills should be made relevant to the learner*.

Social constructivism holds that knowledge serves an adaptive function. Knowledge attained should therefore be relevant to the PSTs' current situations, their understanding, and their goals. If the knowledge is irrelevant to their' needs, they will find no reason for adapting it and no place to store it. Doolittle (2001) claims that "experience with relevant tasks will provide the individual with the mental processes, social information, and personal experiences necessary for enhanced functioning within one's practical environment" (p. 13). Foundation phase teacher educators should therefore carefully select the content and skills that are relevant for FP teaching. If the foundation phase PSTs find the content and skills relevant to their career as teachers, they will adapt the knowledge, but if it is not, they will reject it. For example, if PSTs do not grasp the relevance of RP to their teaching, they will find no reason to engage in the process of learning about it.

4. *Content/skills should be understood within the framework of the learner's prior knowledge*.

Prior knowledge is essential for knowledge construction. Doolittle (2001) likens it to building of house, where each new brick is laid on top of a brick that is already there for the structure to grow. Knowledge construction is dependent on what the PSTs already know. Educators therefore need to understand their students' prior knowledge to be able to create effective experiences resulting in maximal learning.

5. *Students should be encouraged to become self-regulatory, self-mediated, and self-aware*.

One of the key constructivist tenets is that the people who are being taught should be active participants in the construction of knowledge and meaning (Schunk, 2012). Knowledge construction occurs as they mentally manipulate and organise experience. This requires that students regulate their own cognitive functions, mediate new meanings from existing knowledge, and form an awareness of current knowledge structures (Doolittle, 2001). Thus, PSTs should be given opportunities to analyse the given lessons individually to make sense of the lessons and to write individual reflections before they discuss as a group.

6. *Teachers serve primarily as guides and facilitators of learning, not instructors.*

Vygotsky (1978) suggests that with the help and guidance of a more knowledgeable other (MKO), students can perform tasks that they cannot complete on their own and develop knowledge and skills they would not develop on their own. The MKO should not assume the role of a teacher (as the name suggests, the one who teaches), but motivate, provide examples, discuss, facilitate, support, and challenge. The teacher educator is thus expected to facilitate and provide guidance as PSTs engage with video-recorded lessons. The lecturer cannot teach PSTs to reflect but can provide resources, motivate, guide and support them as they themselves learn to reflect. The support giving need to be regulated so that PSTs do no become dependent on the support system.

7. *Teacher educator should provide and encourage multiple perspectives and representations of content*.

Experiencing multiple perspectives on a single event provides the student with the raw materials necessary to develop multiple representations. These representations in turn furnish students with various routes via which to retrieve knowledge and the ability to develop more complex schemas relevant to the experience. In addition, in constructivism there is no privileged "truth," only perceptual understandings that may prove to be more-or-less viable (Schunk, 2012). This being the case, a student's understanding and adaptability is increased when he or she is able to examine an experience from multiple perspectives.

In this section I discussed social constructivism as the broad theory of learning that guided this study. Its principles about knowledge construction adheres to my beliefs about how PSTs' MKfT and ability to reflect on practice should be developed. In harmony with the social constructivist theory is the theory of teaching in context (TTIC). This theory, like social constructivism, advocates that learning about the practice of teaching requires teachers to take an active part and that as a social event, it should be done in its natural setting. That is, learning about the practice of teaching should be done in the context of teaching. In the next section I elaborate on TTIC and how it guides teachers in making decisions that influence both their RP and MKfT.

## 2.6 THE THEORY OF TEACHING IN CONTEXT (TTIC)

The work of teaching is both complex and demanding. As such, it requires copious decision making which has an impact on the outcome of the lesson. According to Schoenfeld (1998) good decisions result in good teaching while poor decisions lead to poor teaching and poor learner performance. Remembering that the third basic premise of this study is that learning about teaching should be done in the context of teaching, as highlighted above, this section discusses the theory of teaching in context (TTIC) as described in Schoenfeld (1998).

According to Schoenfeld (1998), the TTIC is a practice-based, teacher-centred theory that was developed by the Teacher Model Group at Berkeley to provide a "detailed theoretical account of how and why teachers do what they do 'on-line' – while engaged in the act of teaching" (p. 1). The theory is underpinned by two main features. Firstly, TTIC is teacher centred. Because of its purpose, TTIC zooms into the classroom world with the eyes of the teacher in order to focus on the teacher. According to Schoenfeld (1998), contextual factors such as the co-construction of the environment with students are considered "via the lens of the teacher's perception. That is, they manifest themselves in the way that the teacher views them" (p. 4). Schoenfeld (1998) argues that while this represents a significant aspect of classroom reality, it is by no means all of it: there is also the reality from the students' point of view, and the reality of the classroom that is co-constructed by teacher and students.

Secondly, TTIC attempts to explain how and why teachers do what they do while engaged in the act of teaching. According to the TTIC, teachers enter the classroom with a complex set of beliefs, goals and a body of knowledge, which Schoenfeld (1998) identifies as the vital components for decision-making. Teachers have general beliefs about the subject matter and its teaching, about the learners, etc., and they set general and specific goals for instruction that are linked and achieved through tasks and activities given to learners. Teachers then employ the body of knowledge they have during the process of teaching to achieve the set goals. The three elements – beliefs, goals and body of knowledge – work hand in hand during the act of teaching, influencing the decisions the teacher makes during the process of teaching (Schoenfeld, 1998).

### 2.6.1 Key elements in the theory of teaching in context

As mentioned above, the TTIC postulates that there are three key elements that work together to influence the teacher's in-the-moment decisions. In this section I explain their meaning according to the ways in which Schoenfeld (1998) views and uses them.

***Beliefs***: are personal philosophies (often implicitly held) consisting of conceptions, values and ideologies. Discussing beliefs, Schoenfeld (1998) says:

> What is the teacher's sense of the mathematical enterprise? What counts for "understanding "? How important are (for example) formulas, explanations, qualitative reasoning? What does the teacher think these students are capable of learning? What counts for proof, for this audience? How important is discipline? (Is a good classroom a quiet classroom? How does that play out when the teacher chooses between individual or group work for the class to engage in?) How the teacher feels about all of these issues, consciously or unconsciously, will be a major factor in determining which goals have highest priority. These, in turn, will shape what the teacher chooses to do. (p. 7)

Thus, according to Schoenfeld (1998), a teacher's assumptions and beliefs (perhaps sometimes unexamined) influence their choice of goals and shape what s/he chooses to do.

***Goals***: Aguirre and Speer (2000) define goals as cognitive constructs that describe (with varying levels of detail) what the teacher wants to accomplish. According to Schoenfeld (1998), goals can be long term, such as wanting one's students to understand mathematics as a sense-making activity or to become independent learners. They can be medium-term, for example when the teacher wants students to understand a particular concept or procedure, and even short-term or immediate, for example when the teacher decides what she's going to do or say next. Schoenfeld (1998) claims that "decisions about what to do and how to do it are shaped by the set of currently active, high priority goals" (p. 14).

***Body of knowledge***: Aguirre and Speer (2000) defines knowledge as facts, information, descriptions, or skills, acquired through experience or education by perceiving, discovering, or learning. Schoenfeld (1998) characterises it as a "set of intellectual resources the teacher can bring to a situation … include[ing] knowledge of the students, of the context, and of the content. It includes a variety of general and content-specific classroom and interactive routines" (p. 14).

Schoenfeld (1998) contention is therefore that teachers have general beliefs about the subject matter, its teaching, and about students; and they set general and specific goals for instruction that are linked and achieved through tasks and activities given to learners. They then employ the body of knowledge they have during the process of teaching to achieve the set goals through tasks and activities. In the next section I deliberate on how the three work together to influence the decisions the teacher makes in the process of teaching.

### 2.6.2 More about the teaching in context theory

One of the aims of TTIC is to integrate theory and practice through observing and analysing the pattern of what teachers do when teaching and apply the result of that analysis in trying to understand the work of teaching (Schoenfeld, 1998). It seeks to understand the ways in which the teacher's goals, beliefs, and knowledge interact, resulting in the decision-making and actions the teacher engages in as s/he teaches from moment to moment. Hayes (2006) argues that "if effective decision-making is an essential component of 'getting better at teaching', it is important to consider the factors that combine to influence the process" (p. 345). Schoenfeld (1998) claims, "if one has a good understanding of the teacher's beliefs, goals, plans, and knowledge (which includes various pedagogical and content knowledge, the teacher's classroom routines, etc.) in a particular context, then one should be able to provide coherent, detailed explanations of what the teacher does, and why" (p. 5).

TTIC rests upon two basic assumptions. The first is that "the activation levels of beliefs, goals, and knowledge at any moment will be assigned so that, if possible, the highest priority beliefs, goals, and knowledge are consistent and mutually supportive" (Schoenfeld (1998, p.3). The second is that the actions taken by the teacher will be selected so as to be consistent with the teacher's current highly activated beliefs, goals, and knowledge. The teacher then draws upon the knowledge they have for actions that will realise the goals. Now, if something unexpected happens, the current balance of activation may be affected and therefore change. Schoenfeld (1998) observes: "if a classroom event results in the strong activation of a particular belief, or goal, or somebody of knowledge, then there will be a change in the activation level of beliefs, goals, and knowledge. This may in turn result in the choice of a new action plan" (p. 4). Figure 2.2, below, demonstrates the interconnected relationship between the three elements and how decision making is always central to all that happens in the classroom.

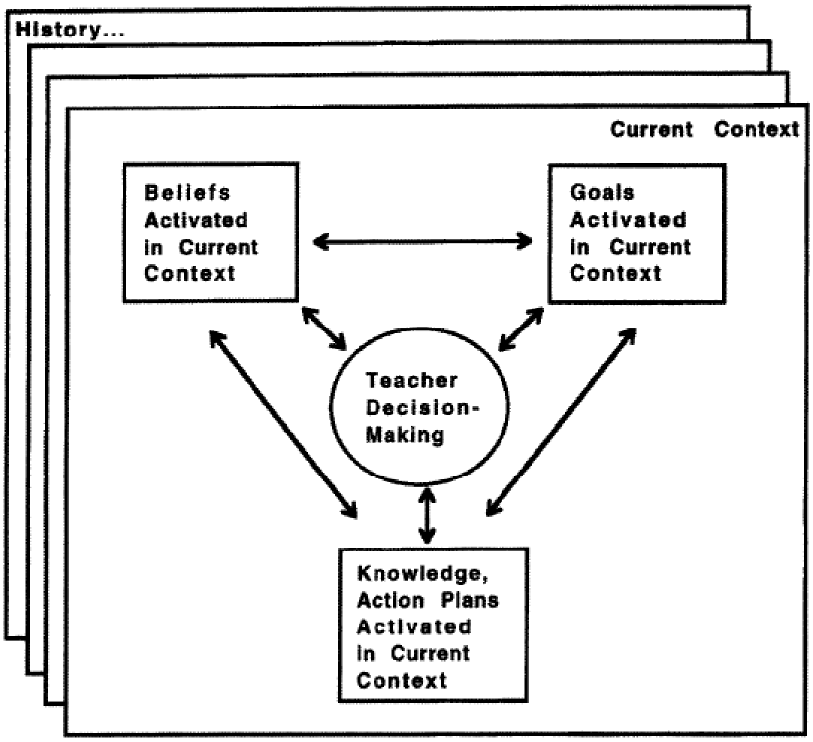



*Figure 2. 2: Aspects of a model of teaching in context, as adapted from Schoenfeld (1998, p. 14).*

Schoenfeld (1998) used the TTIC model in Figure 2.2, above, to illustrate the interplay that occurs (during teaching in the classroom) among beliefs, goals and/or knowledge and results in a new decision. He claims that teaching is a function of the instructional context, a dynamic act that responds to interaction with the students. Thus, the teacher has constantly to monitor what is taking place during instruction and act on the basis of the resultant perceptions.

Schoenfeld (1998) notes that neither beliefs nor goals nor knowledge can claim priority: "One might start with beliefs, asking how the teacher's beliefs shape the teacher's goals, and how those in turn shape the actions taken by the teacher. But any other pathway through Figure [2.2] gives rise to equally important questions" (p. 14). Yet Aguirre and Speer (2000) argue that beliefs play a central role in a teacher's selection and prioritisation of goals and actions. They claim that a shift in the teacher's goals during teaching is likely to illuminate the teacher's underlying beliefs and reveal their priority.

The three boxes in Figure 2.2 show the three key elements of TTIC (beliefs, goals, and knowledge) that are qualified by the phrase "activated in current context". This shows that while the teacher may have many goals that they are seeking to achieve as they teach, at any particular moment of teaching, there is only one goal that is prioritised and strongly activated at a time. Schoenfeld (1998) claims the goal can be activated either because of prior planning or by the occurrence of a particular event; others remain inactive or activated at low levels. According to Schoenfeld (2998), what transpires during each moment of teaching is ultimately a function of history. That could be, the teacher's history, the students' histories, or what has happened in that classroom between teachers and students, etc. (hence the receding boxes at the back he labelled 'history').

The double arrowed lines between each element of the theory reflect the interconnectedness of the three elements in TTIC and their interdependence in the process of decision making. Schoenfeld (1998) claims that understanding the interplay between these three during the context of teaching enables PSTs to understand how and why certain decisions and actions are taken by teachers during the process of teaching. This in turn helps them to make meaningful decisions that foster good teaching when they themselves get engaged in practice: "if you understand the combination of things that enables teachers to be successful at doing particular things, then there is a chance you can help people learn to achieve what that teacher does" (Schoenfeld, 1998, p. 6).

Schoenfeld (1998) places 'decision-making' at the centre of the TTIC model, insisting on the absolute centrality of decision making in the work of teaching. Schoenfeld (1998) describes teaching as a model of constituents that interact through the teacher's decision making. Torner, Rolka, Rosken and Sriraman (2010) concur, remarking that "the teaching process is understood as a continuous decision-making algorithm" (p. 404), similarly attribute teachers' spontaneous decision-making to a combination of available knowledge, high priority goals and beliefs.

Schoenfeld's theory of teaching has been and is being widely used in teacher education, particularly within in-service teacher education (Aguirre & Speer, 2000; Leder, Pehkonen & Toerner, 2002; Philipp, 2007; Schoenfeld, 2010; Torner et al., 2010; Rosken, Pepin & Torner, 2011; Karsenty &Arcavi, 2017). In the next section I describe some studies that have employed this theory.

### 2.6.3 The theory of teaching in context in action

TTIC closely relates to RP and therefore has been largely influential in discourse around development of RP in teacher education. Arcavi and Schoenfeld (2008) claim that the TTIC theory has guided and inspired the contemporary design and implementation of the curriculum for professional learning and pedagogy for professional development. The Teacher Model Group at the University of California, for example, used the TTIC to model various sets of tutoring and teaching episodes (Schoenfeld, 2010). They designed workshops where teachers would teach and reflect on their lessons in a quest to understand how their beliefs, goals and knowledge influenced the decisions they made during teaching. After analysing the data collected through observation and interviews, they reported that the teachers' decision making and problem solving are a function of their knowledge, beliefs and goals, as indeed proposed by the theory of teaching in context.

Torner et al. (2010) applied Schoenfeld's theory to understand teachers' classroom practice. A high school mathematics teacher was requested to teach a mathematics lesson of her choice. On analysing her lesson using TTIC, they found that the teacher's goals and beliefs presented a complex network of dependencies for decision-making. Similarly, Rosken et al. (2011) used the theory to enquire how beliefs affect the teaching and learning of mathematics and found that the model of teaching in context provides evidence for the claim that beliefs take centre stage with respect to instantaneous teacher actions.

Karsenty and Arcavi (2017) affirm that "teachers and researchers can be induced to think about why other teachers make particular instructional moves, and that they can engage substantially with the roles of knowledge, goals and beliefs in shaping instructional choices" (p. 435). Under the influence of TTIC, Karsenty, Acarvi and Nurick (2015) developed a framework with six lenses they named the six lens framework (SLF). This framework was developed to guide mathematics teachers as they analysed video-recorded mathematics lessons to develop RP and MKfT. The SLF was employed for guiding the PSTs in my research to develop RP and MKfT as they also analysed video-recorded mathematics lessons. More detail about this framework is discussed in the next Chapter.

## 2.7 CHAPTER CONCLUSION

I began this Chapter by outlining the three basic premises that I believe are relevant when preparing PSTs for quality teaching that would improve mathematics education in South Africa. The first premise is that there is knowledge that is specific to the work of teaching. PTE should therefore ensure to develop this kind of knowledge in PSTs. The second assumption is that reflective practice is essential for the work of teaching and for the continuous development of teacher knowledge, therefore PSTs should be taught how to reflect on their practice. The third premise is that teacher knowledge should be developed in the context of teaching.  I then discussed social constructivism as the broad learning theory that guided my study. I also discussed its aspects pertaining to generally pedagogic practice and PTE in particular. The

TTIC as propounded by Schoenfeld (1998) was discussed as a theory of learning that support that teaching PSTs about the practice of teaching should be done in the context of teaching. The facets of this theory were discussed to elaborate how its three elements (beliefs, goals and knowledge) work together to influence the decisions the teacher makes about practice and in practice. I also illuminated how the theory have been influential in the field of TE. In the next chapter I interrogate the relevant literature so as to arrive at a clearer understanding of mathematical knowledge for teaching (MKfT), and of how RP impacts on teaching, how it develops and how it has been employed in TE and PTE in particular.

# CHAPTER 3

# REVIEWING LITERATURE ON MATHEMATICAL KNOWLEDGE FOR TEACHING AND REFLECTIVE PRACTICE IN TEACHER EDUCATION

## 3.1 INTRODUCTION

In the previous chapter I discussed Vygotsky's (1978) theory of social constructivism and Schoenfeld's (1998) theory of teaching in context (TTIC) as the theories of learning that frame the working premises on which this study is based. The study has been conducted in response to a need to improve mathematics education in South Africa through equipping teachers with the knowledge and skills they need for effective and efficient teaching of mathematics at foundation phase (FP) level. As discussed in Chapter One, mathematics is poorly performed in South Africa at all levels of education, and teachers' inadequate mathematical knowledge for teaching (MKfT) has been found to be partly responsible for this problem. Pre-service teacher education (PTE) is exploring ways of equipping pre-service teachers (PSTs) not only with adequate MKfT but with the resources to continue developing this knowledge. Reflecting on one's practice is recognised as a means of developing and extending MKfT, which is why this study explores the reflections of PSTs as they analyse video-recorded mathematics lessons. This chapter interrogates the literature for a better understanding of MKfT and how reflective practice fits into the picture. The chapter begins by discussing MKfT as a refinement of Shulman's (1987) pedagogical content knowledge (PCK) by Ball et al. (2008). This framework supports one of the premises highlighted in the previous chapter that there is a form of knowledge that is specific to the work of teaching mathematics. I then move on to understanding RP, its role in teaching and learning and how it is developed, particularly at PTE. The ability to reflect on practice is one of the premises I identified as basic for this study. In the next section I share literature that seek to provide understanding of what knowledge is deemed essential for the work of teaching mathematics.

## 3.2 UNDERSTANDING KNOWLEDGE FOR TEACHING MATHEMATICS

The pursuit of knowledge has been and will remain an everyday endeavour for both young and old in many cultures and societies. From as young as four years of age, children are sent to institutions of learning to begin the pursuit of knowledge. Once this trajectory begins, it hardly comes to end for some people. Teachers are mainly responsible for facilitating knowledge construction in formal institutions of learning, therefore Shulman (1987) claim teachers should "know something not understood by others" (p. 11). This section seeks to provide an understanding of what knowledge is need by teachers to effectively teach mathematics. The section begins by illuminating Shulman's (1986, 1987) contribution to discussions that relate to teacher knowledge. Shulman (1986, 1987) is popular for pioneering research on teacher knowledge. His pedagogical content knowledge (PCK) model is prominent in research on teacher education. Ball et al. (2008) refined Shulman's ideas to develop a domain-specific teacher knowledge framework they named mathematical knowledge for teaching (MKfT). Both PCK and MKfT have been very influential in discussions about mathematics education and teacher knowledge. In this section I discuss the concept of MKfT, proceeding by way of Shulman's (1987) PCK. I begin the section by deliberating on Shulman's (1987) PCK.

### 3.2.1 Shulman's ideas of teacher knowledge: pedagogical content knowledge

Pedagogical content knowledge was conceived under a multi-year study partly financed by the Spenser Foundation, the Teacher Knowledge Project. The Project investigated how new secondary school teachers learn to teach content subjects such as mathematics, science, English and history, and sought to establish general standards and policies for teacher education. It was during this research that Shulman (1986) discovered a significant factor that researchers and practitioners had previously overlooked in the study of classroom teaching. He found that teacher training programmes treated subject knowledge and pedagogy as mutually exclusive, focusing on either the subject matter or the pedagogy. There was no link between content and pedagogic practice to guide PSTs on how each concept might be taught. Shulman (1986) attempted to address the separation of content from pedagogy by introducing a special domain of teacher knowledge which he referred to as pedagogical content knowledge (PCK). PCK was meant to blend subject matter and pedagogy to enable the transformation of content into pedagogically powerful forms. PCK bridges content knowledge and the practice of teaching into an understanding of how particular aspects of subject matter can be organised, adapted, and represented for instruction. Hence, Shulman (1986) defines PCK as the "ways of representing and formulating the subject making it comprehensible to others" (p. 9).

Since all professions have knowledge bases specific to their realms of operation, Shulman and his team investigated teacher knowledge bases and grouped them into seven categories (Shulman, 1986). Four of these were generic in nature and the other three related to content-specific knowledge. He named the generic knowledge categories: knowledge of context, knowledge of the aims of teaching and learning, knowledge of learners and general pedagogical knowledge. The content-specific categories are subject-matter knowledge, pedagogical content knowledge and curriculum knowledge. Each of the seven categories is enlarged upon below. SMK and PCK are of special interest as these forms the backbone of Ball et al.'s (2008) MKfT.

1. *Knowledge of the educational context* includes knowledge about institutions and their hierarchies, stakeholders in the school system, how to operate in a school environment, understanding the governance and financing of schools, the hierarchy of structures in the Department of Education, the communities and cultures around the school and how the school is part of these structures and cultures. Shulman (1987) claims that knowledge of educational context provides the teacher with some understanding of what will either facilitate or inhibit his or her teaching efforts. This kind of knowledge develops as the teacher interacts with the environment, and is not therefore of immediate concern to PTE.

2. *Knowledge of the aims of teaching and learning* pertains to understanding both the long-term and the short-term goals of education. Such knowledge enables the teacher to consciously work towards achieving these goals. The goals they set for each lesson need to align with broader educational aims. This kind of knowledge may influence the teacher's beliefs and purposes, and, hence teaching practice.

3. *Knowledge of students* is knowledge about learners and their characteristics. It entails understanding the nature of learners in relation to learning and the general trends of their behaviour. For example, knowledge about learners' stages of development in relation to what they can comprehend enables a teacher to plan and teach accordingly.

4. *General pedagogical knowledge* refers to the knowledge of theories and principles of teaching and learning, strategies and techniques for classroom management and organisation that transcend subject matter knowledge (SMK). Woolfolk (2010) argues that good teachers use pedagogical knowledge and skills to help learners understand abstract concepts.

5. *Curriculum knowledge* is knowledge and understanding of the curriculum. Shulman (1986) describes the curriculum as:

> the full range programs designed for the teaching of particular subjects and topics at a given level, the variety of instructional materials available in relation to those programs and the set of characteristics that serve as both the indications and contraindications for the use of particular curriculum or program materials in particular circumstances. (p. 10)

Teachers need to know the curriculum to teach content in line with the expectations of policy at each level of education, and to make appropriate use of the teaching tools provided. Curriculum knowledge enables teachers to assess learners' accomplishments and remediate their inadequacies. Shulman (1986) proposes two forms of curriculum knowledge, lateral and vertical. Lateral curriculum knowledge concerns a teacher's ability to relate the content of a given topic across the subjects at a given level of education, while vertical curriculum knowledge involves familiarity with the topics and issues that have been and will be taught in the same subject area during the preceding and subsequent years of schooling. Curriculum knowledge therefore enables teachers to integrate subjects and connect grades. It helps the teacher to estimate the learners' prior knowledge and thereby teach from the known to the unknown. In South Africa, the Curriculum Assessment Policy Statements [CAPS] currently provides the basis for such curricular knowledge.

6. *Content knowledge* (subsequently known as the *subject matter knowledge*) refers to knowledge and understanding of subject matter structures, substantive and syntactic. According to Wilson, Shulman and Richert (1987), the substantive structures of a discipline are the ideas, facts and concepts developed in that subject area. Shulman expands the definition, suggesting that "substantive structures are a variety of ways in which the basic concepts and principles of the discipline are organised to incorporate its facts" (p. 9). The syntactic structures, on the other hand, are the knowledge of different ways in which the discipline creates and evaluates new knowledge (Wilson et al., 1987). These are processes used to generalise, reason, explain, defend thinking and conjecture. Shulman (1986) claims that syntactic structures provide a set of rules for determining what is legitimate or illegitimate in a discipline and therefore establish what is true or false, valid or invalid. He reasons that if there are competing claims regarding a phenomenon, the syntax of the discipline provides the rules to determine which claim has greater warrant. Rowland, Turner, Thwaites and Huckstep (2009) propose that: "both the substantive and syntactic aspects of subject-matter knowledge are important for primary school teachers. It may not be important to understand advanced mathematics to teach primary mathematics effectively, but it is important to have a profound and connected understanding of primary school mathematics."

7. *Pedagogical content knowledge* (PCK) is knowledge that combines content knowledge and general pedagogic knowledge. Shulman (1986) defines PCK as "that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" (p. 9). It is knowledge of the forms and strategies that teachers use

to guide their learners to a meaningful understanding of the concepts within the subject they teach. Park and Oliver (2008) describe PCK as the "teachers' understanding and enactment of how to help a group of students understand specific subject matter using multiple instructional strategies, representations, and assessments while working within the contextual, cultural, and social limitations in the learning environment "(p. 264). According to Shulman (1986) PCK is specific to teaching as it includes the teacher's understanding of what makes the learning of specific topics easy or difficult, and the conceptions, preconceptions and misconceptions that students of different backgrounds bring with them to the classroom.

PCK exists at the intersection of knowledge of content, knowledge of the curriculum and knowledge of pedagogy (Shulman, 1986) Figure 3.1, below, demonstrates Chikiwa's (2017) conceptualisation of PCK with regard to mathematics education.

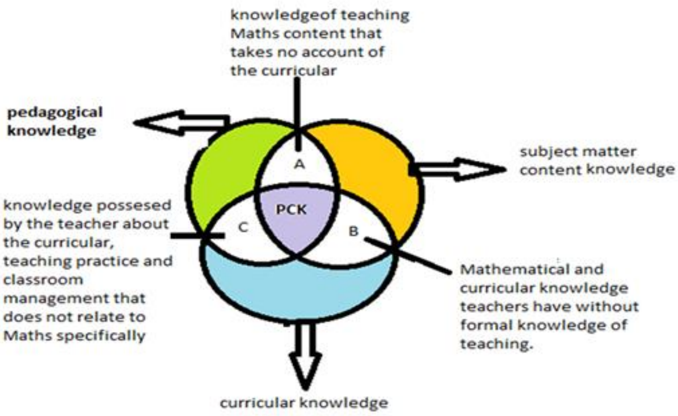



*Figure 3. 1: Illustration of PCK, adapted from Chikiwa (2017)*

As suggested in Figure 3.1, above, Chikiwa (2017) understands PCK as teacher knowledge that lies at the centre of content knowledge, pedagogical content knowledge and knowledge of content and the curriculum. Thus, in relation to mathematics, the teacher needs to have knowledge of mathematical concepts in relation both to the curriculum and to how these can be presented in ways that enable learners to gain conceptual understanding. This kind of knowledge is unique to the work of teaching.

PCK is Shulman's (1986, 1987) significant contribution to educational theory. Academics have unanimously recognised that both SMK and PCK are crucial for good teaching (Rowan, Correnti & Miller, 2002; Hill, Sleep, Lewis & Ball, 2007; Ball et al., 2008; Kersting, Gibbin, Thompson, Santagata & Stigler, 2012). Ball et al. (2008) have adopted key elements of PCK and refined them into a framework they call MKfT. But before moving on to a consideration of MKfT, I discuss some of the limitations of PCK.

#### *3.2.1.1 Limitations of PCK*

PCK has some limitations associated with both its genesis and its application. In a more recent article, Shulman (2015) cites four limitations mainly associated with the origins of PCK. He observes that the idea of PCK emerged at a time when debates and conversations evolved around education as theory, practice, policy and moral action. The focus of research was so much on combatting a prevailing paradigm that ignoring or downgrading content that some important factors relating to teaching and teachers were overlooked. PCK is devoid of all non-cognitive attributes such as emotion, affect, moral judgement, reasoning, feelings and motivation. Berry, Friedrichsen and Loughran (2015) claim that PCK gave short shrift to the moral character of teaching, which annoyed some of the teachers that Shulman dealt with in his research. Berry et al. (2015) claim that "the affective aspect of teacher understanding and action are important both because a lot of what teachers know and do is connected to their own affective and motivation states, as well as their ability to influence the feelings and motives, persistence, and identity formation process of their students" (p. 4).

Shulman argues that the absence of these factors marred the teachers' identities in the world to which they aspired to contribute as professional educators and as citizens. He therefore advises researchers working with the idea of PCK to pay close attention to the affective and moral dimensions of teaching. The second limitation is that, originally, PCK was excessively intellectual. It paid attention to the pedagogical mind, viewing teachers as thinkers, problems solvers and decision makers, but ignored the role that action played in the process of teaching. Shulman insists that PCK came about as a "response to a set of prevailing views that treated teaching as a process without content, and teachers as skilled actors without minds, emotions and careers" (p. 4). Shulman argues that it is not enough to view teaching as a job involving a thinking, solving problems and making decisions while ignoring the physical action and emotional investment involved in teaching.

A third limitation is that PCK did not pay sufficient attention to questions about the broader social and cultural context, despite the extent to which these influence teaching and learning. Shulman therefore suggests that PCK should refer not only to pedagogical content knowledge but also pedagogical cultural knowledge and pedagogical contextual knowledge. He argues that all teaching must be mindfully situated in the disciplinary, cultural, personal and social settings in which it occurs. Fourthly, PCK ignored questions about the outcomes of teaching. The researchers did not consider the relationship among teachers' thinking, instruction and learner achievement, yet this relationship is pivotal. According to Shulman, the "relationship between measured teaching and measured learning is not only an artefact of the accountability policies of government agencies" but also a question of how teaching affects the minds and hearts of learners.

Hill et al. (2007) argue that Shulman's (1986) PCK is not a fixed model and suggest that it be refined for teacher education and development in specific subjects. In response, Ball et al. (2008) conducted a practice-based investigation of what teachers need to know to be able effectively to teach mathematics. Their central goal was to define a framework that made explicit the knowledge that teachers need for this purpose. Ball et al. (2008) therefore developed a practice-based theoretical framework which they named Mathematical Knowledge for Teaching (MKfT).

### 3.2.2 Ball et al.'s mathematics knowledge for teaching

Ball and her team conducted an interactive work session to investigate the mathematical knowledge and skills needed for the teaching of mathematics: "it seemed obvious that teachers need to know the topics and the procedures that they teach … we decided to focus on how teachers need to know that content … we wanted to determine what else teachers need to know about mathematics and how and where teachers might use such mathematical knowledge in practice" (p. 395). Focusing on what teachers do while teaching, Ball et al. (2008) refined two of Shulman's (1986) seven knowledge categories discussed earlier, the SMK and the PCK, and developed a framework with six knowledge domains that relate specifically to the work of teaching mathematics. They named this framework Mathematical Knowledge for Teaching (MKfT). SMK and PCK were each split into three knowledge domains. From SMK they developed common content knowledge (CCK), horizonal content knowledge (HCK) and specialised content knowledge (SCK). These were to illuminate what "effective teaching requires[s] in terms of content understanding" (p. 394). The domain of PCK was divided among knowledge of content and teaching (KCT), knowledge of content and students (KCS) and knowledge of content and curriculum (KCC). These six knowledge domains emerged in response to the question: "What do teachers need to know and be able to do in order to teach effectively?" (Ball et al., 2008, p. 394). Figure 3.2, below, presents these six knowledge domains.

MKfT is defined as the mathematical knowledge, skills, and habits of mind entailed in the work of teaching and is key to the improvement of the teaching and learning of mathematics (National Mathematics Advisory Panel, 2008). It is "concerned with the tasks involved in teaching and the mathematical demands of these tasks" (p. 395). In short, MKfT embraces every aspect of the work of teaching mathematics. Hill et al. (2007) describe this work as involving tasks such as: presenting mathematical ideas; selecting appropriate representations and recognising what is involved in using a particular representation; providing mathematical explanations for common rules and procedures; and scrutinising and understanding unusual solution methods to problems. Ball et al. (2008) say that MKfT is "everything that teachers must do to support the learning of their students [...] involve[ing] mathematical ideas, skills of mathematical reasoning, fluency with examples and terms, and thoughtfulness about the nature of mathematical proficiency" (p. 395).

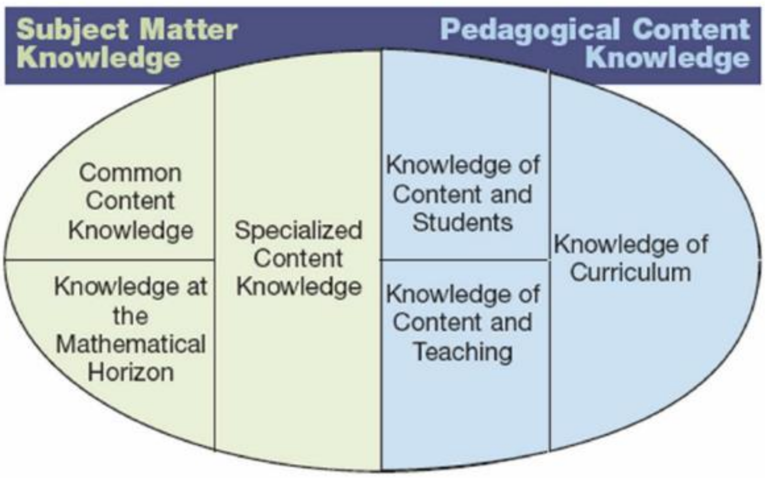



*Figure 3. 2: Model of mathematical knowledge for teaching (Ball et al., 2008, p. 403)*

Further elaboration on each of MKfT's six domains of knowledge follows below.

*Common Content Knowledge* (CCK) is "the mathematical knowledge and skills used in the settings other than teaching" (Ball et al., 2008, p. 399). It is the mathematical knowledge and skills used in everyday life, by anybody, regardless of age and profession. It is used in the work of teaching mathematics in the same way that it is used in other professions or occupations that also use mathematics, such as accounting, economics, statistics and others (Ball et al., 2008).

Although CCK is not specific to the work of teaching, teachers need this type of knowledge to be able to understand the work that they assign to their learners, to be able to identify correct or incorrect answers, identify errors in learning materials such as textbooks, and be able to use terms and notation correctly in speech and writing. Taylor (2008) points out that "teachers cannot teach what they do not know" (p. 24). As mentioned in Chapter 1, "primary school mathematics teachers should, at the most basic level, have mastery of the content that they are required to teach" (Venkat & Spaull, 2014, p. 2). A sound knowledge of common content enables teachers to teach with confidence, effectively present content and make the concepts accessible to a wide variety of learners.

*Horizonal Content Knowledge (HCK)* is the teacher's mathematical perspective on content that faces, as it were, in all directions simultaneously, locating current instruction in the context of the discipline and the logic of its educational application (Mosvold & Fauskenger, 2014). It is not directly deployed in instruction in a particular content area but is a general knowledge of mathematics that spans all grades and topics. HCK helps the teacher to understand mathematical concepts and how they connect with each other, so that s/he can determine learners' prior knowledge and prepare them for the next grade.

*Specialised Content Knowledge* (SCK) is the last domain of SMK. Ball et al. (2008) define SCK as "the mathematical knowledge and skill unique to the work of teaching" (p. 400). This knowledge cannot be used for any purposes other than teaching. Ball et al. (2008) suggest that it involves an "uncanny kind of unpacking of mathematics that is not needed … or even desirable … in settings other than teaching. Many of the everyday tasks of teaching are distinctive to this special work and requires unique mathematical understanding and reasoning that is uncommon to other professions" (p. 400). Teaching requires knowledge that goes beyond identifying correct and incorrect answers and requires the ability to understand why the answer is correct or incorrect (Ball et al., 2008).

*Knowledge of Content and Teaching* (KCT) intertwines knowing about mathematics and knowing about teaching. Ball et al. (2008) claim that most mathematical tasks require the teacher to integrate their mathematical knowledge with instructional design. KCT includes "knowledge about how to choose appropriate representations and examples, how to build on students' thinking, and how to address student errors effectively" (Wilkie, 2015, p. 249). For instance, the teacher needs to know what teaching strategies to employ where and when, what resources to use and what representations and examples to employ, so that students can learn with understanding.

*Knowledge of Content and Students* (KCS) can be described as knowledge that integrates knowing about students and knowing about mathematics in a way that enables teachers to relate to learners, to understand the students' thinking and what makes the learning of particular concepts easy or difficult (Nolan, Dempsey, Lovatt & O'Shea, 2015; Ball et al., 2008). Wilkie (2015) argues that with this knowledge, teachers can "attend to how students typically learn a concept, and to common mistakes and misconceptions" (p. 250). KCS enables the teacher to anticipate what learners are likely to think, what common errors they are likely to make, and what learners will find interesting, motivating or confusing in the work assigned to them. Knowing content in relation should enable the teacher to hear and interpret students' emerging and incomplete thinking as they themselves express it (Ball et al., 2008). Thus, the teacher should be able to understand what is going on in student's mind even when the student cannot express herself or himself fluently.

*Knowledge of Content and Curriculum* (KCC) is knowledge of the full range of programmes and variety of instructional materials designed for the teaching of a particular subject and its different topics at a given grade (Petrou & Goulding, 2011). KCC includes knowledge of the syllabus and/or the national workbooks. The teacher needs KCC to evaluate, adapt and use this material in the teaching and learning of different mathematical concepts

Table 3.1, below, provides a summary of the MKfT domains and examples of how each domain is employed in teaching.

*Table 3. 1: A summary of Ball et al.'s (2008) MKfT domains and examples of how each domain is applicable in practice (adopted from Hurrel, 2013)*

| PCK categories | MKfT domains | Definition of the MKfT domains | MKfT domain indicators |
|---|---|---|---|
| SMK | Common Content Knowledge (CCK) | General knowledge of mathematics and mathematical skills used by anybody who has done mathematics successfully at school. Teachers need this knowledge to understand the work they assign to their learners | • calculate an answer correctly<br>• understand the mathematics you teach<br>• recognise when a student gives a wrong answer<br>• recognise when a textbook is inaccurate or gives an inaccurate definition use terms and notations correctly |
| | Horizon Content Knowledge (HCK) | Mathematical knowledge that spans across the mathematics curriculum that helps the teacher to view mathematics as whole, but not in parts | • make connections across mathematics topics within a grade and across grades<br>• articulate how the mathematics you teach fits into the mathematics which comes later |
| | Specialised Content Knowledge (SCK) | Special knowledge that is specifically required for the work of teaching. | • interpret students' emerging and incomplete ideas<br>• evaluate the plausibility of students' claims give or evaluate mathematical explanations<br>• use mathematical notation and language and critique its use<br>• ability to interpret mathematical productions by learners, other teachers or learning materials<br>• evaluate mathematical explanations for common rules and procedures<br>• appraise and adapt the mathematical content of text books |
| PCK | Knowledge of Content and Teaching (KCT) | Knowledge that combines knowledge of mathematics content and knowledge of teaching | • sequence mathematical content<br>• present mathematical ideas<br>• select examples to take students deeper into mathematical content<br>• select appropriate representations to illustrate the content<br>• ask productive mathematical questions<br>• recognise what is involved in using a particular representation<br>• modify tasks to be either easier or harder<br>• use appropriate teaching strategies<br>• respond to students' why questions<br>• choose and develop useable definitions<br>• provide suitable examples |
| | Knowledge of Content and Students (KCS) | Knowledge that combines knowledge of mathematics content and knowledge of students | • anticipate what students are likely to think and do<br>• predict what students will find interesting and motivating when choosing an example<br>• anticipate what a student will find difficult and easy when completing a task<br>• anticipate students' emerging and incomplete ideas<br>• recognise and articulate misconceptions students carry about particular mathematics content |
| | Knowledge of Content and Curriculum (KCC) | Knowledge of the content requirements of the curriculum and the materials that can be used to teach that particular content | • articulate the topics in the curriculum<br>• articulate the competencies related to each topic in the mathematics curriculum<br>• articulate and demonstrate a familiarity with the structure of the mathematics curriculum<br>• link representations to underlying ideas and to other representations<br>• knowledgeability of available materials (e.g. textbooks) and their purposes |

### 3.2.3 Limitations of the mathematical knowledge for teaching framework

The MKfT framework has significant implications for mathematics teacher education. Depaepe, Verschaffel and Kelchtermans (2013) describe it as the most influential reconceptualization of teachers' PCK within mathematics education. Yet some reservations have been expressed about MKfT. Hurrel (2013) claims that the lines between the various MKfT domains are too blurred, to the point that it becomes difficult to discern where one domain ends and another begins. For example, it is difficult to differentiate between CCK and SCK, or among KCT, SCK and KCS. Ball et al. (2008) concede that:

> The lines between our four types of knowledge can be subtle. For instance, recognizing a wrong answer is common content knowledge (CCK), while sizing up the nature of the error may be either specialized content knowledge (SCK) or knowledge of content and students (KCS), depending on whether a teacher draws predominantly from her knowledge of mathematics and her ability to carry out a kind of mathematical analysis or instead draws from experience with students and familiarity with common student errors. Deciding how best to remediate the error may require knowledge of content and teaching (KCT). (p. 400)

Hurrel (2013) further argues that "the model does not display the possibilities of all the interactions between the domains" (p. 59). The representation of the domains in the diagram suggests that some are more important than others. For example, SCK appears to occupy a larger area of the MKfT model than KCT (see Figure 3.2), suggesting that it is more important. Hurrel (2013) alleges that there is no evidence that any one domain is more important than any other. Schoenfeld (2008) has also criticised the division of domains in the MKfT and argued the need for further research to determine the extent to which they reflect the desired competencies. However, the research conducted by Chikiwa (2017) to investigate what MKfT teachers in the Foundation Phase require in order to teach mathematics competently showed that there is a strong interdependence between these MKfT domains and thus a very 'thin line' between them. However, KCT was found to be at the centre of all the other knowledge domains, claiming that the other five knowledge domains are important for informing the teacher on how and what they should teach. Figure 3.3 below show Chikiwa's (2017) findings on how MKfT domains interrelate for effective teaching at FP.

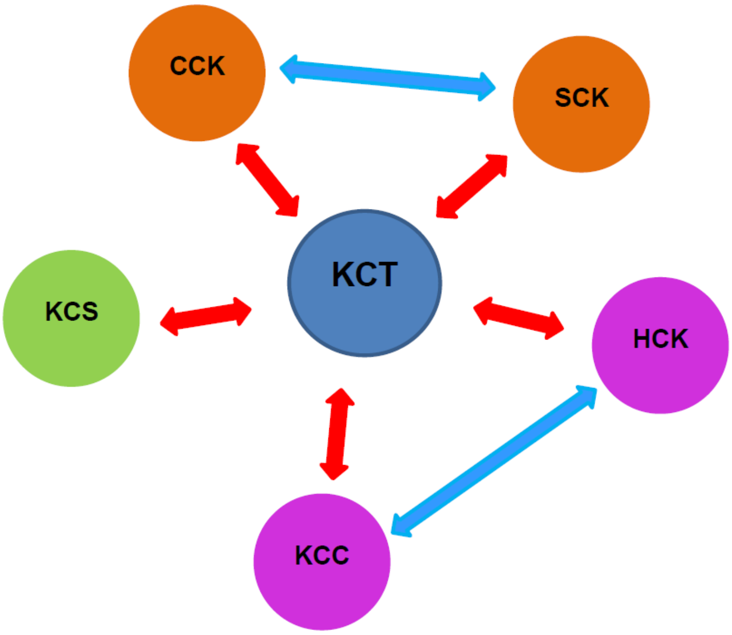



*Figure 3. 3: How MKfT interrelates for the effective teaching of mathematics (adopted from Chikiwa, 2017 p. 123)*

Chikiwa (2017) found that Gail[2] used all six knowledge domains during the process of teaching counting and developing children's number sense through counting. Chikiwa (2017) claims that through her research, she "realised that Gail was not always conscious of her MKfT. Her counting sessions were seamless and, in many respects, her MKfT was automated. Like an experienced driver, Gail did not stop to think about what MKfT domain she was drawing on at any particular moment in time" (p. 124). This suggests that all the MKfT domains are important and influence the effective teaching of mathematics.

Having discussed the knowledge, the teachers need to be competent mathematics teachers in this section, my next section sought to understand how RP contributes to the construction and perpetuating of the mathematical knowledge for teaching. I discuss why RP is therefore important in education, particularly mathematics teacher education.

## 3.3 WHY REFLECTIVE PRACTICE IS IMPORTANT FOR TEACHER EDUCATION

Reflective practice has become an influential concept in various forms of professional education since Dewey's time, and many scholars have emphasised its importance in a variety of professional programmes (Schön, 1983, 1987; Boud & Walker, 1998; Urzua & Vasquez,

[2] the expert teacher who participated in the study

2008; Collin, Karsenti & Komis, 2013). Although the notion of RP was introduced by John Dewey (1933), it has been a prominent topic in literature relating to teaching and teacher education since the seminal work of Donald Schön (1983, 1987). RP has been widely accepted as significant for teacher education and vital for teaching practice. This section seeks to shed light on why RP is gaining so much popularity in teacher education. My discussion is inclined more to mathematics teacher education as the major aim of this research is to contribute to the improvement of the teaching and learning of mathematics. I begin this section by describing the modern work of teaching that necessitates teachers to be reflective and adaptive in their classrooms and to continuously reconstruct their knowledge to keep pace with demands of their work of teaching.

### 3.3.1 Understanding the modern work of teaching

Teachers play a critical role in every education system and society. According to Mathew, Mathew and Peechattu (2017) they stand at the interface of the transmission of knowledge, skills and values. Their ability to provide quality education is of critical importance to the development of any nation. The different classroom practices teachers engage in as they interact with learners play an important role in developing learners' understanding of concepts and their overall performance.

Arends, Winnaar and Mosimege (2017) note that teacher classroom practices are meant to improve learning, but may sometimes not do so, as a result of the level of the teacher's effectiveness. Teacher effectiveness is determined by what the teacher does during the process of teaching measured against learner performance (Dar, 2012; Coe, Aloisi, Higgins & Major, 2014). Dar (2012) defines teacher effectiveness as the ability to teach in a way that results in conceptual understanding and good learner performance. It is "an activity that leads to improved student achievement using outcomes that matter to the future success of the students" (Coe et al., 2014, p. 2). Research indicates that factors such as a teacher's knowledge, attitudes, beliefs and professional behaviours contribute significantly to his or her effectiveness (Dar, 2012; Coe et al., 2014). Bahr and Mellor (2016) concur that "quality teaching cannot exist where teacher knowledge is weak, flawed or patchy, and neither can it exist where a teacher does not have appropriate pedagogical skills" (p. 58). Effective teachers "continually consider the quality of their [learners'] work … the habit of reconsidering and reflecting upon teaching episodes after the event contributes to effective teaching" (Bahr & Mellor, 2016, p. 2). Thus, effective teaching requires teachers to reflect and be adaptive. Bahr and Mellor (2016) argue for the importance of paying attention to what happens in the work of teaching that requires teachers to adapt. This is addressed in next section.

### 3.3.2 Why teachers need to become adaptive professionals

The complexity of the modern work of teaching cannot be underestimated. Teaching has become a dynamic profession, plagued by change resulting from the continuous re-conceptualisation and restructuring of education to meet the demands of society that are often based on political whim or positioning (Bahr & Mellor, 2016). Teachers and teacher educators are therefore challenged to adapt their knowledge and skills to keep pace with changing expectations. Darling-Hammond (2006) describes the demands of the modern work of teaching in a more elaborate way. She writes:

> If all students pursued an identical path to understanding, learning might be ensured by designing the perfect scripted curriculum. Teachers could be prepared to implement a prescribed to set of lessons using a limited range of teaching techniques. … However, given human diversity and cognitive complexity, learning cannot be achieved through a single set of activities that presume standardized experiences and approaches to learning. Teaching that aims at deep learning, not merely coverage of material, requires sophisticated judgement about how and what students are learning, what gaps in their understanding need to be addressed, what experiences will allow them to connect what they know to what they need to know and what instructional adaptions ensure that they reach common goals … if teachers are to help learners who begin and proceed differently to reach similar outcomes, they will need to be able to engage in experimentation, incisive interpretation of complex events, and rigorous reflection to adjust their teaching based on student outcomes. This means that teachers must become adaptive experts who cannot only use routines that afford greater efficiency, but also their ability to innovate where routines are not enough.… Preparing teachers who can learn from teaching, as well as learning for teaching, is a key challenge for teacher education today. (pp. 10-11)

The work of teaching and preparing teachers for effectiveness has undoubtedly become more complex. Besides the demands of teaching in a modern classroom noted above, teachers are increasingly faced with large numbers of learners with diverse learning needs. An average class in most South African public schools comprises at least 40 learners. The classes in the urban schools are much bigger while they are smaller in rural and farming areas. For example, I have visited a Grade 2 class (for TP assessments) with 69 learners in one of our local schools. The teacher is expected to meet all the learners' individual needs for effective learning to happen. To achieve this, teachers need to transform traditionally held notions of what it means to be an effective teacher, understand the situation they are working in, and keep adjusting their knowledge in order to meet the everyday needs of the classroom (Darling-Hammond, 2009; Sellars, 2012).

According to Ziegler and Loos (2017) teaching mathematics is an additional complexity to the work of teaching that is already complex. They claim that many students fail mathematics mainly because “mathematics is hard. It is abstract (that is, most of it is not directly connected to everyday-life experiences). It … But a lot of the insuffícent motivation comes from the fact that students and their teachers do not know what Mathematics is” (p. 4). Teachers are expected to find means of creating “a multifaceted image of mathematics as a coherent subject, all of whose many aspects are well connected, [as this] is important for a successful teaching of mathematics students with diverse (possible) motivations” (p. 4). such challenges of teaching lead Bahr and Mellor (2016) to sigh “these are tough times to be a teacher” (p. v).

Thus, the demands of the modern work of teaching confirms Dewey’s (1933) argument cited earlier that “it is impossible to become, and continue to be, an effective teacher without a personal commitment to reflective practice” (p. 9). As indicated earlier, the ability to reflect on practice has been found helpful in making teachers understand and meet the demands of teaching in the modern classrooms (Darling-Hammond, 2006; Shandomo, 2010; Sellars, 2012; Yaman, 2016). According to Yaman (2016), teachers need to reflect on their learners’ thinking, understandings, interests and developmental thinking. In line with Ward and McCotter (2004), Yaman (2016) proposes that teachers should be trained to reflect both on the content of the subject they teach and how to apply particular teaching strategies. My next section discusses RP in teacher education.

## 3.4 REFLECTIVE PRACTICE IN TEACHER EDUCATION

Reflective practice is widely accepted as significant for teacher education and vital for teaching practice, it nevertheless continues to draw criticism (Beauchamp, 2014). Collin et al. (2013) claim that its theoretical grounding remains problematic and that the empirical approaches it has engendered are excessively diverse. There is also concern that to this day there is no clear consensus on what it is and how it can be developed (Beauchamp, 2006; Collin et al., 2013; Ibrahim-Didi, 2015) which may result from that different professions interprets RP differently (Poom-Valickis & Mathews 2013). This is evidenced by the different names identifying the concept such as: reflection, reflective thinking, RP, reflectivity, reflexivity – and the various definitions formulated. Beauchamp (2006) conducted an in-depth theoretical analysis covering 55 definitions of reflective practice and found a wide diversity of meanings. She was therefore unable to establish a conclusive definition of the concept and reported several types of reflective processes, objects, and rationales. Like other researchers, Beauchamp (2006) nevertheless found that scholars agreed on its significance as a tool for lifelong learning and professional development, and on its ability to influence effective teaching (Kaminski, 2003; Russell, 2013; Poom-Valickis & Mathews, 2013). Kaminski (2003) attributes the lack of consensus about RP to the fact that it has been approached from a variety of perspectives, including the political, moral, social and educational. But Russell (2005) reassures us that the absence of consensus on what RP is and how we recognise it may aid teachers and teacher educators to understand why RP is not a simple practice to adopt or teach.

Another critique of RP relates to the gap that exists between the theory associated with reflection and the putting of this theory into practice in classroom contexts (Russell, 2013; Correa Molina, Collin, Chaubet & Gervais, 2010; Beauchamp, 2014). Correa Molina et al. (2010) point to the confusing status of emotion in approaches to reflection and possible cultural biases that may affect these approaches. These criticisms have led to doubts about the value of reflection for teaching. Some scholars (such as Akbari, 2007; Postholm, 2008; Russell, 2013) wonder why the link between theory and practice cannot be made and therefore pose serious questions about the significance of focusing on RP in PTE. Akbari (2007) argues that there is "no evidence to show improved teacher or student performance resulting from reflective techniques" (p. 192). In flat contradiction, Beauchamp (2014) claims that "the value of reflection in teaching has repeatedly been confirmed in literature on teacher education, and many frameworks for understanding the process of reflection have been suggested as aids to its incorporation into teacher education programs" (p. 126). This perspective suggests that its benefits outweigh doubts about its conceptual clarity and practical applicability.

### 3.4.1 Defining reflective practice

Postholm (2008) notes that the word reflection comes from the Latin word *reflectio*, in which 're' means 'back' or 'again,' and 'flectio' means 'to turn'. Reflection, therefore, literally translated, means to turn back. One turns back to a situation, analyses it and derives insight that will improve similar future situations. Dewey (1933) defines reflection as an "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the ground that supports it … [it] allows individuals to think critically and scientifically" (p. 9). Boud, Keogh and Walker (1985) regard reflection "as an important human activity in which people recapture their experience, think about it, mull it over and evaluate it" (p. 19). These conscious, explicit and critical thoughts contribute to the intellectual and moral development of a person (Yaman & Armutcu, 2010). Thus, RP provides an opportunity for lifelong learning through experience which Garza and Smith (2015) deem critical for professional growth and development. RP can assist in the integration of learning experiences and in the enhancement of the quality of learning (Kaminski, 2003). It can be viewed as a critical and deliberate inquiry into professional practice in order to gain a deeper understanding of oneself, others and the meaning that is shared among individuals. This can be during practice and after the fact and can be done alone or with others.

### 3.4.2 Reflection in teacher education- particularly in mathematics teacher education

Reflective practice has become a focus of interest and a powerful movement in teacher education. According to Mathew et al. (2017), "The complexity of teaching requires teachers to question their practices for their own professional development in order to improve and to increase learner performance" (p. 126). RP enables teachers to reflect on their actions, thereby engaging in a process of continuous learning (Schön, 1983). Since RP involves paying critical attention to the practical values and theories which inform everyday actions, examining practice reflectively leads to developmental insight. Mathew et al. (2017) therefore propose that experience alone does not necessarily lead to learning, but deliberate and appropriate reflection on experience can and does.

As mentioned earlier, the concept of RP originates from the seminal work of Dewey (1933). Dewey (1933, p. 107) described five reflective thoughts with varying influence on the reflective process. These levels were non-sequential and included:

- Intellectualization- that is changing the experience or situation into a problem for solving.
- Guiding idea/hypothesis- this is working through a problem to find a working solution
- Reasoning- involves elaborating on the situation or analysing the problem from different perspectives.
- Suggestion – described as an impulsive thought / immediate though about the solution.
- Testing the hypothesis by action- this involves conclusive thoughts for verifying the possible solutions.

Thus, RP is more than mere thinking or sequencing ideas about practice but regarded as a process in which thoughts about practice are organised into a system of specific outcomes (Hegaty, 2011).

Schön (1983) foregrounds the complexities of reflective practice by exploring different types of knowledge. He paid attention to the role of tacit knowledge, which develops in individuals as they go through different experiences. Tacit "knowledge is unconscious and extemporaneous" (Collin et al., 2013, p. 109). With the individual's transit into the workplace, their tacit knowledge grows and influences their actions. Schön (1983) also introduced the notions of reflection-in-action, reflection-on-action and knowing-in-action to illustrate the tacit knowledge that develops as one engages in RP.

Knowing-in-action is described as "the unconscious reflective practice that occurs when a person's acts are based on prior experience. The person does not actively reflect on the event but uses tacit knowledge before engaging in action" (Meierdirk, 2017, p. 24). Eraut (1994) associates knowing-in-action with tacit knowledge since it is knowledge gained through experience that often dictates how a teacher behaves and reacts. According to Meierdirk (2017), knowing-in-action is influential for PSTs in that as they move on to become professionals their tacit knowledge increases and influences their actions (p. 24).

Reflection-in-action is when one thinks about what one is doing while doing it and makes decisions through bringing tacit knowledge to bear on one's actions. Meierdirk (2017) defines reflection-in-action as conscious reflection that is undertaken during the process of teaching. Meierdirk (2017) calls it reflection 'on the spot' to emphasise that it is a reaction to what is occurring at that particular time, rather than an instant reaction using tacit knowledge. Urzua and Vasquez (2008) associate reflection-in-action with such terms as thinking on your feet, keeping your wits about you, and learning by doing. Schön (1983) argues that reflection-in-action is central to the art of teaching, as teachers often have to deal with situations of uncertainty, instability, uniqueness and with a degree of conflict during the process of teaching.

Reflection-on-action on the other hand, is the deliberate analysis of a classroom event performed after the event has passed with the intention of improving practice (Schön, 1983, 1987; Urzua & Vasquez, 2008). Meierdirk (2017) adds that reflection-on-action is a continual process of review and improvement. As is the case with RP, there is no consensus on how the process of reflection-on-action takes place and several models have been developed to help understand the process. Although the models differ in the number of steps they involve, they all agree on a reflection cycle that begins with the experience and ends with learning from that experience. The reflection process is discussed later in this section. In line with Schön (1987), Meierdirk (2017) encourages teachers to use reflection-on-action by continuously reflecting on a problem to generate new knowledge to solve problems and resolve dilemmas.

Schön's reflective practice has become the most widely embraced view of reflection in education (Kaminski, 2003). It has been incorporated in both in-service and pre-service teacher education programmes as a significant part of the international movement to reform teaching and improve the quality of education (Boud & Walker, 1998; Collin et al., 2013). Currently it is a compulsory competency in many Western universities that offer teacher education (Urzua & Vasquez, 2008; Collin et al., 2013). However, Schön (1987) has been criticised for limiting reflection to 'in-action' and 'on-action'. Urzua and Vasquez (2008) argue that Schon overlooks the importance of other forms of reflection. Ghaye (2010), building on Schön's (1987) reflection on practice, added two more types of reflection: 'reflection-for-action' and 'reflection-with-action'. According to Ghaye (2010), reflection-for-action focuses on future courses of action, while Meierdirk (2017) describes it as the implementation of an action that occurs after the reflection-on-action has been undertaken. Reflection-for-action is therefore a plan for improvement after reflection-on-action. One learns from the previous situation or practice and considers a way forward to improve it. This type of reflection requires teachers to anticipate what will occur during a lesson, as well as to reflect on their past experiences resulting in continuous improvement and manifests itself as a cyclical process (Farrell 2015).

Reflection-with-action, on the other hand, is described as reflecting with someone so that you can come up with a plan for improvement. For example, PSTs can reflect on their lessons with peers, mentor teacher or a lecturer who has observed it. Meierdirk (2016) argues that this is useful for developing PSTs' teacher knowledge and RP.

As mentioned earlier in this chapter, just as there are many definitions of reflection, there are also various models of reflection. Boud et al.'s (1985) triangular representation (Figure 3.4, below) is considered the simplest model that captures the essential elements of meaningfully reflection on experience that results in learning.

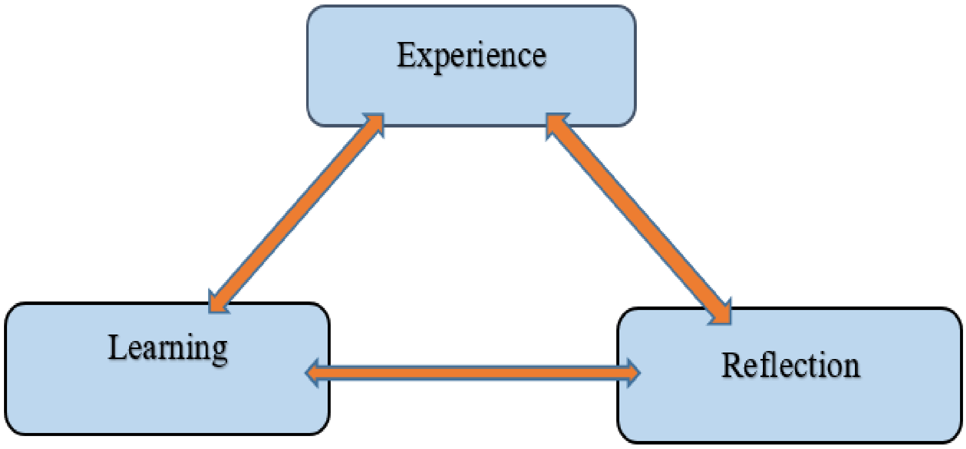



*Figure 3. 4: Boud et al.'s (1985) triangular representation model*

Like other models of reflection, this one is cyclic in design, suggesting that the process of learning from experience through reflecting never ends. Critiques of Boud et al.'s (1985) model claim that it does not explain what reflection might consist of, or how the learning might translate back into experience. Gibbs (1988) proposes that aligning key reflective questions with the model would help people understand the reflective process. Gibbs (1988) therefore developed a model with six steps in the process of reflection (see Figure 3.5, below). Gibbs's first step in the process is identifying an event, which Johns (2000) claims should prompt an inner feeling of discomfort and a need to describe what has happened. The second step is to give a rationale as to why the event occurred or was employed. The third step pertains to evaluating the event, to assess whether it enhanced or hindered learning. This leads to the fourth step, in which there is analysis of the event. In step 5 a conclusion is drawn and alternative ways of dealing with the event are suggested. Lastly, an action plan is devised to improve the aspect of instruction concerned. In other words, Gibbs ends the reflective cycle with reflection-for-action. The suggested change is implemented, which is followed by description of what happened, and so the cycle goes around once more. Gibbs (1988) claims that the more one gets into the habit of reflection the more competent one becomes as more tacit knowledge is developed during the process of reflection on action.

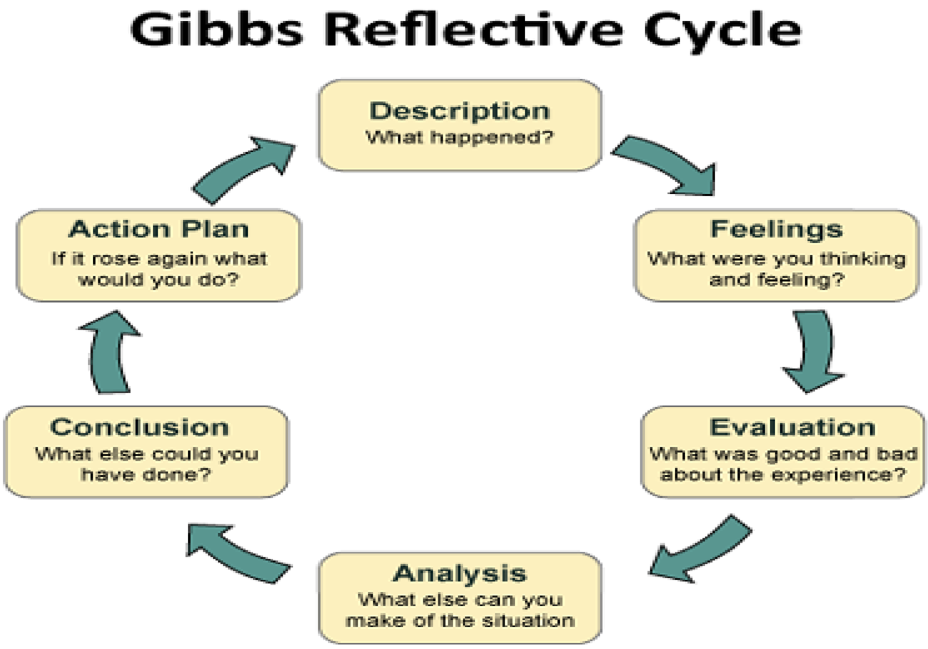



*Figure 3. 5: Gibbs's model of reflection (adapted from Dye, 2011)*

As seen in Figure 3.5 above, each of the steps in Gibbs's (1988) reflective cycle model is accompanied by a question that can prompt a novice in RP to reflect in meaningful ways. I found Gibbs's model relevant for my research, especially because my study dealt with PSTs who had no experience of reflecting at all. Johns (2000) agrees that Gibbs's (1988) cycle provides a good starting point for people who are learning to reflect. He claims the model makes one aware of all the stages one goes through when reflecting on an event. While Gibbs's model provides cues that support practitioners in accessing, making sense of, and learning through experience, it has been criticised for promoting superficial reflection. According to Atkins and Murphy (1993) the model makes no reference to critical thinking, analysis, assumptions or views from a different perspective, while Johns (2000) claims that it has too few deep or probing questions to stimulate deep reflection. If the key features of reflection proposed by Pfeiffer and Ballow (1988) are accepted, I find that Gibbs's model neglects the fourth key feature of reflection. These are the key features proposed by Pfeiffer and Ballow (1988):

- Reflection must result in learning: that is, through reflecting, you are enabled to change your ideas and understanding of the situation.
- Reflection is an active and dynamic process: that is, reflection is not done once and for all. It involves reflecting 'for' action (actions that you may wish to take in the future), reflection 'in' action (on an incident as it happens) or reflecting 'on' action (past experience).

- Reflection is not a linear process, but cyclic: it leads to the development of new ideas which can be used to plan the next stages of learning.
- Reflection encourages looking at issues from different perspectives: it enables one to understand the issue at hand and to scrutinise one's own values, assumptions and perspectives.

According to Hegarty (2011), once reflection was accepted as a staged process of thinking, "research and debate about the process of reflection per se led to the diverse terminology and understanding about the nature of reflections" (p. 24). Van Manen (1977) is well known for initiating the idea of categorising reflections to establish their nature. Van Manen's (1977) work is influential in research that seeks to understand the nature of reflection. More discussion about levels of reflections and Van Manen's influence is discussed in Chapter 4, Section 4.5, where I discuss how I developed the tool I used for analysing the PSTs' reflection in search of answers to my research questions.

The ability to reflect is closely relates to the skill of noticing. One needs to notice the classroom event they will reflect on. Sherin, Jacobs & Philipp (2011) conceptualise noticing as "professional vision in which teachers selectively attend to events that take place and then draw on existing knowledge to interpret these noticed events" (p. 80). Reflection takes one beyond noticing to thinking of what one might possibly do about what one has noticed. This suggests that the ability to reflect goes hand in hand with the ability to notice; hence, frameworks have been developed to guide teachers on what to notice. One such framework is the six lens framework discussed in section 3.6.2 as a tool for guiding reflections on a mathematics lesson. In the next section, I discuss development of RP in PTE.

## 3.5 DEVELOPING PRE-SERVICE TEACHERS REFLECTIVE PRACTICE

The value of reflection as a medium to facilitate adapting to the dynamics of teaching and developing teacher knowledge (as discussed in Section 3.3.1, above) has repeatedly been confirmed in literature on teacher education (Gore & Zeichner, 1991; Loughran, 2002; Russell, 2005; Beauchamp, 2014; Karsenty, 2018). Darling-Hammond (2006) proposes the need for developing RP in PSTs. She claims that RP provides PSTs with a comprehensive understanding of the complex dynamics of teaching and the factors that influence the classroom context.

As discussed in Chapter 1, PTE is putting efforts to develop PSTs holistically and has therefore included RP in PTE programs. This section highlights the reasons for this.

Many teacher preparation institutions include a component of teaching practice[3] (TP) to expose PSTs to the actual practice of teaching. Here PSTs are sent to learn more about the practical work of teaching under the mentorship of a more experienced teacher. Teacher educators have very little control (if any) over what happens in the schools during this period. Professional development of classroom practice (including RP) is left in the hands of the mentor teachers at the schools where PSTs are placed. Some researchers find this situation disturbing, and fear it conduces to a disconnection between academic instruction and practice during TP (Ward & McCotter, 2004; Darling-Hammond, 2006; Green, 2010). Green (2010) comments:

> "Today, the teacher-education curriculum is a confusing patchwork. Academic instruction and clinical instruction are disconnected. Graduates are insufficiently prepared for the classroom . . . by emphasizing broad theories of learning rather than the particular work of the teacher, methods classes and the rest of the future teacher's coursework often become what the historian Diane Ravitch called 'the contentless curriculum'" (Green, 2010, p. 7).

While PSTs' field experiences can provide them with learning opportunities to extend their teacher knowledge, skills and dispositions (Garza & Ovando, 2012), they also need proper guidance to help them "learn how to learn about those experiences" (Garza & Smith, 2015, p. 15). Like Darling-Hammond (2006), Green (2010) is concerned that leaving such crucial development of teacher knowledge and skills in the hands of schools not only results in disjointed learning but also erodes the holistic development of PSTs. Important skills such as RP may not yet be well developed among them, but they nevertheless have to situate themselves in the practice of teaching. Garza and Smith (2015) claim that "this knowledge is acquired through experience and through considered and deliberative reflection about or inquiry into experience" (p. 15). Examining the practice of teaching can foster critical inquiry into teaching experiences and challenge the way one views and behaves in authentic teaching contexts (Poom-Valickis & Mathews, 2013).

Zeigler and Loos (2017) allege that without the opportunity to critically enquire the practice of teaching mathematics, mathematics PSTs fail to make connections between their learning at school as learners, their teacher education studies and the practical work of teaching. They claim:

[3] Teaching practice is also known as practicum

> At the beginning of his university studies, the young student is confronted with problems that do not remind him at all of what he has dealt with up to then, and of course, he forgets all these things immediately and thoroughly. When after graduation he becomes a teacher, he has to teach exactly this traditional elementary mathematics, and since he can hardly link it with his university mathematics, he soon readopts the former teaching tradition and his studies at the university become a more or less pleasant reminiscence which has no influence on his teaching. (p. 8)

Russell (2005) therefore suggest PSTs should be taught to reflect on practice to enable them to make connections. Reflection is necessary to assist PSTs in acquiring the knowledge that can validate their classroom decisions and actions and improve their teaching proficiency (Farrell, 2015). According to Lane, McMaster, Adnum and Cavanagh (2014) their understanding of teaching is improved by thinking about why teachers employ particular strategies. PSTs, however, need to be taken through a structured process of reflection because it enables them "to see student learning: to discern, differentiate, and describe the elements of that learning, to analyse the learning and to respond" (Rodgers, 2002, p. 231).

To capacitate development of RP in PTE, accrediting bodies such as the National Council for Accreditation of Teacher Education (NCATE), the National Board for Professional Teaching Standards (NBPTS), and recognition organisations, such as the Council for Higher Education Accreditation (CHEA), all support development of RP as a valuable practice for the professoriate and future educators (Giaimo-Ballard & Hyatt, 2012). For example, NCATE have incorporated reflective thought in four its six standards as an ideal means to improve teaching practices, and they give accreditation to institutions who successfully meet the requirements of all the six standards. This suggests that PTE programmes should include developing PST reflectivity for them to be accredited. Giaimo-Ballard and Hyatt (2012) advise PTE that learning how to reflect and how to teach PSTs the fundamentals of reflection are vital.

Gore and Zeichner (1991) acknowledge that reflective orientations have been 'fashionable' for so long that "there is not a single teacher educator who would say that he or she is not concerned about preparing teachers who are reflective" (p. 120). In confirmation Russell (2005) claims that in about 1977 PTE

> already had a strong commitment to having students keep journals of their practicum experiences … Thus, I was not at all surprised when reflective practice attracted a great deal of attention in the mid-1980s and then seemed to fade away when there was little

> evidence that reflective practice prepared better new professionals. More than 20 years later, there is a journal named *Reflective Practice* that confirms that many professional educators continue to pursue reflective practice as an important element of professional preparation. (p. 199)

Thus, there is consensus in the research that the concept of developing RP in PTE is not new or unrecognised (Ward & McCotter, 2004; Russell, 2005). Institutions offering PTE are committed to ensuring that PSTs develop RP, as witnessed in most mission statements. The desire is that by the end of preparation all PSTs should have reached higher levels of reflection (Ward & McCotter, 2004). However, it is sad that currently there is not a clear understanding of how RP can be developed meaningfully in PTE. Russell (2005) claims that "year after year those whom I teach report that many of their teachers urge them to engage in reflective practice but no one either helps them develop specific skills or provides a personal model of reflective practice" (p. 199).

Ward and McCotter (2004) set out to understand how PSTs reflect and develop a rubric to illuminate the dimensions and qualities of PSTs' reflections. They found that their participants were not engaging in meaningful reflections, and they commented:

> We realized that we have often asked our students to reflect on field experiences without ever discussing the qualities of good reflection and often with disappointing results. Students do not automatically know what we mean by reflection; often they assume reflection is an introspective after-the-fact description of teaching. Reflection, meant to make teaching and learning understandable and open, has itself been an invisible process to many of our preservice teachers. (p. 255)

Ward and McCotter (2004) suggest that PTE needs to find better and more dynamic ways of developing PSTs' RP than simply asking them to write reflective journals. They argue, "As teacher educators, we must be able to make a clear case for reflection as an outcome above and beyond its short-term instrumental value. Further, we should be able to define reflection in a way that makes the qualities we value visible" (p. 255).

Learning to reflect on practice should be related to the practice of teaching and should be done in the context of teaching (Schönfeld, 1988; Ward & McCotter, 2004). Ward and McCotter (2004) state that in order for reflection to be evaluated, PTE "must overtly connect the qualities of reflection to the process of teaching and learning. It is only through this integral connection that we can prevent reflection from becoming a rote process, or see it eliminated altogether. (p. 256). On the same note Mirzaei, Phang and Kashefi (2013) insist that teacher educators be mindful of showing their PSTs how to reflect and what to reflect on. Thinking about these two components of reflection would expand and focus PSTs' understanding of the concept of RP.

As mentioned earlier, while most researchers agree on the value of developing PSTs' RP, there is no consensus as to how to go about this. Some researchers report that, PSTs find it difficult to reflect and hardly reach the higher levels of reflection (Ward & McCotter, 2004; Russell, 2005; Giaimo-Ballard & Hyatt, 2012). Others claim that PSTs understand what RP is and can therefore aspire to the higher levels of reflection (Liou, 2001; Huntley, 2008). In separate studies Liou (2001) and Pedro (2005) tracked the development of Taiwanese PSTs' reflective practices to determine the nature of their reflections. Liou (2001)'s study found that PSTs generally discussed topics related to teaching and were more critical than descriptive but did not demonstrate much improvement in their ability to reflect over time. Pedro's (2005) study sought to investigate how PSTs understand and interpret reflective practice and found that they possessed a sound general understanding of reflection and improved their RP through courses and experiences in different contexts.

While evaluating his own practice in PTE, Russell (2005) contemplated whether to teach RP to PSTs or not. His findings indicated that reflective practice can be taught explicitly (if necessarily patiently!) by employing reflection-in-action to understand and promote one's teaching of reflective practice to others. Cavanagh and Prescott (2009) investigated whether teachers' reflections changed or developed during their practicum and upon entry into the workplace. They found that the participants' reflections remained descriptive in nature and that they made minimal progress in their ability to reflect on their teaching during the practicum period. Similarly, Maaranen and Stenberg (2017) explored the nature of PSTs' reflections and found that they generally focused on more concrete factors such as environment and behaviour and paid least attention to competence. Huntley (2008) therefore suggests that PTE should adopt approaches that support critical reflection. This requires breaking off from the traditional educational focus on "good models of teaching", with the unacknowledged conflicts it engenders between institutional ideals and the actual context of schools.

The fact that very little direction is given to teacher education institutions regarding methods and processes of developing reflectivity was a matter of concern to Giaimo-Ballard and Hyatt (2012). They therefore explored the teaching of RP from the perspectives of NCATE, using Schön's (1983, 1987) reflection-in-action as their conceptual framework. Using interviews as the primary method of data collection they found that the participants practised (a) note taking,

(b) requesting feedback, (c) setting up checkpoints, and (d) adjusting to improve practices, as key reflective teaching strategies during the observation of practice. They concluded that reflection is not haphazard and does not happen by chance, but (as Dewey suggested in 1933) must be a persistent habit that consists of careful thought and systematic procedures. Giaimo-Ballard and Hyatt (2012) report that their "participants made it clear that intentionality was key to reflective thought" (p. 9). They argue that "making reflection intentional is similar to Dewey's concept of reflection in that it becomes a habit of the mind, including a plan that is well thought out and purposeful. This is an important step in the continuous process of enhancing teaching and learning" (p. 9).

The next section discusses tools that are currently being employed to develop RP in teacher education. However, because of the nature and aim of my study, I focus on the tools that support development of RP in Mathematics teacher education

## 3.6 TOOLS FOR SUPPORTING DEVELOPMENT OF REFLECTIVE PRACTICE IN MATHEMATICS TEACHER EDUCATION

Recent research efforts have focused on designing strategies to develop RP in PTE. Lane et al. (2014) suggest various strategies for developing PSTs' RP. These include involving PSTs in an oral or online class discussion of a teaching situation, being interviewed or writing a reflective essay about their own teaching experiences, conducting an action research project, or keeping a journal or a blog while participating in school experience. Modern research however encourages the development of settings, representations of teaching, and activities that approximate practice, and decomposing these into parts that are more manageable in developing reflectivity in teacher education (Blomberg, Sherin, Renkl & Glogger-frei, 2014; Santagata & Yeh, 2013; Karsenty et al., 2015). Garcia, Sanchez and Escudero (2006), addressing mathematics teacher educators, say:

> For us, it is very important to assume that reflection is not only an individual psychological process, which can be studied from formal frameworks independent of content, context or interaction. We accept that reflection implies the conscious immersion of an individual in the world of his/her experience, a world with values, interactions, affects, social and political interest, etc. (p. 1)

Garcia et al. (2006) further allude that in mathematics teacher education, reflection on mathematics teaching practice should be mediated through the situations that resemble practice for teacher knowledge to grow. They argue that it is the mathematics teacher educators' responsibility to ensure a proper context for RP. They claim that "mathematics teachers' reflection on teaching situations is an important process providing information that contributes to our understanding of their professional knowledge" (p. 2).

The use of video as a learning material in teacher development provide an opportunity for PSTs being prepared for mathematics teaching to learn to reflect on practice in the context of mathematics education. Video lesson analysis has become a popular resource for developing RP in TE and for helping PSTs connect theory and practice. Blomberg et al. (2014) confirm that video-based lesson analysis provides PSTs with a 'window' into teaching without the pressure of having to interact in the classroom situation. In the next section, I discuss video lesson analysis as means for developing PSTs' RP.

### 3.6.1 Use of video in mathematics pre-service teacher education

Many teacher educators have attempted to develop quality reflective thinking in teacher education. The National Council for the Accreditation of Teacher Education (NCATE, 2010) proposes that:

> to prepare effective teachers for 21st century classrooms, teacher education must shift away from a norm which emphasizes academic preparation and course work loosely linked to school-based experiences. Rather, it must move to programs that are fully grounded in clinical practice and interwoven with academic content and professional courses. (p. ii)

Practice-based approaches to teacher preparation assist in closing the distance between university coursework and work experience and in ensuring that future teachers learn to implement innovative research-based instructional strategies. Video analysis has become a significant tool in the teacher education setting that attempts to link theory and practice, and its use has been changing over time in line with technological development (Putnam & Borko, 2000; Sherin, 2004). Sherin and Van Es (2009) are nevertheless concerned that "far too little is known about how video supports teacher learning, particularly given its extensive use in teacher education and professional development" (p. 20). This research therefore seeks to contribute to the field of research that assesses the impact of video lesson analysis in teacher education, particularly with regard to development of RP in PTE. I explored the nature of reflections PSTs develop as they analyse video-recorded mathematics lessons.

The use of video as a stimulus for reflection has been the subject of discussion among many scholars advancing reflective practice in teacher education (Santagata, Zanonni & Stigler, 2007; Sherin & Van Es, 2009; Karsenty et al., 2015). Researchers who have conducted research on the effectiveness of video in teacher education share the general sentiment that it has enormous potential to promote teacher development (Sherin & Van Es, 2009; Blomberg et al., 2014; Borko et al., 2011). They claim that analysis of video-recoded classroom situations fosters PSTs' skills to reflect about classroom events. Blomberg (2014) concur that "when pre-service teachers are provided opportunities to observe teaching through video, they become more reflective and provide more elaborate analyses of classroom situations" (p. 445). It is proposed that using of video lesson analysis with PSTs encourages greater attention to the details of specific classroom events, rather than attention to more general features of a classroom (Van Es & Sherin 2002).

Stockero (2008) investigated the extent to which one's reflectivity developed when reflecting on video-based lessons as opposed to reflecting on one's own practice. At the end of the study, Stockero observed four major changes in the PSTs' reflective habits. There was improvement in: (1) the PSTs level of reflection, where these PSTs' reflections moved from a focus on describing ideas and events, to a stance of interpretation and in-depth analysis; (2) their tendency to ground reflections in evidence; (3) the way they analysed student thinking; and (4) their use of pedagogy and student thinking as bases for analysing teaching practice.

Vondrova (2018) carried out a similar intervention study with 32 mathematics PSTs, to ascertain whether their mathematical content knowledge and reflectivity improved through conscious noticing. After observing three carefully guided two-hour sessions on selected videos, she found that the video influenced the PSTs' ability to pay attention and notice detail. The PSTs "increasingly focused on the mathematical aspect of the lesson and the students rather than the teacher, and their comments were more specific than general" (Vondrova, 2018, p. 1). She concluded that "video-based intervention influences noticing in important ways" (p. 1), noting that the participants' reflections became significantly longer and more specific after the video intervention.

Research suggest the need for guiding teachers as they develop RP as they claim the development of RP is not an easy and straight forward task, (Ward & McCotter, 2004; Blomberg et al, 2014; Azimi, Kuusisto, Tirri & Hatami, 2019). Blomberg et al. (2014) claim "It is important to note that without guidance, pre-service teachers find it difficult to identify what matters in videos of teaching and to elaborate on what they see" (p. 445).

Various models have been developed for supporting the development of RP in teacher education. One such framework that is of interest to me, that have been recently developed and is gaining a lot of interest from researchers in mathematics teacher education around the world is the Six Lens Framework that was developed by Karsenty et al. (2015). While Karsenty et al. (2015) developed this framework to support the in-service high school mathematics teachers in their Viewing, Investigating and Discussing Environments of Learning Mathematics (VIDEO-LM) project, the framework is fast gaining popularity internationally, even in the pre-service mathematics teacher education. The SLF is of particular interest to this research in that it responds directly to the development of RP in mathematics teacher education and as mentioned earlier, the lecturer in this research also employed it to provide support to the PSTs' as they analysed the video-recorded lessons to develop RP and MKfT. In the next section I give more detail about this framework.

### 3.6.2 The six Lens Framework supporting reflective practice in mathematics teacher education

Since the process of reflection "requires teachers to identify an issue of practice, frame that issue of practice using their beliefs and previous experiences, develop solutions and implement solutions for solving issues of practice" (Deacon, 2012, p.1), it is necessary to make it a systematic and purposeful methodology for examining teaching practice. As mentioned above, the proponents of RP in teacher education have found it useful to have the use of a tool to guide teachers as they reflect (Arcavi & Schoenfeld, 2008; Karsenty et al., 2015). Karsenty, et al. (2015) caution that developing reflectivity through video watching requires good management and therefore a tool to guide teachers on what to notice in the video-recorded lesson. Inspired by Schoenfeld's (1998) TTIC (discussed in the previous chapter) and Arcavi and Schoenfeld's (2008) discussions on RP, Karsenty et al. (2015) from the Weizmann Institute of Science in Israel developed a SLF to guide teachers in their project as they analysed video-based lessons to develop their RP and MKfT. The VIDEO-LM project aimed at providing a supportive and nonthreatening high school environment in which to 'talk mathematics', elicit ideas and thoughts, and reflect on the practice of teaching mathematics (Karsenty et al., 2015). As its name denotes, the SLF is a framework with six lenses used for viewing and analysing mathematics lessons. Karsenty (2018) explains how she and her colleagues

> designed a framework consisting of six analytical tools with which mathematics teachers can reflect on a videotaped lesson. We call these tools lenses, to emphasize their use as means of observation, in the dual sense of watching an occurrence but also

> commenting on it. Viewing a lesson through a certain lens implies shedding light on a specific feature of the mathematics teaching practice. (p. 2)

The SLF was designed to direct teachers' attention to certain elements of a mathematics lesson that Karsenty and her team considered crucial. The six lenses are: (1) mathematical and meta-mathematical ideas around the lesson's topic (which I identify as MMI); (2) Explicit and implicit goals that may be ascribed to the teacher (which I denote simply as Goals); (3) Tasks and activities selected by the teacher (Tasks); (4) Interactions with students (Interactions); (5) Dilemmas and decision-making (DDM) and (6) Beliefs about mathematics teaching (Beliefs). I elaborate on each of these lenses below.

*1. Mathematical and meta-mathematical ideas around the lesson's topic*

Karsenty et al. (2015) describe MMI as the range of relevant concepts, procedures and ideas that may be associated with a given topic. A given mathematics topic can be developed in different ways, and therefore it is up to the individual teacher to decide what to develop and how to develop it. In the VIDEO-LM project, before teachers watched a video-recorded lesson, they were asked to brainstorm and elicit concepts, ideas, and procedures around the topic, so as to gauge the range of associated concepts and ideas that can be developed and how they might be developed. Karsenty and Arcavi (2017) claim that discussing MMI explicitly with teachers triggers very productive conversations. They observe that "when the space of mathematical and meta-mathematical ideas is made explicit, explored and discussed, teachers may have clearer reasons for choosing some ideas over others, since not everything is relevant or possible to be brought up in a lesson" (p. 441). According to Karsenty and Arcavi (2017), discussing MMI "not only enables teachers to overtly explore ideas related to a certain topic; it also helps to refine, rethink and re-connect among them, and sometimes even to learn something new" (p. 441).

*2. Explicit and implicit goals*

Under normal circumstances teachers enter the classroom with a set of goals they desire to achieve. The choice of goals to be pursued is usually determined by the network of mathematical concepts and ideas around a given topic (Karsenty et al., 2015). Just as different teachers can develop different concepts and ideas from the same lesson topic, different teachers can pursue different goals within the same mathematics lesson topic. As the teachers watch the video, they are required to identify the goals they think the filmed teacher intended to achieve and if there was any shift in these goals during the teaching process. Attributing goals "compels teachers to delve into the space of possible reasons for a certain action, decision or choice"

(Karsenty & Arcavi, 2017, p. 442). In other words, the ability to ascribe goals to the screened teacher helps the participating viewing teachers to understand the screened teacher's actions and decisions, while also alerting them to the significance of setting meaningful goals. According to Karsenty et al. (2015), this lens promotes the teachers' ability to set meaningful lesson goals, helps them to realise the possibility of alternate and sometimes competing goals within a particular mathematical topic, and alerts them to the possibility of goals shifting during a lesson. Karsenty and Arcavi (2017) assert that discussing the goals can improve the participants' awareness of different possible goals for a given topic and provide opportunities to negotiate the advantage and disadvantages of preferring certain goals over others.

*3. Tasks and activities selected by the teacher*

Tasks and activities are the mathematical problems and activities assigned to learners by the teacher in pursuit of lesson goals. Research recognises the essential role of mathematical tasks and activities in providing learners opportunities to learn mathematics (Shimizu, Kaur, Huang & Clarke, 2010; Joseph, 2015). Karsenty et al. (2015) claim that analysing tasks shown via video (tasks-in-action) promotes rich discussion by providing an additional angle to that of written task analysis. Using this lens enables the observing and reflecting teachers to notice and discuss how the filmed teacher introduced and developed the lesson and how she handled learners' concerns and reactions.

*4. Interactions with students*

Teachers interact with their learners in various ways and at various times during a lesson to facilitate learning. Learners interact with their teacher and with one another to gain more understanding as they learn. Because the SLF is teacher centred, only teacher interactions are considered under this rubric. These interactions include how the teacher assigns the tasks and activities to leaners; how she introduces the tasks and activities; how she poses further questions; how much time she gives the learners to respond; how she listens to learners; how she navigates the learners' responses, and what feedback she gives. The observing/reflecting teacher trainees discuss the nature and effects of these interactions in order to improve their MKfT.

*5. Dilemmas and decision making*

Decision making is central to the work of teaching (Schoenfield, 1998, 2010) and is often necessitated by the dilemmas a teacher faces during teaching. According to Karsenty and Arcavi (2017), a dilemma is "a situation for which there is no apparent optional course of action and thus, each of the options available to the teacher may entail 'costs' and benefits which need to be weighed" (p. 448). Teachers are frequently face dilemmas, often caused by unexpected responses and questions from learners. They have to think on their feet and weigh the costs and benefits of giving this response instead of that, or of following up a learner's question or ignoring it. For example, if a learner raises an unanticipated concern during a lesson that implies confusion about a certain aspect of the concepts the teacher is developing, the teacher is placed in a dilemma: whether to abandon what they had planned in order to follow up on the question, or to put the learner's concern on hold and continue with the lesson as planned. If the teacher decides to address the learner's concern, they have to decide immediately how they will address, given that there are always several ways of developing learners' conceptual understanding.

When reflecting on the video-based lesson, the watching teachers are provided with opportunities to observe and discuss the dilemmas that filmed teachers encounter as they teach and the decisions they make to resolve these dilemmas. They get to notice the effects of the decisions made and create their own knowledge regarding how they might possibly deal with similar situations. Regular participation in such discussion and reflection improves teachers' ability to make instant meaningful decisions. Karsenty and Arcavi (2017) concur that "these discussions have the potential to equip teachers with tools for a more informed and reflective on-site decision-making and for more explicit posteriori justifications of it" (p. 448). Coles (2013) warns of the risks of the discussion descending into negative criticism and judgement when video-based lessons are watched through this lens. Karsenty et al. (2015) therefore caution facilitators in video-based lesson analysis sessions to ensure that as reflecting teachers ponder on the pluses and minuses of the filmed teacher's choices, they should avoid evaluating and judging her. They should rather examine these choices and consider alternatives that might possibly have been explored.

*6. Beliefs about mathematics teaching*

There are various definitions of belief, but they all agree that belief is something that exists in a person's mind. Schoenfield (1998) defines a belief as the state of mind in which a person thinks something to be the case, with or without empirical evidence to prove that that something is indeed the case. Schwitzgebel (2006), on the other hand, defines a belief as a mental representation of an attitude that conditions people's experiences and understandings. Beliefs arise from people's experience, shape their perceptions and influence everything they do (Schoenfield, 1998; Arcavi & Schoenfield, 2008; Li & Moschkovich, 2013). What teachers believe about mathematics teaching and learning can be inferred from their actions (Karsenty et al., 2015). Exposing the explicit and implicit attitudes reflected in another teacher's actions will help PSTs to realise the impact of one's beliefs on mathematics teaching and learning.

#### *3.6.2.1 Features of the six lens framework*

Karsenty and Arcavi (2016) describe several features of the SLF that help us to understand the reflective tool and its purpose better. These features are discussed in this section. One feature is that the SLF is teacher centred, focused primarily on the teacher and teacher practices. Learners and their thinking processes only come into play in so far as the filmed teacher interacts with them. The SLF values peer discussions as a component that enhances the ability to reflect meaningfully. The choice of videos for the reflection session does not necessarily depend on the filmed teacher demonstrating good teaching or best practice, but on the ability of the filmed lesson to stimulate meaningful discussion on diverse aspects of teaching. The SLF is a non-evaluative, non-feedback oriented framework whose purpose is "to establish non-judgmental norms of discussion through redirection of highly evaluative comments into issues to think about" (Karsenty, 2018, p. 438). That is, the reflecting teachers are not to use the framework to judge the filmed teacher, but to think about the significance of the teacher's actions and decisions and what they might have done differently if they were to find themselves in the filmed teacher's shoes. The SLF assumes that, whatever teachers decide to do, they are always acting with the best interest of their learners at heart (Arcavi & Karsenty, 2015). Karsenty (2018) argues that reflecting with this assumption in mind "allows for deeper layers of reflection than those entailed in such comments as 'she is doing it all wrong" (p. 5).

| Lenses for observing a videotaped mathematics lesson | The focus of activities around each lens | Examples of questions that direct teachers' discussions |
|---|---|---|
| Mathematical and meta-mathematical ideas | Scanning the space of relevant ideas, concepts, and procedures, as well as meta-mathematical ideas (e.g., one counter example is sufficient to refute a conjecture) that may be associated with the lesson's topic | • Which ideas did the filmed teacher bring forward in the lesson? Which ideas were left out? How can this decision be explained?<br>• Which meta-mathematical notions were evident in the lesson? |
| Explicit and implicit goals | Attributing goals that may underlie the teacher's actions or decisions, on the basis of what was observed in the video. Rather than "scientifically verifying true goals", the aim is to sharpen awareness of different possible goals and negotiate the pros and cons of preferring certain goals over others. | • Try to identify the goals that you think the filmed teacher was attempting to achieve. Show evidence from the video to support your assertion.<br>• Did you notice a moment when the teacher's goals have changed or a new goal was added? Why do you think this happened? |
| Tasks and activities | Conducting an "a posteriori task analysis": discussing features of the task and how it was enacted by the filmed teacher and students. Noticing if and when it develops differently than expected. | • Observe and document how the task is introduced and carried out and how the teacher addresses students' reactions.<br>• What may be the benefits and pitfalls in bringing this task to class? |
| Interactions with students | Observing and analyzing if and how the filmed teacher poses further questions to those of the task; listens to (or ignores) comments or difficulties raised by students; manages discussions; delegates responsibilities in the process of knowledge generation. | • How does the filmed teacher navigate students' responses during the mathematical activity? What kind of questions does the teacher ask? Who gets permission to speak?<br>• Characterize the teacher's feedback to students. |
| Dilemmas and decision-making | Uncovering situations of dilemma (i.e., when there is no evident optimal course of action) that the filmed teacher seemed to have faced during the lesson. Discussing the decisions taken in order to resolve these dilemmas, and their consequent tradeoffs. | • Did you notice a dilemma during the lesson? What did the teacher decide to do? Are there alternatives you can think of for this decision?<br>• What may be the constraints and affordances of the teacher's choice and of the suggested alternative paths? |
| Beliefs about mathematics teaching | Eliciting orientations, beliefs and values that may be attributed to the filmed teacher on the basis of the video. Unpacking implicit messages that may be conveyed to students through the teacher's communications and actions. | • What may be the filmed teacher's views about the nature of mathematics as a discipline?<br>• How does the teacher perceive his or her role? What may be the teacher's ideas about what "good mathematics teaching" is? What does the teacher think about the students' role as learners? |

*Figure 3. 6: The Six Lens Framework prompts (adapted from Karsenty, 2018)*

Figure 3.6, above, offers a summary of the lenses within the SLF. As seen, the SLF is deeply rooted in mathematics content, paying attention to the mathematical concepts and the processes undergone to formulate and communicate these concepts. It advocates the use of full lessons that provide a complete picture of what transpired in the classroom rather than short clips edited from a lesson. As Arcavi and Karsenty (2015) put it, "the units of analysis for teachers' discussions are whole lessons, in which a more comprehensive story can unfold with a beginning, a development of a process, and a closure" (p. 5). Arcavi and Karsenty claim that this characteristic makes the SLF unique compared to other professional development frameworks, which normally extract episodes from a lesson for discussion.

## 3.7 CHAPTER CONCLUSION

This chapter explored the literature in search of understanding the knowledge that mathematics teachers need to teach effectively. I deliberated on the development of MKfT as refinement of Shulman's (1987) PCK and the influence of MKfT in the teaching of mathematics at FP. I also discussed the significance of RP in education and teacher education and how the general research consensus on the value of RP has led to teacher educators seeking to develop RP in PTE. It was highlighted that merely tasking PSTs with writing reflective journals seems not to be working, as most PSTs remain uncertain about what reflection is and how they should do it. It was noted how current research recommends the use of video-lesson analysis in collaboration with a framework that clearly guides PSTs on how to reflect. The next chapter discusses this study's research orientation and methodology.

# CHAPTER 4

# RESEARCH ORIENTATION AND METHODS

## 4.1 INTRODUCTION AND METHODOLOGICAL OVERVIEW

In the previous chapter I discussed the knowledge needed for effective teaching of mathematics and RP as means for both developing and sustaining that knowledge. I highlighted the challenges associated with the modern work of teaching, to elaborate why teachers need to reflect and be adaptive practitioners and why it is therefore important for PTE to include RP development in the teacher preparation programmes. This chapter explains how I carried out my research to explore the reflective activity of PSTs as they analyse video-recorded lessons to develop their reflective practice (RP) and enhance their mathematical knowledge for teaching (MKfT). I was guided by the following research questions (RQs) in pursuing the aims of the research:

1 What is the nature of the reflections that PSTs develop as they engage in video-recorded lesson analysis?
2 How does the nature of these reflections change over time, if at all?
3 What role is played by the six lens framework as the reflective tool used to guide pre-service teachers' reflective practice?
4 (a) How do PSTs reflect on video of their own teaching? (b) Are these reflections any different from their reflections on video of other teachers' lessons?
5 What is the nature of PST reflections after receiving guidance from a skilled facilitator in small group sessions?
6 How did their reflections on their own practice change following skilled facilitation, if at all?

This chapter sets out the research orientation and methodology I chose for this study, the reasons for these choices and how they assisted me in answering the research questions. I begin the chapter by explaining the ontological and epistemological assumptions that influenced my choice of methodology. Secondly, I describe the interpretive paradigm that furnished a framework for the study, discussing its characteristics, benefits and challenges. Thirdly, I elaborate on the qualitative case study as the research design used in the study. Fourthly, I discuss the research methodology, including data collection strategies, instruments, and methods of analysis methods and the rationale for these. I conclude the chapter with a consideration of research ethics, the limitations of the study, and how the validity of the study was secured. Figure 4.1, below, provides an overview of the elements dealt with in each section of the chapter and indicates the interconnections among them.

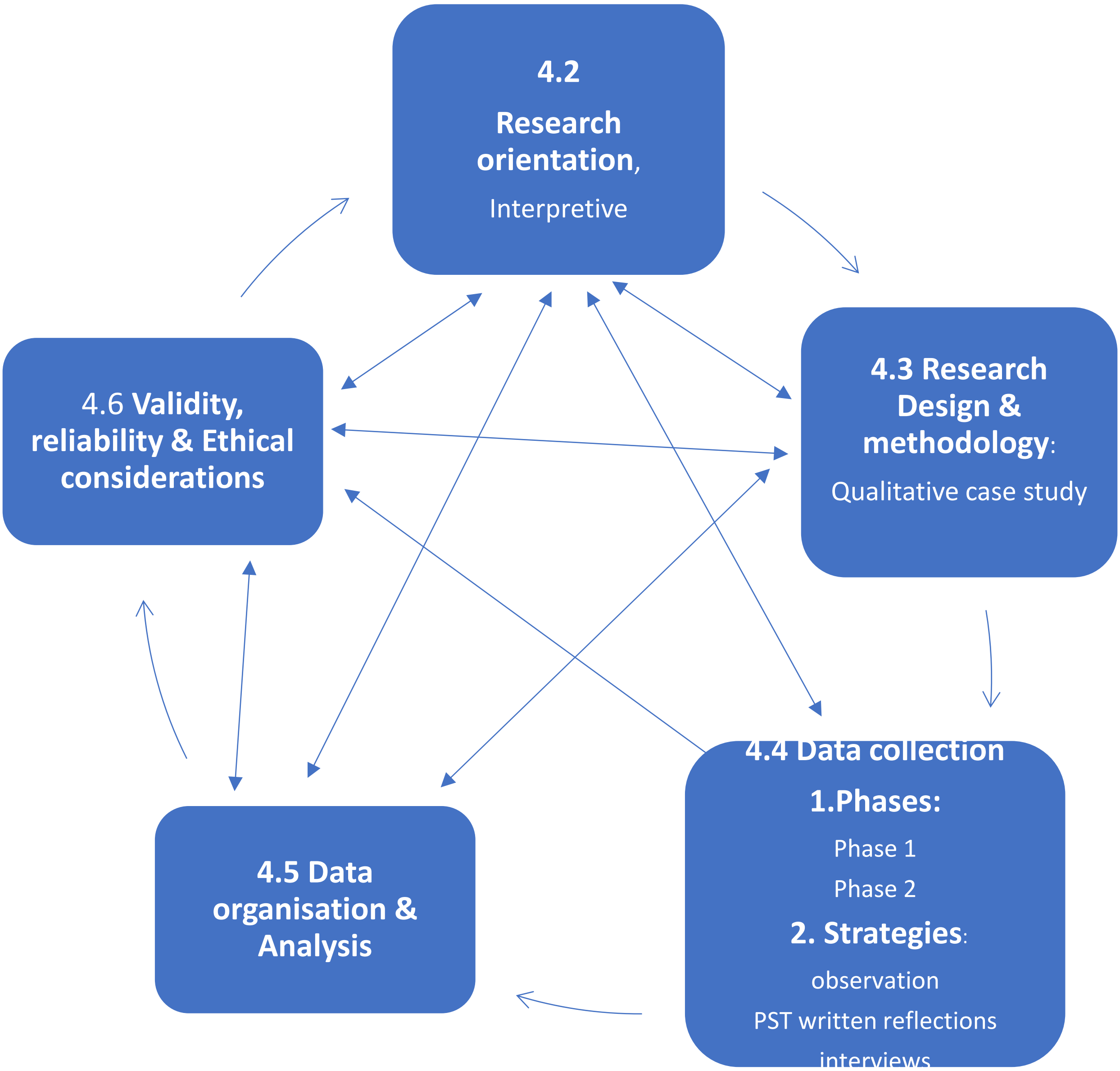



*Figure 4.1: An overview of the methodological processes in this study*

## 4.2 RESEARCH ORIENTATION

According to Thomas (2011), making explicit the philosophical assumptions that underpin a given study is important for meaningfully determining the scope of the study and the way in which the research enquiry is conducted. I discuss the research paradigm for my study in this section to alert the reader of the philosophical assumptions that guide my research and for myself to understand what I should abide by for my research to be valid and to meet its purpose.

### 4.2.1 Choosing a research paradigm for my study

Thomas (2011) notes that the term paradigm originated from the Greek word *paradeigma* which means pattern and was first used in the research context by Thomas Kuhn in 1962 to denote a conceptual framework shared by a community of scientists. Such a framework provides a convenient model for examining problems and finding solutions. Thus Patel (2015) defines a research paradigm as “the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed” (p. 1). Olsen, Lodwick, and Dunlop (1992) identify a paradigm as “a pattern, structure and framework or system of scientific and academic ideas, values and assumptions” (p. 16) which influence what should be studied, how it should be studied, and how the results of the study should be interpreted. The research paradigm I discuss in the next section provided this study with a useful pattern for conducting the research in a manner acceptable to social science, while ensuring that the findings are valid and adequately grounded in theory.

A research paradigm is determined by assumptions in three major philosophical fields: ontology, epistemology and methodology (Terre Blanche & Durrheim 1999; Patton, 2002; Chilisa & Kawulich, 2012). According to Chilisa and Kawulich (2012) choices in these fields determine the “assumptions and beliefs that frame a researcher’s view of a research problem, how they go about investigating it, and the methods they use to answer the research questions” (p. 2). Patton (2002) defines ontology as the belief that one holds with regard to the nature of reality, for instance, whether one maintains that there is one verifiable reality or multiple, socially constructed realities. For Cohen et al. (2018), epistemology is about one’s beliefs and assumptions about the nature of knowledge and knowing. Methodology is a more pragmatic matter, concerning one’s approach to problem solving or the strategies one employs to understand the world (Patton, 2002; Chilisa & Kawulich, 2012). Clearly, the beliefs one holds about the nature of reality and how knowledge is constructed influence one’s choice of methodology and the research instruments one employs.

Patel (2015), borrowing ideas from Crotty (1998) constructed a flow chart (that appears below as Figure 4.2) to explicate what ontology, epistemology and methodology are and illustrate how these relate to each other in the process of producing knowledge about a social phenomenon. My responses to the questions posed in Patel's (2015) flow chart guided my choice of paradigm for this research.

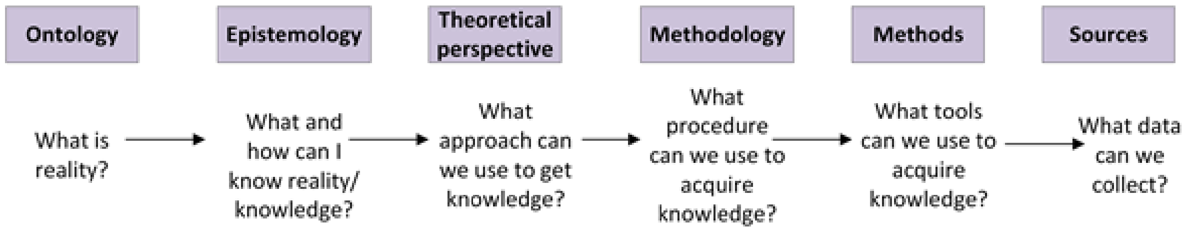



*Figure 4. 2: Meaning and relationship among ontology, epistemology and methodology (adopted from Patel, 2015, p. 2)*

As seen in Figure 4.2, above, one's ontological perspective has precedence over and conditions one's other assumptions. Research can have its origin in a variety of ontological perspectives. For example, there is positivism that believes in the use of scientific experiments to investigate reality, which is perceived to be absolute (Cohen et al., 2018). Relativists, on the other hand, maintain that reality, knowledge, truth, and morality are relative and exist in relation to culture, society, or historical context. With relativism there is no absolute truth or absolute reality (Cohen et al., 2018). In this study, I assume an interpretivist approach which like relativism rejects absolutist notions. Interpretivism, as the name suggests, perceives reality and knowledge as socially constructed by human beings through interpreting evidence around them. In this context, then, I postulate that there is no absolute truth about the nature of the reflections that PSTs develop as they analyse video-recorded lessons, but that through the study I construct a reality that relates to my theoretical framework. My ontological assumptions cohere with an interpretive epistemology and research paradigm, and these are discussed next.

Because of the explorative nature and the purposes of this study, I adopted an interpretivist ontological perspective, which posits that reality is socially constructed. The literature provides various definitions and descriptions of interpretivism. Walsham (1993) defines interpretivism as an approach that asserts that there is no objective knowledge waiting to be discovered, rather, reality and knowledge are socially constructed by human beings as they interpret (elements in) their environments. Interpretivism therefore allows for multiple versions of reality, subjectively and socially constructed through language, consciousness and shared meaning (Walsham, 1993). Schwandt (1994) puts it this way:

> The constructivist or interpretivist believes that to understand this world of meaning one must interpret it. The enquirer must elucidate the process of meaning construction and clarify what and how meanings are embodied in the language and actions of social actors. To prepare an interpretation is itself to construct a reading of meanings; it is to offer the enquirer's construction of the constructions of the actors one studies. (p. 222)

Schwartz-Shea and Yanow (2012) add that interpretivism is fundamentally concerned with the meanings that people ascribe to their own actions and experiences, and how these meanings inform people's everyday lives. This is in alignment with my intention to make meaning out of PSTs' written reflections in order to determine the nature of these reflections. Bhattacherjee's (2012) characterisation of interpretivism corroborates this alignment: interpretivism, he argues, is

> based on the assumption that social reality is not singular or objective but is rather shaped by human experiences and social contexts (ontology) and is therefore best studied within its socio-historic context by reconciling the subjective interpretations of its various participants (epistemology). Because interpretive researchers view social reality as being embedded within and impossible to abstract from their social settings, they "interpret" the reality through a "sense-making" process rather than a hypothesis testing process. (p. 103)

I was particularly drawn to the way in which interpretivism emphasises experience and interpretation (Henning, 2004), and avoids rigid structural frameworks such as those found in positivist research (Hudson & Ozanne, 1988; Carson, Gilmore, Perry, & Gronhaug, 2001). According to Neuman (2000) the goal of interpretivist research is to understand and interpret the meaning in human behaviour rather than to generalise and predict causes and effects. Interpretivism therefore permitted me to adopt a more personal and flexible research structure, receptive to capturing the meanings implicit in human interaction and making sense of what my participants perceived as reality (Carson et al., 2001).

According to Hudson and Ozanne (1988), the interpretivist researcher enters the field with some sort of prior knowledge of the research context but assumes that this is insufficient to develop a fixed research design due to the complex, multiple and unpredictable nature of what is perceived as reality. The researcher therefore interacts with the participants to construct reality. Acknowledging that the interpretivist researcher and the participants are interdependent and mutually interactive (Hudson & Ozanne, 1988), I worked hand in hand with the PSTs in their natural learning environment to construct the reality of their reflections after interacting with video-recorded lessons to develop RP.

I remained open to new knowledge throughout the study and let it develop with the help of my participants (Neuman, 2000). Hudson and Ozanne (1988) claim that the use of such an emergent and collaborative approach is consistent with the interpretivist belief that humans have the ability to adapt, and that no one can gain prior knowledge of time- and context-bound social realities. As an interpretivist researcher it was important for me to understand the motives, meanings, reasons and other subjective experiences of the PST participants (Hudson & Ozanne, 1988; Neuman, 2000). In the next section I share the principles of interpretivism that informed this study.

### 4.2.3 The principles of an interpretive paradigm employed in this study

Among the key interpretivist principles to which I adhered in this research are the following. The first is that of ***naturalistic inquiry***. According to this principle, the phenomena of interest in interpretive research are situated within their social context and cannot be isolated from them (Patton, 2002; Myers, 2009; Bhattacherjee, 2012). To understand and interpret such phenomena the researcher must ground herself within the phenomena's socio-historical context and study them within their natural setting (Patton, 2002; Myers, 2009). As I explored the nature of the PSTs reflections, I realised the need to be physically present in their natural learning environment and to use naturalistic methods of collecting data such as observation and interviews. Bhattacherjee (2012) concurs that "contextual variables should be observed and considered in seeking explanations of a phenomenon of interest, even though context sensitivity may limit the generalizability of inferences" (p. 106).

The second principle presents the ***researcher as an instrument*** in the research process. According to Bhattacherjee (2012), "researchers are often embedded within the social context that they are studying and are considered part of the data collection instrument in that they must use their observational skills, their trust with the participants, and their ability to extract the correct information" (p. 107). In this study I steered the research process and became part and parcel of it. I assumed the role of a non-participant observer during the lectures to gain a preliminary understanding of the phenomenon of interest to this research. Being present in their lectures provided me with an opportunity to understand the participants' experiences. The aim was to provide a "thick description" or rich narrative story capable of illuminating why the participants reflected the way they did (Bhattacherjee, 2012). I conducted the interviews to elicit a deeper understanding of the reflections that the PSTs wrote down when observing videos of their own teaching. My personal insights, values, knowledge, and experiences were inherent in all phases of the research process (Chikiwa, 2016).

The third principle is that of ***interpretive analysis***. Schwandt (1994) argues that "the activity of interpretation is not simply a methodological option open to the social scientist, but rather the very condition of human inquiry itself" (p. 224). Thus, as its name suggest, analysing and interpreting data lies at the centre of the interpretivist approach. Meaning making is attained through the analysis and interpretation of data. In this study, after collecting the participants' written reflections I organised the data, analysed and interpreted it, to establish the nature of each PST's reflections on each given occasion. Myers (2009) advises that interpretive research data should be interpreted through the eyes of the participants embedded in the social context. Being in the lecture room helped me understand the context of the PSTs' reflections, so that I was able to perform a holistic analysis of the data.

The fourth principle relates to the significance of the ***expressive language*** in interpretive research. Van Nes, Abma, Jonson and Deeg (2010) remark that qualitative research pursues the study of meaning in subjective experiences. They postulate:

> The relation between subjective experience and language is a two-way process; language is used to express meaning, but the other way round, language influences how meaning is constructed. Giving words to experiences is a complicated process as the meaning of experiences is often not completely accessible for subjects and difficult to express in language. To capture the richness of experience in language, people commonly use narratives…. (p. 314)

Language played a critical role in this study. The PSTs used language to express in their terms what they observed in the video-recorded lesson. I then coded and analysed these written narratives. Schwartz-Shea and Yanow (2012) comment that "interpretive research takes language very seriously" (p. 46) because interpretation is necessarily conveyed through the medium of language, while Bhattacherjee (2012) notes that "documenting the verbal and non-verbal language of participants and the analysis of such language are integral components of interpretive analysis" (p. 107).

The fifth interpretivist principle is a function of its ***temporal nature***. Bhattacherjee (2012) claims that interpretive research is often not concerned with searching for specific answers, but with understanding or making sense of dynamic social processes as they unfold over time. Since there is no absolute reality with interpretivism it means reality as described today can be different tomorrow. Interpretive research therefore typically requires the unswerving and reliable involvement of the researcher at the research site for an extended period, in order to capture the entire evolution of the phenomenon of interest (Myers, 2009; Bhattacherjee, 2012). I ensured to be present in all the sessions that pertained to this research.

The sixth principle is the ***hermeneutic circle***. According to Henning (2004), an interpretivist researcher constructs knowledge not only by observing phenomena, but also by describing people's intentions, beliefs, values, reasons, meaning making and self-understanding in respect of the phenomenon under study. Knowledge construction in this study was realised through an iterative process of moving back and forth "from pieces of observation (text) to the entirety of the social phenomenon (context) to reconcile their apparent discord and to construct a theory that is consistent with the diverse subjective viewpoints and experiences of the embedded participants" (Bhattacherjee, 2012, p. 107). As soon as I had collected my first set of data, I started coding and analysing it. I then pursued an iterative process until I had completed my data collection. Bhattacherjee (2012) maintains that oscillation between the understanding/meaning of a phenomenon and observations must continue until "theoretical saturation" is reached, that is, the point after which any additional iteration yields no further insight into the phenomenon of interest.

Having shared the principles I adhered to in this study, in the next section I discuss the research design and methodology I employed.

## 4.3 RESEARCH DESIGN AND METHODOLOGY

In this section I share my research design which stands as a comprehensive plan for data collection. Bhattacherjee (2012) defines it as a "blueprint" for empirical research aimed at answering specific research questions or testing specific hypotheses. Mouton (2001) likens research design to a house plan, which shows on paper what the final house is going to look like and guides a builder on how the house should be built. In this section I describe the plan that I as the researcher followed to secure responses to my research questions. I begin by discussing the qualitative case study as my research design and provide a rationale for this choice. As Bhattacherjee (2012) suggests, I also specify three of the essential processes for my research: (1) the sampling process, (2) the data collection process, and (3) the instrument development process.

### 4.3.1 Qualitative case study

According to Creswell (2013),

> A case study is a qualitative approach in which an investigator explores a real life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (for example, observations, interviews, audio-visual material, and documents and reports), and reports a case description and case themes. (p. 97)

In order to explore the nature of the reflections in which PSTs engage as they analyse video-recorded mathematics lessons, a case study (as described above) seemed ideal. Bell (1993) claims that a case study "is particularly appropriate for individual researchers because it gives an opportunity for one aspect of a problem to be studied in some depth within a limited time scale" (p. 8). In the course of the case study I was able to study the PSTs' actions, thoughts, experiences and other behaviour in the totality of their own environment (Ary, Jacobs & Razavieh, 2006). A case study provides a unique example of real people in real situations, enabling researchers to understand the researched phenomenon more clearly than if it were presented in abstract theories and principles (Cohen et al., 2011). As Creswell (2013) notes, case studies "catch unique features that may otherwise be lost in larger scale studies … these features might hold the key to understanding the situation" (p. 293).

Another advantage is that case studies allow for multiple methods of collecting data, such as interviews, lecture observations, document analysis (written reflections analysis), and field notes (Yin, 2009; Cohen et al., 2011; Creswell, 2013). Using multiple sources of data facilitated triangulation of data. The qualities of a case study and the opportunities it affords seemed ideally matched to my study of RP development in the context of teaching. in the next section I discuss my research site, context and the sampling process.

### 4.3.2 Research site, context and sampling

According to Steinhagen (2015) a good research site is a location where the researcher can carry out meaningful research, collecting complete and accurate data at a minimum possible cost. He claims that researchers often undervalue the task of selecting a research site, yet site selection can play an immense role in the success of a research study. Following Steinhagen's (2015) advice, I carefully considered the following factors when choosing a research site for my study:

- The proximity to the researcher – is the site easily accessible to the researcher?

- Population – does the site have the appropriate population to potentially enrol as participants?
- Previous experience with the site – does the researcher have any previous experiences with the site? if so, was this interaction positive or negative?
- Suitability – is the site suitable for the desired kind of research?

I decided to conduct my research at a university in Eastern Cape, one of the poorer provinces of South Africa. It was convenient for me to carry out my research at this university since I live in the area where the university is situated. This made the site easily accessible to me at limited cost. I have worked and studied at this university and had built good rapport with both the students and staff. This assured me of the possibility of completing my research without encountering too many challenges.

In 2017 I worked part time at the university as assistant lecturer in the mathematics method courses, in which my research is situated. During this time, I collaborated with the mathematics education lecturer with whom I co-taught mathematics methods courses within the Foundation Phase Bachelor of Education (BEd, FP) program. I developed good working relations with both her and the PSTs. The lecturer and I shared an interest in engaging PSTs in video-recorded lesson analysis to develop the PSTs' reflective practice and MKfT. She shared with me her willingness to introduce video stimulated reflective practice sessions in the mathematics methods course with the third-year cohort of 2018 (see Table 4.1, below). This provided an excellent opportunity to investigate the RP development process through focusing on PSTs' reflective activity as they analyse video-recorded lessons.

The third-year cohort was particularly favourable for my research. This is because beside the fact that I had worked with them before and developed good working relations with them, they had already spent at least two years at the university and had thus gained some exposure to the mathematics content they needed for teaching at FP and some experience with the practice of teaching. In Table 4.1, I provide a summary of the four-year programme scheduled for the PSTs doing BEd FP at the university where I carried out this research. I have highlighted the courses that are particularly relevant to my study. This shows how and where my research fits within the broader BEd programme.

As shown in Table 4.1, in year 2, PSTs do Mathematics for FP, where they are taught the mathematics content they need for teaching at the FP level, and Mathematics 1 for mathematics content for primary school education, so that their content knowledge is above the levels at which they are expected to teach. They also do teaching practice (TP) 1A where they visit schools to familiarise themselves with the school environment. PSTs spend 1 week (5 working days) in a school of their choice, usually during January before the university opens. During this week, they are expected to make detailed observations of a range of lessons as well as of the whole school context and are be expected to present their findings during term 1 after the university opens. During TP 1B they do micro teaching within the university, where each PST plans a lesson (usually a mathematics lesson) and teaches their peers. They are then given feedback by their peers and the tutor in charge of the group.

In year 3, they do a mathematics methods courses where they are taught how to teach mathematics in the FP. Towards the end of term 3 they go on TP in local schools for four weeks where they are attached to mentor teachers individually and are expected to practise teaching different FP subjects, at least one subject a day. They are visited by university tutors twice to support and assess their teaching. This would be the PSTs' first experience of actual teaching a class. Before the tutors visit, each PST is required to send to the tutor scheduled to visit them, a sample of their teaching in form of a video-recorded lesson so that the tutor can assess their teaching and give advice on how the PSTs can improve their teaching. In year 4 they go on TP for eight weeks, when mentor teachers are encouraged to increasingly leave them in control of the class for longer periods. They are also visited by the tutors twice in the eight-week period, to assess their teaching practice.

*Table 4. 1: The Bachelor of Education FP four-year programme at my university*

| YEAR 1 | YEAR 2 | YEAR 3 | YEAR 4 |
|---|---|---|---|
| **Elective A :Language A1**<br>Afrikaans 1/English 1 <u>or</u> Eng Lang & Ling 1/isiXhosa MT 1 <u>or</u> isiXhosa AL 1<br><br>(30 credits at Level 5) | **Elective A2: Language A2**<br>Afrikaans 2/English 2 or Eng Lang & Ling 2/isiXhosa MT 2 or isiXhosa AL 2<br><br>(30 credits at Level 6) | **Education and Professional Studies 3**<br><u>Education studies</u>: Sociology of ed, History & economics of ed; Curriculum studies<br><u>Professional Studies</u>: Introduction to research; responsibility for learners' health & safety; reflection on TP; effective teaching.<br>(30 credits at Level 7) | **Education and Professional Studies 4**<br><u>Education studies</u>: Philosophy of ed; Pedagogy; Reflection on TP; Conference<br><u>Professional studies</u>: Research proposal, Understanding how schools work; entering the teaching profession, Inclusive ed; Materials development; First Aid<br>(30 credits at Level 7) |
| **Elective B: Language B1**<br>Afrikaans 1/English 1 <u>or</u> Eng Lang & Ling 1/isiXhosa MT 1 <u>or</u> isiXhosa AL 1<br>(30 credits at Level 5) | **Performance and Multimodalities 1**<br>• Art<br>• Physical education and movement<br>( 15 credits at Level 6) | **Performance and Multimodalities 2**<br>• Music, dance and drama<br>• Physical education<br>( 15 credits at Level 6) | **Foundation Phase Studies 4**<br>• Home Language English or isiXhosa 3<br>• First Additional Language English 3<br>• First Additional Language Afrikaans or isiXhosa 3<br>• Mathematics 3<br>• Life Skills 3<br><br>( 66 credits at Level 7) |
| **Foundation Phase Studies 1**<br>• Children's literature<br>(10 credits at Level 5) | **Understanding the Social and Physical World 1**<br>• Natural sciences and mathematics for the Foundation Phase<br>(15 credits at Level 6) | **Understanding the Social and Physical World 2**<br>• Social sciences and technology for the Foundation Phase<br>(15 credits at Level 6) | |
| **Education and Professional Studies 1A** Understanding the whole child in context<br><br>(25 credits at Level 5)<br><br>**Education and Professional Studies 1B**<br>Holistic development of the teacher<br><br>(25 credits at level 5) | **Teaching Practice 1A**<br>Observation in schools with assignments and community engagement activities (10 credits at Level 6)<br><br>**Foundation Phase Studies 2**<br>• Home Language English or isiXhosa 1<br>• First Additional Language English 1<br>• First Additional Language Afrikaans or isiXhosa 1<br>• Mathematics 1<br>• Life Skills 1<br><br>( 45 credits at Level 6)<br><br>**Education and Professional Studies 2**<br>• Learning to teach<br>(10 credits at level 6)<br><br>**Teaching Practice 1B**<br>(15 credits at Level 6) | **Foundation Phase Studies 3**<br>• Home Language English or isiXhosa 2<br>• First Additional Language English 2<br>• First Additional Language Afrikaans or isiXhosa 2<br>• Mathematics 2<br>• Life Skills 2<br><br>( 45 credits at Level 6)<br><br>**Teaching Practice 2**<br>(25 credits at Level 6) | **Teaching Practice 3**<br><br>(24 credits at Level 7) |

The RP development course is introduced at the beginning of year 3 of PTE, within the Mathematics Method course. This course is designed to prepare the PSTs for the practical work of teaching mathematics. Therefore, the lecturer's plan to introduce RP development to the third-year cohort was timely, considering that these PSTs were being prepared for TP when they were expected to teach mathematics and evaluate their teaching. As they analysed and discussed the video-recorded lessons, they were exposed to different teaching strategies and worked on the RP they needed for evaluating their lessons and writing their reflective practice journal in year 4 as highlighted in Table 4.1 above. In the next section I discuss how participants for this study were sampled.

### 4.3.4 Sampling

As indicated in the preceding section, this research was carried out with the whole 2018 third-year cohort in the BEd FP programme comprising of 52 PSTs. The research was carried out in the mathematics method course with permission from the lecturer (discussed further in section 4.3.2). The nature of my study required a smaller sample than the 52 students. Because of the nature of my study coupled with my empirical field, I used self-selected sampling, also known as volunteer sampling. According to Sharma (2017),

> self-selection sampling is appropriate when we want to allow units or cases, whether individuals or organisations, to choose to take part in research on their own accord. The key component is that research subjects volunteer to take part in the research rather than being approached by the researcher. (p. 752)

The invitation to participate in the study was open to all 52 PSTs in the cohort so that those who were interested to take part in the study could do so. I did not mind how many of them would volunteer but wanted a broad representation of the population in terms of culture, language background and academic achievement. From this broader set of volunteers, I intended to select a smaller sample of four to six PSTs for deeper investigation of the research phenomena later. Only 20 PSTs out of the 52 volunteered to take part in the study and signed the consent forms. One PST later withdrew from participation and thus I remained with 19 PSTs. These 19 became the sample for Phase 1 of my data collection. (The phases of data collection are discussed in the data collection section, 4.7). The sample size of 19 was enough for Phase 1 of my data collection. It was a fair representation of the third-year BEd FP PSTs in terms of gender, culture and academic performance. I thus considered them. Faber and Fonseca (2014) argue that samples should neither be too big nor too small, because both have limitations that can compromise the conclusions drawn from the study. They claim that samples that are too small may prevent the findings from being extrapolated, whereas samples that are too large may amplify the detection of differences or over-emphasize differences that are not relevant. As Sharma (2017) observed, one key advantage of self-selected sampling is that the individuals who volunteered to participate were committed to the study. the attendance was good, only one PST was absent on the first day of data collection due to a factor beyond his control. All my participants showed willingness to provide more insight into the phenomenon being studied.

In addition to working with the sample of 19 participants, I also needed a smaller sample for deeper and more detailed investigation. For this smaller sample I used convenience sampling (also known as availability sampling, accidental sampling or opportunity sampling Faber and Fonseca (2014) describe opportunity/convenience sampling as a haphazard type of nonprobability or non-random sampling, in terms of which the first available primary data source is used for the research because they are conveniently available. My phase 2 data collection needed to involve PSTs who had video-recorded mathematics lessons of their own teaching. The four PSTs who became my smaller sample were among five PSTs who had both volunteered to take part in this research and submitted video-recorded mathematics lessons for pre-TP assessments.[4] As mentioned earlier, all the third-year PSTs had been required to submit video-recorded lessons of their own teaching (on any subject of their choice) for pre-TP assessments, but only seven of them submitted video-recorded mathematics lessons. Five of these seven were part of my larger sample. However, when I invited all the five to participate in Phase 2 of my data collection, one of the five declined participation, leaving me with only four participants. In the next session I discuss how I collected data from my two samples described in this section.

## 4.4 DATA COLLECTION

Data for this research was collected in two phases using a variety of data collection instruments.

### 4.4.1 Phases of data collection

The phases of data collection that generated the data that I analyse in Chapters 5 and 6 are portrayed in Table 4.2, below. Data collection started in February 2018 and ended in October 2019. Phase 1 data collection occurred between February and May 2018. Phase 2 took place from August 2018 to October 2019.

[4] The lecturer to visit a particular PST for Teaching Practice (TP) assessment was to assess that particular PST's video-recorded lesson and give the PST advice on what they needed to improve and how.

*Table 4. 2: The phases of data collection and brief information about each phase*

| PHASES OF DATA COLLECTION | STIMULUS FOR REFLECTIONS IN EACH SESSION | | SOURCE OF DATA | No/ of PSTs | No/ of Lenses per PST |
|---|---|---|---|---|---|
| PHASE I | **3 VIDEO-RECODED LESSONS** | | Individual PST written reflections on other teachers' practices following Lecture Sessions 1, 2 & 3 | | |
| | SESSION 1 21 Feb 2018 | Grade R lesson entitled 'The umbrella story' | | 18 | 2 |
| | SESSION 2 25 April 2018 | Grade 1 lesson entitled 'Ten-Frames and Dot Cards' | | 19 | 3 |
| | SESSION 3 25 May 2018 | Grade 3 lesson entitled 'Bridging through ten' | | 19 | 6 |
| PHASE 2 | **PST VIDEO-RECORDED LESSONS OF OWN TEACHING** | | 1. Individual PST written reflections based on video-recorded lessons on own practice | 4 | 6 |
| | August 2018 | Reflections on own practice 1 | | 4 | 6 |
| | Aug 2018 to Oct 2019 | Three facilitator guided reflection sessions | | | |
| | October 2019 | Reflections on own practice 2 | | | |

During Phase 1, I collected data from my larger sample of 19 participants who had consented to participate. I observed three video-based lecture sessions and made field notes during each session. I also photocopied the individual participants' written reflections for all three sessions. These are the reflections I analysed to develop a broad understanding of the nature of PSTs' reflections on video-recorded lessons. The stimuli for reflection for these sessions of Phase 1 data collection were video-recorded mathematics lessons that were taught by local in-service FP teachers.

During Phase 2, data was collected from a smaller sample of four PSTs who volunteered to participate in the second phase of the study. I asked these four to write reflections based on the video-recorded mathematics lessons of their own teaching using all six lenses of the SLF. I chose to use the SLF in Phase 2 so that there would be coherence with the Phase 1 data in which the SLF was the tool provided to students in their mathematics methodology sessions. I collected these written reflections from each PST. I conducted semi-structured interviews with them to understand their reflections more deeply. After the interviews, the four PSTs went through an intervention to support their reflections. They went through three sessions of facilitator-guided reflections with experienced facilitators probing for deeper reflections. I share what transpired in these facilitator guided sessions in appendix 4.1

After these facilitator-guided sessions, I asked the four PSTs to again write reflections on the same video-recorded lessons of their own teaching (from 2018 during their TP) to analyse if their reflections had changed as a result of the intervention. I collected these four individual written reflections on their own practice and prepared them for analysis. In the next section I deliberate on how each of the data collection instruments was employed during the two phases of data collection.

### 4.4.2 Data collection instruments

While I used observations, PST written reflections and interviews as means for collecting data for this research, I chose to focus my analysis of PST reflective practice on PST written reflections rather than on my field note observation notes and my interviews of a small sample of students. This focus enabled me to explore possible changes in PSTs RP over time as the written reflections occurred at three points over the period of 2018 for the larger sample and at two points in 2019 for the smaller sample of 4 PSTs. The observation data and the interview data did however inform my research process and the decisions I made in relation to how I approached my research. Furthermore, the observation notes enabled me to contextualise the PSTs RP written work as these reflections are directly connected to the instructions they were given by their lecturer and the video that they were watching as the stimulus for their reflections. For these reasons, I include some discussion of these data gathering methods below.

#### *4.4.2.1 Observation*

In Phase 1, I observed the three mathematics lectures that the mathematics method lecturer had dedicated to developing PSTs' RP through analysing video-recorded mathematics lessons. In Phase 2, I observed the three facilitator-guided RP sessions with the small group of four PSTs. My intention in observing the sessions was to note and record events, settings, routines, behaviours and artefacts through direct contact with the research environment and participants (Marshall, 2006).

Cohen et al. (2011) claim that observation is more than merely looking at something: "it is looking (often systematically) and noting systematically (always) people, events, behaviours settings, artefacts, routines and so on" (p. 456). I chose observation as one of my data collections instruments for several reasons. First, observation allowed me to observe and take notes while in attendance at these lectures. I was able to see for myself what was taking place at the research site rather than relying on second-hand accounts (Marshall, 2006). Secondly, observation enabled me to collect live and authentic data from naturally occurring lecture room situations, as opposed to such data as I would get when using mediated or inferential methods (Cohen et al., 2011). Being in the lecture room and observing PSTs interact and reflect on video-based lessons permitted me to gain knowledge about my research context and what was happening in it. Thirdly, observation encouraged me to look closely at language and behaviours that might otherwise have been taken for granted or gone unnoticed (Cooper & Schindler, 2001). I was also able to access non-verbal evidence of PSTs when engaging in reflections.

Cohen et al. (2011) outlines two kinds of observation performed in social research: participant observation and non-participant observation. In participant observation the researcher watches the events or situation or action from inside, as it were, taking part in the activities of the group being observed; in non-participant observation, the researcher observes the group passively from a distance without participating in or influencing the participants' activities (Cohen et al., 2011). I chose the latter because I wanted to collect data in a natural setting and did not want to disrupt the normality of events in the lecture room. As a non-participant observer, I could observe and listen to the PSTs' interactions without manipulating the situation or the participants in the direction of my research interests (Simpson & Tuson, 2003). As a non-intrusive presence, I was able to record authentic data (Randolph, 2007).

While Randolph (2007) claims that participants may feel uncomfortable and act unnaturally in the presence of a non-participant observer, my research did not have this effect as I had worked with this group of PSTs as an assistant to the mathematics method lecturer in the previous year. To counteract any disadvantage resulting from the inadequacy of my observations, I placed two video cameras at different positions in the lecture room so that they could capture what I missed.

#### *4.4.2.2 Pre-service teachers' written reflections*

All PSTs in the lecture sessions were assigned to watch selected video-recorded lessons and write individual reflections before discussing their impressions with each other, as mentioned earlier. I made copies of the participants' reflections and these became the primary source of data in this study. I read them repeatedly to determine the nature of each PST's reflective activity during each of the data collection sessions. As shown in Table 4.2, above, I collected three sets of written reflections from Phase 1 and two sets of written reflections from Phase 2.

#### *4.4.2.3 Interviews*

In this research, I carried out two sets of two semi-structured interviews. The first set was with the lecturer while the second set was with the four PSTs in the smaller sample. I conducted the first interview with the lecturer, at the beginning of the data collection session to establish her plans for the course so that I could plan the research process accordingly. The second interview was at the end of data collection to get feedback on how the lecturer felt about the course, and to obtain such recommendations as she had for improving the course. The focus of my research is PSTs' RP rather than how lecturer used RP in teacher education. In this sense the interviews with the lecturer primarily broadly informed the way in which I conducted my research and enabled me much appreciated opportunities to engage in conversations about the nature of PSTs reflection and some of the challenges related to developing RP. These insights are drawn on in the concluding chapter of this research in relation to possible implications for RP in mathematics teacher education. The interviews were transcribed and all reference in the thesis to these interviews and transcriptions have been checked by the lecturer.

I also conducted a semi-structured interview with each of the four participants who took part in phase 2 of my data collection to gain a better understanding of the reflections they wrote about their own practice. Semi-structured interviews were favoured because, although not inflexible, they gave one an opportunity to plan beforehand (Merriam, 2009). The one-on-one, 20-30-minute semi-structured interviews with each of the four participants in the smaller sample were conducted in my office at times convenient for the interviewees. All the PSTs were comfortable with being interviewed in my office as the privacy was conducive to recording the interviews. I used a paper-based interview guide to regulate the order in which the questions were asked and to make sure that all interview items were covered (Wright, Martland, Stafford & Stanger, 2006). Using video-stimulated recall during the interviews helped the PSTs to remember situations and reasons for the decisions they had made while teaching, and to reflect on these (Reitano, 2005). The interviews were both audio and video recorded to insure the process against technical failure. Cohen et al. (2011) observe that recordings offer unfiltered records and have the advantage of being available for repeated playback for clarity. In the next section I discuss how the data was organised and analysed.

## 4.5 DATA ORGANISATION AND ANALYSIS

Data is not helpful until it has been analysed and meaning has been made of it. Data analysis is therefore one of the key elements in the research process. This section discusses how the data in this research was analysed to respond to my research questions. I also discuss how I adapted and developed my analytic frame for analysing my data.

In this study, data analysis and data collection were performed concurrently throughout the data collection period, allowing for mutually developed data collection processes which informed the research process as the study unfolded (Adler, 1996). Coffey and Atkinson (1996) advise that in qualitative research one should never collect data without substantial analysis going on simultaneously, as analysing and collecting data synchronously provide opportunities for generating categories according to emerging themes, and constructing theories from these (Merriam, 1998).

Data analysis was performed on PSTs' written reflections, in two stages as the data was collected. The first stage was when I was analysing the data collected during Phase 1 to gain a broad understanding of the nature of PSTs' reflections on video-recorded lessons of other teachers. The second stage involved analysing the data collected in Phase 2 to establish the nature of the four PSTs' reflections when they reflected on their own practice.

I employed an iterative technique to analyse the data, generate units of meaning, construct categories, develop themes and derive theory. Srivastava and Hopwood (2009) describe iterative data analysis as "the heart of visiting and revisiting the data and connecting them with emerging insights, progressively leading to refined focus and understandings" (p. 77). As I went back and forth with data analysis, I was able to make increasing meaning of the data and take note of the changes that were taking place in the nature of PSTs' reflections.

Before I explain how I coded my data I describe how I developed and used my analytic tool so that my coding procedures are readily understandable.

### 4.5.1 Choosing and refining the analytic tool for reflective practice

To prepare to analyse the data I had collected from my participants, I searched the literature to ascertain what other scholars had theorised about the reflective tendencies of PSTs. I was looking to see if there was a suitable model I could adopt for my research. I found several models that seemed interesting and relevant but did not exactly suit the needs of my research, so I adapted and combined elements from them into one that was tailored to my needs.

Most scholars working in teacher education identify three levels of reflection, hierarchically progressing from simple descriptions of classroom events, often with a main focus on technical aspects of teaching, such as classroom management and content delivery; to thoughts about the what, how and why of teaching, suggesting alternative viewpoints and raising new questions that need to be resolved (Van Manen, 1977; Lee, 2005; Cavanagh & Prescott, 2009; Muir & Beswick, 2007). Lee (2005) provides a list of models of reflection developed by different scholars between 1933 and 2002, with Dewey (1933) introducing the notion of reflective thinking and Schon (1983) extending it to the teaching profession. Reflective thinking and the Schon's notion of the reflective practitioner were discussed in the literature review chapter.

Here I focus on the reflective practice frameworks in the literature that influenced the development of my analytic tool which I used to categorise PST's reflections.

Leijen, Valtna, Leijen and Pedaste (2012) claim that categorising reflective thinking began with Habermas in 1972, almost forty years after Dewey. According to Leijen et al. (2012), Habermas (1972) proposed three different kinds of knowledge-constitutive interests: technical, practical and emancipatory, with each knowledge interest initiating a certain 'way of knowing'. Leijen et al. (2012) note that Van Manen (1977) adjusted Habermas's (1972) ideas and by distinguishing between technical, practical and critical reflection. Scholars have subsequently developed various models of RP for both in-service teachers and PSTs from Habermas (1972) and Van Manen's (1977). I cite a few examples of those that had an impact on this study.

I begin with Van Manen (1977) who proposed a hierarchy of levels of reflection. Van Manen (1977) studied PSTs' reflective thinking with a focus on the moral and social implications of teaching and developed a framework to describe PSTs' RP development. After analysing PSTs' reflections based on the orientations of social science and their cognitive interests, he concluded that "it is possible to outline levels of reflectivity" (p. 226) and proceeded to distinguish three hierarchical stages of RP. He identified the first stage as *technical rationality*, where PSTs' reflections simply attend to strategies that work or fail in classroom settings. The second stage is *practical action*, where the PSTs focus on the learning experiences and start to recognise teaching as problematic. Stage three is *critical reflection*, in which the participants deliberate on the moral and social implications of classroom practices. Van Manen's (1977) model of reflection has been influential in research that seeks to understand RP in both in-service and pre-service teacher education.

Lee (2005) carried out a study with PSTs registered to train as secondary school mathematics teachers. In her investigation of the content and depth of PSTs' reflective thinking, she analysed their reflections on their own experience teaching during teaching practice. Like Van Manen, Lee (2005) concluded that the PSTs' RP goes through three hierarchical stages. Lee (2005) identified the first stage as *recall*. According to Lee (2005), at this stage the PST "describes what they experienced, interprets the situation based on recalling their experiences without looking for alternative explanations, and attempts to imitate ways that they have observed or were taught" (p. 703). Lee (2005) named her second stage *rationalisation*. At this stage PSTs provide a rationale for the identified classroom events. They consider possible reasons behind classroom experiences and use these to develop general principles for future instruction. Lee

(2005) identified her third and final stage as *reflectivity*, which occurs when the PSTs start to analyse experiences from various perspectives and think of alternatives for future action. This stage is identified by other scholars as the critical reflection level (e.g. Robinson & Kelley, 2007; Muir & Beswick, 2007). Lee (2005) claims that at this level “one approaches their experiences with the intention of changing/improving in the future, [and] analyses their experiences from various perspectives” (p. 703). On the same topic, Robinson and Kelley (2007) observe that reflectivity “considers entire context; discourse with self and explores possible reasons for actions. Steps out of self and observes from a distance” (p. 36).

Muir and Beswick (2007) investigated how a relatively experienced teacher reflected on his practice. To analyse their data, they developed a model with “three increasingly sophisticated levels of reflection” (Muir & Beswick, 2007, p. 78), as shown in Figure 4.3, below. The model is furnished with examples of statements that illustrate each level of reflection. Like Van Manen (1977) and Lee (2005), Muir and Beswick (2007) found that RP develops in three hierarchical phases. Muir and Beswick (2007) named their first stage *technical description*, probably from Van Manen’s (1977) first level of *technical rationality*. At this stage, PSTs give general accounts of classroom experience, often focusing on the technical aspects of teaching (such as delivery of content or maintaining students’ attention) without any consideration of their value or importance. Both Muir and Beswick (2007) and Van Manen (1977) display interest in the technicalities of teaching. Lee (2005) does not mention the technical aspect of reflections, most probably because she was dealing with PSTs who were not yet familiar with the technical vocabulary of teaching. Muir and Beswick’s (2007) level 2 is *deliberate reflection*, a level at which critical incidents are identified and explained. What is key in this stage is that, both for Lee (2005) and Muir and Beswick (2007), there is provision of an explanation for the identified classroom incident. Their level 3 is *critical reflection*, where the teacher moves beyond identifying and explaining critical incidents to considering and contemplating alternative actions. Figure 4.3 presents Muir and Beswick’s (2007) levels of reflection, with corresponding descriptions and examples.

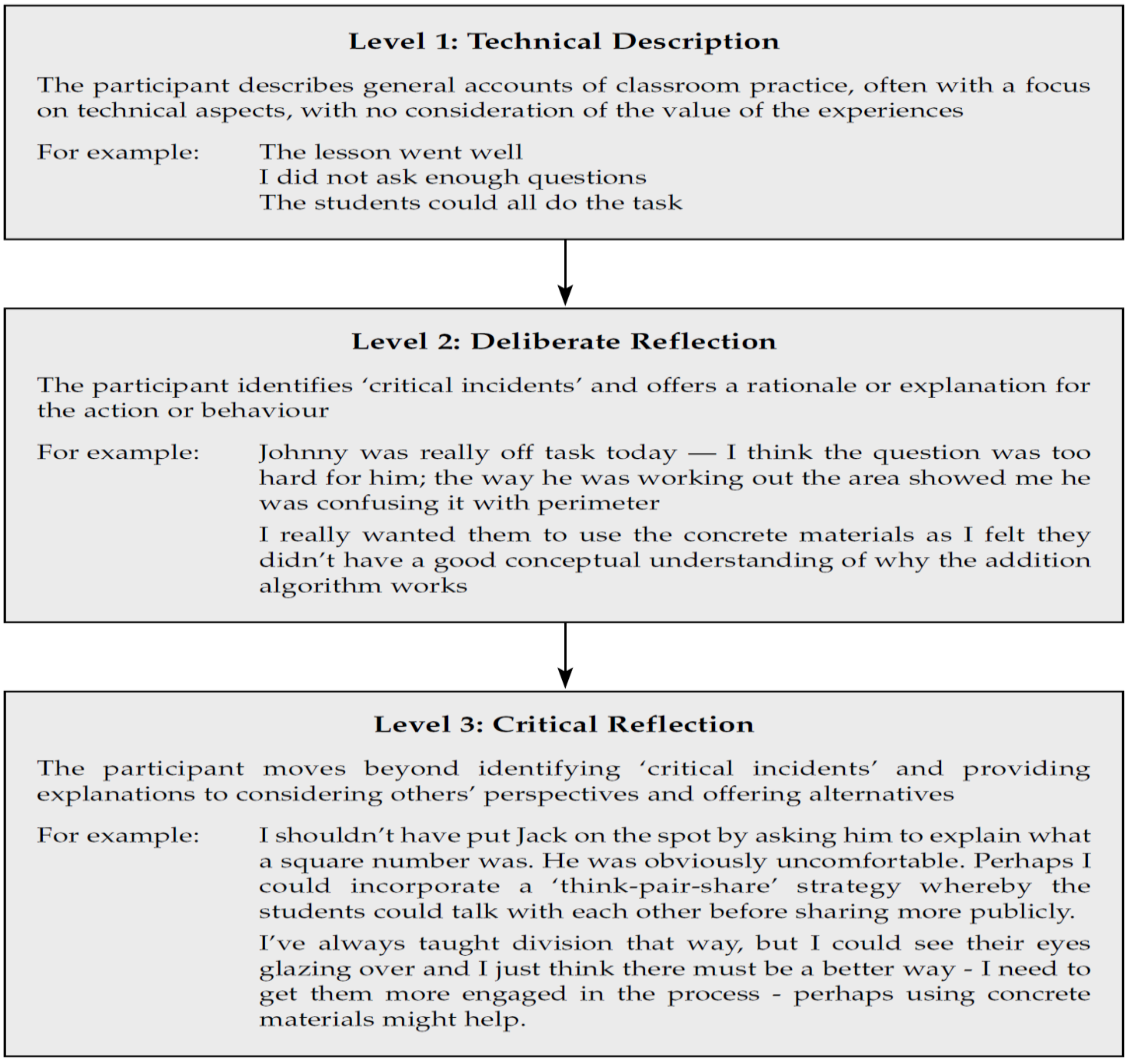



*Figure 4. 3: Levels of reflection. Taken from Muir and Beswick (2007, p. 79)*

As noted above, both Lee (2005) and Muir and Beswick (2007) associate the first level with description of classroom occurrences, level 2 with both identification and provision of a rationale for the classroom occurrence, and level 3 with critical reflectivity, in which teachers analysed the classroom event from different perspectives and suggested alternatives for improving instruction. I merged the models of Lee (2005) and Muir and Beswick (2007), adopting the key indicators for each of their levels of reflection for the levels identified in the tool I was developing for data analysis. Both Lee (2005) and Muir and Beswick (2007)'s ideas were influential in the development of my analytical tool which I present in Figure 4.4. In Table 4.4, below, I compare Lee's (2005) and Muir and Beswick's (2007) models of levels of reflection and the corresponding indicators that were instrumental in the development and naming of levels of reflection in my analytical tool.

*Table 4. 3: Comparison of Lee's (2005) and Muir and Beswick's (2007) models of levels of reflection*

| LEVEL | MODEL OF REFLECTION | | KEY INDICATOR for each level |
|---|---|---|---|
| | **Lee (2000)**<br>Depth of reflective thinking | **Muir and Beswick (2007)**<br>Levels of reflection | |
| 1 | **Recall level**<br>PSTs describe classroom events recalling their learning experiences without looking for explanations | **Technical description level**<br>The participants give general accounts of classroom experiences, focusing on the technical aspects of teaching without giving explanation for them | **Description** of classroom incidents without giving explanation |
| 2 | **Rationalisation**<br>PSTs look for relationships between pieces of their experiences, interpret the situation with rationales, search for ''why it was,'' and generalise their experiences or come up with guiding principles | **Deliberate reflections**<br>Participants identify critical classroom incidents and provide possible explanations for them | Providing **Explanation** behind identified classroom experiences |
| 3 | **Reflectivity**<br>PSTs approach their experiences with the intention of changing/ improving in the future, analyse their experiences from various perspectives, and suggest alternatives | **Critical reflections**<br>Participants move beyond identifying 'critical incidents' and providing explanations to considering others' perspectives and offering alternatives | Analysis of event from various perspectives and **Suggestion** of alternatives for future instruction |

As seen in Table 4.3, above, the key indicator for both Lee's (2005) and Muir and Beswick's (2007) level 1 of reflection is the 'description' of classroom incidents. I therefore named level 1 of my model ***description***. The key indicator for level 2 consists of explanations provided for the classroom incidents identified. I therefore named level 2 of my model ***explanation***. Both Lee's (2005) and Muir and Beswick's (2007) third levels are characterised by analysis and the provision of suggestions. I named the third level of my model ***suggestion***. My participants tended to provide occasional suggestions but without any evidence of these being linked to analysis, which meant that I was reluctant to classify such suggestions as evidence of critical reflection. I therefore positioned my level 3 ***suggestion*** at a level of reflection between Lee's (2005) and Muir and Beswick's (2007) levels 2 and 3. I then added a fourth level which I named ***reflectivity***, and which was aligned with both Lee's (2005) and Muir and Beswick's (2007) level 3. My model therefore comprises four hierarchical levels of reflection: Description, Explanation, Suggestion, and Reflectivity, and I named it the Four Levels of Reflection Model (FLRM). As mentioned earlier, the names of the levels were taken from the key indicators I identified in Table 4.4, above. I chose the name *description* for my first level of reflection because at this level PSTs merely describe classroom events without providing a rationale or explanation. I decided not to adopt the term 'technical' because the descriptions were in general not as technical as Muir and Beswick's examples, which came from an experienced teacher. I was working with third year PSTs who did not have much classroom experience and tended not to use technical language when noting classroom experiences.

As mentioned above, I named the second level *explanation*. This level is similar to Lee's rationalisation level but is more closely associated with what I consider to be the key indicator for this level (i.e. any explanation given by the PST for what is described). At this level the PSTs go beyond describing and provide possible explanations for why the teacher in the video engaged in the event described. For example, a participant named Dee wrote: "The first task given to the children was to go under the umbrella *so that* the children all together may represent the number 5" (Dee, S1, C8-C9). Dee provides a simple explanation for why the teacher requested five learners to go under the umbrella: "*so that* the children all together can represent the number 5".

I named my third level *suggestion* because at this level the PSTs go beyond describing or explaining the classroom events to suggest alternative methods that could have been employed during instruction. Some of the suggestions, as mentioned earlier, may not necessarily be of much help. For example: "She may have to explain the role of rain in our lives and why we should not get wet, as to why there were umbrellas in the story" (Langa, S1, C7-C9). Langa suggests what the teacher could have done but does not clarify how or why this might have been of benefit to the learning process. That is why I considered *suggestion* as a level between explanation and reflectivity. I would not classify Langa's example as reflectivity because reflectivity is a more complex activity that involves more than merely suggesting an addition or an alternative. Reflectivity requires systematic and rigorous engagement with the identified event from various perspectives.

For my fourth and last level I adopted Lee's (2005) term *reflectivity*, which conveys a deeper reflection and engagement with what is happening in the lesson. The reflectivity level, although my fourth level, links to both Lee (2005) and Muir and Beswick's (2007) third levels, reflectivity and critical reflection respectively. Muir and Beswick (2007) describe this as a level where the participants move "beyond identifying critical incidents, and providing explanations, to considering others' perspectives and offering alternatives" (p. 79). According to both Lee (2005) and Muir and Beswick (2007), this level of reflection has two major indicators: viewing the incident from various perspectives and proposing alternatives that can help improve instruction. (To note in passing: explanation and suggestion are both elements of reflectivity but on their own without deeper analysis and engagement from multiple perspectives they do not constitute reflectivity.)

I did not adopt Muir and Beswick's (2007) characterisation of critical reflections level as one at which participants should go beyond identifying 'critical incidents'. Since I was dealing with PSTs, I did not expect them to be able to do this as they were unlikely to be sufficiently familiar with the practice of teaching mathematics to recognise a 'critical incident'. I do nevertheless agree that reflectivity should go beyond identifying a classroom event and providing explanations and suggestions, to a deeper engagement with the identified event that enables the proposal of alternatives. Lee (2005) attests that at this level PSTs should engage in a dialogue with self and analyse the event from different perspectives to come up with better ways of dealing with similar events in the future. She argues that at the reflectivity level "one approaches their experiences with the intention of changing/ improving in the future, analyses their experiences from various perspectives" (p. 703). As an example, Bonga displayed reflectivity in his last set of reflections on his own practice in 2019 when he wrote:

*I shouldn't have put together addition and subtraction because learners were not really focused and couldn't understand the subtraction part, they needed it to be done separately. These two [algorithms] are already complicated for Grade 1 to use on 2-digit numbers and putting them together was not a good idea because I ended up spending more time on addition and very less time on subtraction. Many learners seemed to get confused when I wanted them to subtract. That was not good for the learners. They didn't learn much from it. I should have stuck with only one*. (Bonga, ROP 2, C80- C85)

Table 4.4 below shows the characteristics of the Four Levels of Reflection Model

*Table 4. 4: The four levels of reflection, their indicators and examples from my data*

| LEVEL OF REFLECTION | DESCRIPTION OF EACH LEVEL | KEY INDICATORS | EXAMPLES |
|---|---|---|---|
| **Level 1 Description** | PSTs describe classroom incidents without providing an explanation for them | Description of classroom occurrences with no explanations | The teacher encouraged children to respond in full sentences |
| **Level 2 Explanation** | PSTs identify the classroom occurrences and provide explanations for them | so that; because; so as to; in order to; which resulted; which made; as a result of; to; this was done to | This was to encourage children to answer questions in full **in order to** build their communication skills |
| **Level 3 Suggestion** | PSTs go beyond identifying and providing explanation for classroom occurrences to analysing the classroom experiences and suggesting alternatives | could have<br>would have<br>should<br>could<br>next time | Other strategies such as using a spider diagram **could have** made her lesson more interesting and easier. |
| **Level 4 Reflectivity** | PSTs engage dialogically with the classroom event, analysing it from different perspectives | Analysis from various perspectives and suggestion to improve instruction | See example written by Bonga, above |

Also working with PSTs, Cavanagh and Prescott (2009) merged Lee's (2005) and Muir and Beswick's (2007) levels of reflection models similarly I have done. They were investigating how PSTs developed RP by analysing the reports they wrote about significant classroom incidents from their TP experiences. In merging Lee's (2005) and Muir and Beswick's (2007) models, they developed a three-stage hierarchical model of levels of reflection. Cavanagh and Prescott named their first level *descriptive recall*, a level at which participants provide "general descriptions of classroom practice, evaluating the success or failure of actions, focusing on the technical aspects of teaching e.g., 'I ran out of material at the end of the lesson'" (p. 275). The term 'descriptive recall' echoes the terminology of Lee's (2005) and Muir and Beswick's (2007) level 1: 'recall' and 'technical description' respectively. Cavanagh and Prescott's (2009) second level was named *practical rationalisation,* where PSTs could identify classroom incidents and provide explanations for them. The term 'rationalisation' is seen in level 2 of Lee's (2005) model, where *rationale* is the key indicator. Cavanagh and Prescott (2009) call this level 'practical rationalisation' because PSTs give "accounts of critical incidents;

explaining the actions; searching for causes…" (p. 274). Cavanagh and Prescott's (2009) third level is *critical reflection*, like that of Muir and Beswick (2007). Here the PSTs provide analysis of classroom experiences from various perspectives and offer alternatives. This level is equivalent to my fourth level of *reflectivity*. I did not adopt Cavanagh and Prescott's (2009) model for the reason I gave above that I need a level between rationalisation/explanation and critical level because my PSTs were giving suggestions that did not qualify to be categorised at critical level. Figure 4.4 below show the Four Levels of Reflection I developed by merging Lee (2005) and Muir and Beswick's (2007) models of reflection. The examples used in this model were cited from this research's data

In the next section I discuss how I coded and analysed the data using the tool that I had developed for the purpose.

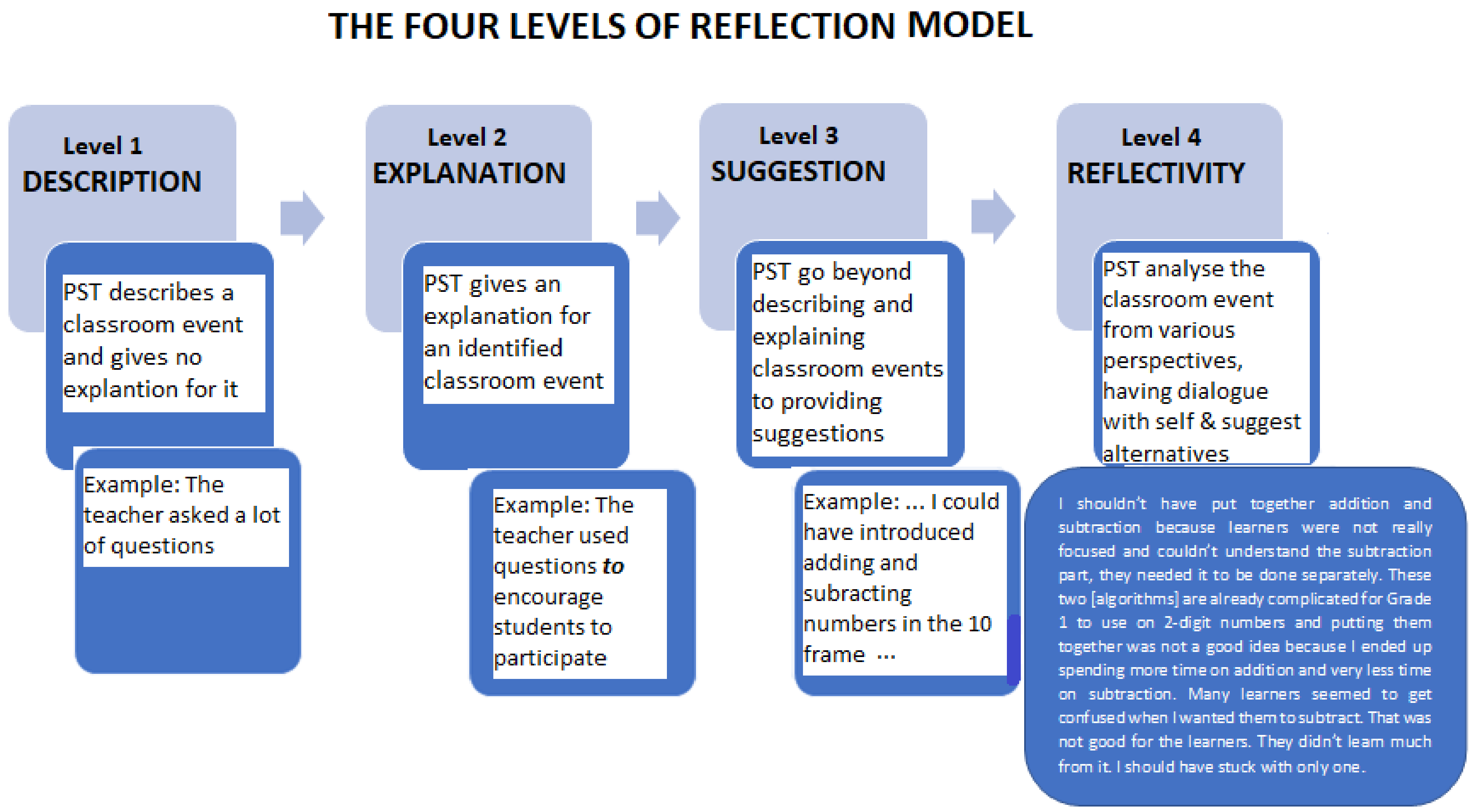



*Figure 4. 4: The Four Levels of Reflection model as adapted from Lee (2005) and Muir and Beswick (2007)*

### 4.5.2 Data coding and analysis

This section is divided into two parts: the first discusses the codes that I developed as I interrogated my data with the analytic tool presented above in mind. The second part explains how I chunked and coded the PSTs' reflections.

#### *4.5.2.1 Developing codes from the data using the FLRM analytic tool*

As mentioned above, the data was analyzed using content analysis and the FLRM as an analytic tool. The analytic tool comprised four broad themes: description, explanation, suggestion and reflectivity. To code the data appropriately I developed certain sub-themes as these emerged from the data. It seemed that the reflections were either ***general*** or ***mathematica****l*, so the reflections at each level were coded as general or mathematical, resulting in:

level 1: general descriptions (GD) and mathematical descriptions (MD);

level 2: general explanations (GE) and mathematical explanations (ME);

level 3: general suggestions (GS) and mathematical suggestions (MS); and

level 4: general reflectivity (GR) and mathematical reflectivity (MR).

I coded the PSTs' reflections using the codes as discussed below. I cited examples from the data and referenced these examples using the name of the PST, the session from which the example was taken from (S1, S2 or S3) and the number of the coded phrase (C1, 2, 3…). For example, if the example was taken from Lee's second session written reflections and it was the seventh coded phrase the reference would be (Lee, S2, C7).

*General* reflections are either generally pedagogic, applying to the teaching and learning of any subject (such as "The teacher asked a lot of questions" [Charity, S1, C7]) or relating to any classroom event not specific to the teaching and learning of mathematics (such as "The teacher used an actual umbrella" [Alice, S1, C6]); or something about the atmosphere in the classroom, (e.g. "The children were familiar with the story, therefore it was fun" [Bonga, S1, C1]). Thus, a reflection was deemed general when PSTs made no mention of mathematical concepts, terms, symbols, numbers, and/or ideas.

*Mathematical* reflections are those that relate specifically to the teaching and learning of mathematics. These are identified through the explicit mention of mathematical concepts, terms, numbers, symbols or ideas, e.g. "She [the teacher] also takes an opportunity to introduce number names and digits" (Liz, S1, C5), or through implicit reference to mathematical terms, numbers, symbols or ideas, e.g. “There are other concepts that are emerging as she continues with the lesson” (Dee, S1, C2). The statement “there are other concepts,” coming after the description of a mathematics concept in the preceding sentence was considered to be implicitly about mathematical concepts and was therefore regarded as a mathematical reflection. Some statements that seemed general were considered mathematical if the rationale given for them was mathematical. For example, “By asking the questions **it helps** in developing mathematical skills **because** it was quick thinking that changed over the lesson” (Mandy S2, C12 & 13). The first statement “by asking the questions” is a general description, however, the rationale given for this classroom occurrence that asking questions “[helped develop] mathematical skills” is mathematical and therefore implicitly identifies it as a mathematical reflection.

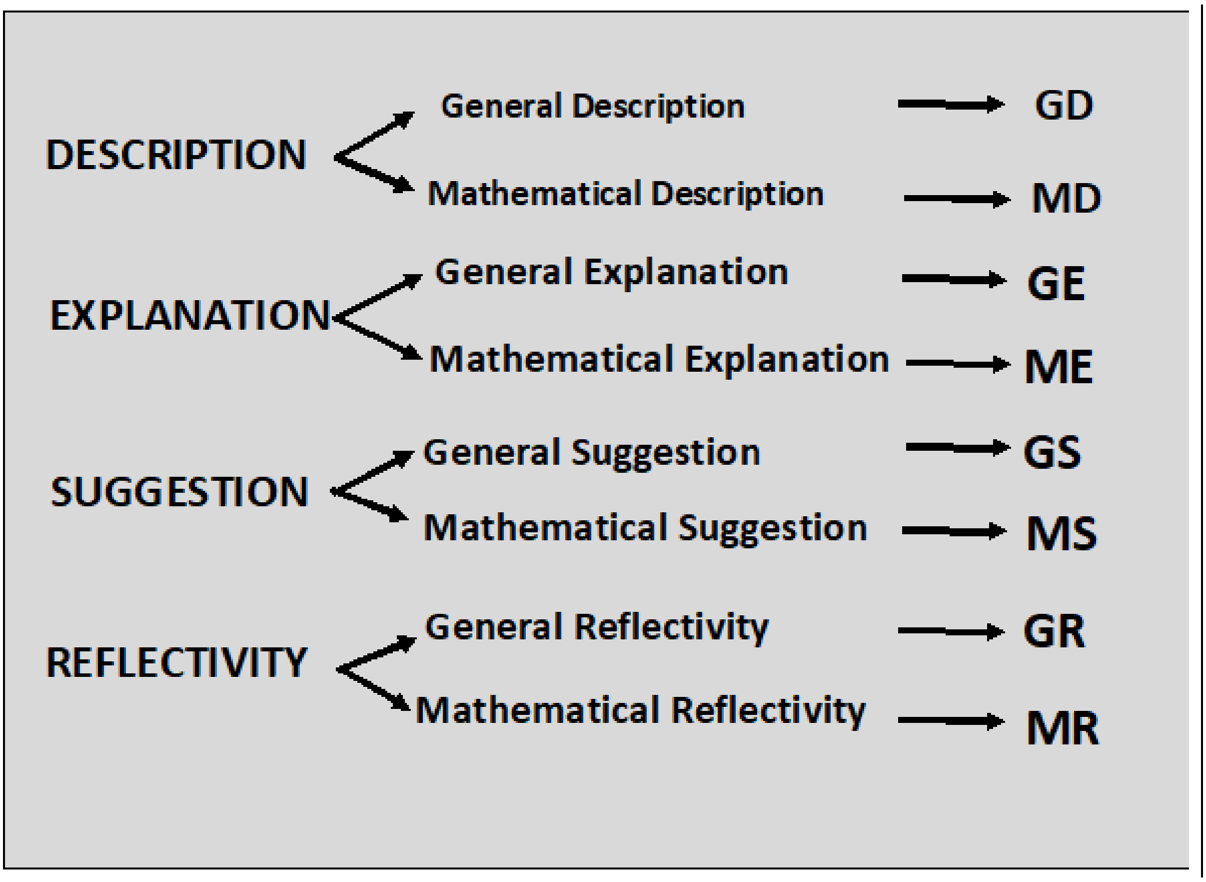



*Figure 4. 5: Codes generated from the analytic tool and the data*

The codes as depicted in Figure 4.5, above, generally worked in all the data sessions although some modifications had to be made as I engaged with the data emerging from subsequent sessions. The modifications made are explained in detail in the sections that follow. The next section provides details of the coding process in preparation for analysis.

#### *4.5.2.2 The data coding process*

The coding of data was not an easy process. Several iterations of coding were conducted and each time I drew on the experience of my supervisor and a colleague in the SANCP for inter-rater reliability by asking them whether my coding made sense to them and to see whether they coded the data similarly. In each iteration differences in decisions about coding were thoroughly discussed, resulting in clearer delineation and specification of the indicators for each code. Where necessary, new categories and codes or sub-qualifiers for codes were introduced.

After I had established my first set of themes/codes and sub-codes, I coded my first set of 18 PSTs' written reflections and asked my supervisor to similarly code the data to achieve further inter-rater reliability. After a long meeting discussing the similarities and differences in our coding we decided that we had to be more explicit in stating our indicators for each code and sub-code, and chose to ask a colleague who is both an academic and an English language specialist to provide an additional perspective on our coding and how I had 'chunked' the data into code-able ideas. Following established rules for what constitutes a code-able part and what constitutes indicators for each code and sub-code, we re-coded all 18 PSTs' reflections. We established that each phrase or clause that holds an idea within a sentence would be given a code.

Breaking up sentences into code-able chunks was not an easy task. The rules of English could not be strictly used to interpret meaning as most PSTs were second-language English speakers and thus did not always use terms that typically indicate the joining of ideas. In several cases the whole surrounding paragraph needed to be looked at in order to decide how many different ideas were within a sentence, and if an idea was an explanation or simply a description. Words like "because" or phrases such as "so as to" should indicate explanation, but occasionally this was not the case. Grasping the meaning of some of the sentences and ideas and appropriately coding them was a challenge. Doing inter-rater coding was particularly helpful in this respect. If consensus could not be reached as to what idea was embedded in a sentence or part of a sentence it was annotated as uncode-able (UN).

Since content analysis was used, I had to employ data chunking to be able to manage, code and perform the analysis. Jones (2012) describes data chunking as the process of breaking down large amounts of data into smaller units that can be more easily processed. I now discuss how I chunked and coded phase 1 session 1 data. I describe the coding rules that were established as we interrogated the PSTs' written reflections. The established rules for breaking up written data into code-able chunks were applied also to all the other written reflections in sessions 2 and session 3 and the remaining phases of the research.

**1. Breaking sentences into single ideas -** Sentences were broken down into single ideas and each idea was numbered and coded. Complex and compound sentences were split into their separate clauses and each clause was coded as a single idea:

- **If a sentence had more than one clause** as evidenced by the use of conjunctions such as 'and' or 'but', each clause was assigned an independent code. For example, a sentence like "The learners are able to recognize numbers and they represent numbers in words and numerically" (Vee, L1, C4-C5) was broken into three ideas. The first idea is that learners were able to recognize numbers. The second idea is that they represented the numbers in words and the third is that the learners were able to represent numbers numerically. Each PST's ideas were numbered in chronological order and in color to make them stand out. For example: "1 The learners are able to recognize numbers 2 and they represent numbers in words 3 and numerically".
- **There were examples where PSTs gave an explanation for a described event** within the same sentence. The sentence was broken into its separate clauses and each clause was coded in a similar way. For example: "1 She used the actual umbrella (GD) 2 **so that** the learners can visually see the concept (GE)" (Alice, L1, C4-C5). Part of the sentence*:* "1 She used the actual umbrella" was considered an idea (a general description) and coded as a GD, while "**so that** the learners can visually see the concept" was another idea (a general explanation) and was numbered and coded separately (as GE).
- **There were examples where more than one explanation was given for a single description.** For example: "She gave the learners a sum that they did the day before so that the learners could remember and use that as a foundation that they can build on for this current lesson" (Charity S3, C13). The idea that was followed by an explanation was given a code that has an arrow and an 'E' signifying that the description is followed by an explanation. The explanation was coded as an expanded explanation. The explanation was broken into single ideas and each idea was numbered as a subset. For example, "13 She gave the learners a sum that they did the day before (MD$^{\rightarrow E}$ )14 **so that** the learners could remember 14b and use that as a foundation that they can build on for this current lesson (ME$^{e)}$." Sometimes multiple ideas were used in one explanation, for example: "She made it practical which makes children participate. I like the way she is in the video [I

like the way the teacher does it in the video]. It is what we get when we get to school. The children learn better when they are included, doing the practical thing as it will be stored in their long-term memory. Children learn by touch, feel, see. With them doing the story together and participating in it is a learning for them according to me" (Langa, S1, C3-C9). In these cases, each of the explanations was taken as a separate idea and numbered separately. The explanation was however coded as an expanded explanation with six ideas. Thus, Langa's above reflection was coded as follows: L1 reflected: "3 She made it practical (GD) 4 which makes children participate. GE. 5 I like the way she is in the video [I like the way the teacher does it in the video] GD$^{\to E}$. 6 it is what we get when we get to school. 6b The children learn better when they are included, doing the practical thing, 6c as it will be stored in their long-term memory. 6d Children learn by touch feel see. 6e With them doing the story together, 6f and participating in it is a learning for them according to me GE$^{e6}$." Langa's ideas from 6a-6f are explaining his idea number 5. That is that he likes what the teacher is doing in the video-based lesson, which Langa interpreted as practical. These explanatory ideas were numbered separately and coded as shown in the example. The small 'e' in the code followed by a number indicates that the explanation was expanded on, and by how many ideas (6 in the case of the example above).

- **Where there was a possibility that the idea might be unclear to someone who did not see video-recorded lesson being reflected on,** I introduced material in square brackets [ ] for explanatory purposes. Since I had watched the video-based lesson, I was in a better position to understand the reflections and therefore made these insertions to help contextualise them. I used square brackets because the PSTs had already used round brackets ( ) in their written reflections.
- **If the idea was not clear enough for coding as a result of how it was written I coded the idea 'UN' for 'uncode-able'.** For example, "The shows us the decision making that are taken by the teacher explain when she had to choose who will give her answer" (Lee, L1). It was not possible to understand the meaning of this sentence, so it was designated uncode-able. Table 4.6, below, provides a summary of the codes used during the coding phase.

### How Session 1 (S1) written reflections were initially coded

I mentioned earlier that processing the data was not easy and described how I had initially coded my first set of reflections after breaking the reflections into single ideas. Appendix 4.2 contains the codes initially used for session 1 (S1) data, together with examples taken from the data. In the case where I do not provide examples, this is because I did not get any reflections for that code from the S1 data. However, since my way of coding had of necessity been expanded and refined when I moved on to the S2 data, the table remained incomplete. As mentioned earlier, classroom occurrences were first distinguished as general or mathematical, and these were further sub-categorized as factual or subjective. Factual statements described an event that could have been observed by anyone watching the lesson. That is, there is no personal judgement embedded in a statement such as “A learner has to raise hand to talk” (Lethu, S1, C12). Subjective statements, on the other hand, were those in which some kind of personal judgement was passed. For example, “The children were familiar with the story GD 2. Therefore, it was fun” (Bonga S1, C1 & C2).

The way of coding illustrated above worked well for the first set of data and a high degree of inter-rater agreement was achieved in the coding. However, the second data set emanating from the same students yielded many more ideas that were coded as explanation, and thus further unpacking and refining of codes and sub-codes was needed.

**Coding of the Session 2, Session 3 and Phase 2 written reflections**

Session 2 was conducted on 24 April 2018 and Session 3 on 25 May 2018. Coding these sets of reflections obliged me to make some adjustments from how I had coded the S1 data. While the first run of chunking and coding ran quite smoothly, in coding the second (S2) and third set of data (S3), which included many more explanations of various descriptions, it became clear that some further work would be needed. Three main changes emerged through inter-rater discussion of the differences and similarities in our coding of this second set of data.

First, while the chunking used for S1 data still worked: explanation could only be considered simple or not if the explanation was looked at in its entirety, not if each idea in an explanation was considered independently code-able. Thus, for explanations sentences were still broken up into ideas but were numbered in a way that linked them – as for example 3a, 3b, 3c – to indicate they (ideas a, b and c) were all part of the same explanation of a particular observation or experience. Such explanations needed to be catered for without breaking the coding rules explained earlier in this section.

Secondly, it was deemed important to distinguish which descriptions had explanations attached to them and which did not. A further refinement of our coding of descriptions thus emerged, that is, an appropriate code accompanied by a superscript arrow with an ‘E’ ($^{\rightarrow E}$) at the end of each of the descriptions and suggestions that were followed by explanations. Those without superscripts were considered simple descriptions/suggestions. For example, 17 "The teacher uses open-ended questions $MD^{\rightarrow E}$ 18 **to** promote the meta-mathematical idea she had" ME (Marylyn S2, C 17-C18).

Thirdly, my initial labeling of an explanation as simple or analytic did not capture the two main types of explanation noted, which were simple explanations (one explanatory idea linked to a description) and expanded explanations, where two or more connected ideas jointly explained a description. These were therefore coded together with a superscript number indicating the number of explanatory ideas. If the explanation was expanded with one idea, the code was given a superscript 'E' but no number. For example, 3 "She used the number line to find to the nearest 10 $MD^{\rightarrow E}$ 4 **because** using a number line makes it is easy to find the nearest 10" ME (Tiny S3, C3). However, if the explanation was expanded with more than one idea then a superscript 'E' was followed by a 'e' signifying the number of ideas in the explanation. For example, 34 "The chorus answering may cause a problem $GD^{\rightarrow E}$ 35 **because** the children may parrot each other. 35b This means that a student may not understand, 35c and the teacher may not know" $GE^{e}$ (Mickey S3, C34-C35). If the explanation was expanded, a superscript e was added to the code as shown in the above example ($GE^{e}$). Thus, the absence of superscript indicated that this was a simple explanation, hence the superscript 'e' indicated that the explanation was expanded with one idea or more. Table 4.5, below, presents the codes that I finally used to code all the data I had collected, together with examples extracted from data.

*Table 4. 5: The codes developed from the analytical tool and data finally used for coding all the PSTs' written reflections*

| LEVEL OF REFLECTION | CODES | | INDICATORS | EXAMPLES |
|---|---|---|---|---|
| **Level 1: DESCRIPTION** | General Description | **GD** | The description is general and observable | She asked learners questions. |
| | General Description followed by explanation | **$GD^{\rightarrow E}$** | The description of the classroom event is followed by an explanation | *The teacher asked "why" questions a lot* ***because*** she wanted the learners to justify their answers.<br><br>She promotes more discussion by asking learners to explain as well |
| | Mathematical Description | **MD** | The description is mathematical and observable | The third one [task] is when the children are asked to bring the number 5 and 0 |
| | Mathematical Description | **$MD^{\rightarrow E}$** | The mathematical description is followed by an explanation | She gave the learners a sum that they did the day before **so that** the learners could remember |

| | | | | |
|---|---|---|---|---|
| | followed by an explanation | | | |
| LEVEL 2: EXPLANATION | General simple Explanation | **GE** | A general description is accompanied a simple explanation (no justification for the explanation). Explanation is evidenced by such words/phrases as: So…<br>So that…, because…, So as to…, to…, this was to<br>in order to…, which made…, this was done to…, got learners to…<br>This way she can … | The teacher asked the learners on the mat questions **so that** they may be involved in the lesson<br><br>She used the umbrellas **so** the learners could visually see the concept<br><br>She promotes more discussion by asking learners to explain their answers |
| | General expanded Explanation | **GE$^{e}$** | More than one explanation provided for a general description | She would try to explain all methods for learners to try. **By this**, the teacher is helping the learner to understand, and the learner would get the correct answer |
| | Mathematical simple Explanation | **ME** | The mathematical description is accompanied by an analysis/ a reason/ an explanation | 7. Using dice pattern also got the children to recognize the number of dots.<br><br>She gave the learners a sum that they did the day before **so that** the learners could remember |
| | Mathematical expanded Explanation | **ME$^{e}$** | More than one explanation is provided for a mathematical description | The key cards got more and more difficult as the order of the dots changed, this way she can see at what standard the learners are at. This way she can see if learners understand counting |
| Level 3: SUGGESTION | General Suggestion | **GS** | A simple suggestion is given to improve instruction. (suggestion with no justification) | She may have to explain the role of rain in our lives and why we should not get wet, as to why there were umbrellas in the story |
| | General suggestion followed by an explanation | **GS$^{\rightarrow E}$** | A suggestion is accompanied by an explanation/ justification) | Other strategies such as using a spider diagram could have made her lesson more interesting and easier |
| | Mathematical Simple suggestion | **MS** | The reflection comprises of a description that is mathematical, accompanied by a simple suggestion (suggestion with no justification) | As the teacher, I would use the numbers as well, as she only gave the dots and asked for numbers, but not the numbers to ask how many dots |
| | Mathematical Suggestion | **MS$^{\rightarrow E}$** | The reflection comprises of a description that is mathematical, accompanied by an analytic suggestion (suggestion with a justification) | Learners must not rely on number line. It could take time with big sums |
| Level 4: REFLE | General Reflectivity | **GR** | Reflection displays deeper engagement with the non-mathematical identified event. The PST engages in a dialogue | No examples could be found in the data |

| | | | | |
|---|---|---|---|---|
| | | | with self, analyzing the event from different perspectives to come up with better ways of dealing with similar events in the future. | |
| | Mathematical Reflectivity | **MR** | Reflection displays deeper engagement with the mathematical identified event. The PST engages in a dialogue with self, analyzing the event from different perspectives to come up with better ways of dealing with similar events in the future | I shouldn't have put together addition and subtraction because learners were not really focused and couldn't understand the subtraction part, they needed it to be done separately. These two [algorithms] are already complicated for Grade 1 to use on 2-digit numbers, and putting them together was not a good idea because I ended up spending more time on addition and very less time on subtraction. Many learners seemed to get confused when I wanted them to subtract. That was not good for the learners. They didn't learn much from it. I should have stuck with only one. |

The shaded block in Table 4.5 indicates that there was no example provided from the data because there were no PSTs who wrote a reflection exhibiting general reflectivity. Note also that there was only one PST, Bonga, who wrote a reflection that was at the fourth level of mathematical reflectivity. Figure 4.6, below, offers a summary of the codes elaborated in Table 4.5, above.

| | | |
|---|---|---|
| **DESCRIPTION** | General Description → | **GD** |
| | General Description Followed by explanation → | **$GD^{\to E}$** |
| | Mathematical Description → | **MD** |
| | Mathematical Description Followed by explanation → | **$MD^{\to E}$** |
| **EXPLANATION** | (Simple) General Explanation → | **GE** |
| | Expanded General Explanation → | **$GE^{e}$** |
| | (Simple) Mathematical Explanation → | **ME** |
| | Expanded Mathematical Explanation → | **$ME^{e}$** |
| **SUGGESTION** | General Suggestion → | **GS** |
| | General Suggestion Followed by explanation → | **$GS^{\to E}$** |
| | Mathematical Suggestion → | **MS** |
| | Mathematical Suggestion Followed By explanation → | **$MS^{\to E}$** |
| **REFLECTIVITY** | General Reflectivity → | **GR** |
| | Mathematical Reflectivity → | **MR** |

*Figure 4. 6: The summary of codes developed from the analytical tool and data finally used in coding all the data in this research*

## 4.6 ETHICAL CONSIDERATIONS

This research was conducted in an ethical manner which furthermore supports its validity and reliability (Merriam, 2009). Oates, Kwiatkowski and Coulthard (2010) describe research ethics as the moral principles the researcher adheres to during the research process from the beginning to the end, mainly in order to minimise potential harm to those involved in the study (Mills, 2003). Ethical clearance was obtained from my university before I commenced the study. In this section, I describe the ethical principles I followed in the conduct of this research.

### 4.6.1 Informed consent and right to withdraw

The first principle I adhered to was that of informed consent. According to Emmanuel, Wendler and Grady (2000), informed consent is the provision of information to participants about the purpose of the research, its procedures, potential risks, benefits and alternatives. Denscombe (2010) observes that when engaging in any research, the researcher should get consent from both the participants and any institution with which they are associated. Denscombe (2010) adds that participants should be informed about being studied and should participate voluntarily. This research adhered to all these requirements. Before I started this research, I sought permission from the university and was awarded an ethical clearance certificate. I explained my research to the Dean of the Faculty of Education and the Head of Department, was granted permission to carry out the research in Education department in this university. I sought permission from the lecturer responsible for the Mathematics Method course in which my research was to be based to observe her lectures, notably those devoted to developing the PSTs' RP using video-based lessons. I also sought permission to access the participating PSTs' written reflections and assignments. I explained my research to the whole third-year BEd FP cohort and invited them to participate in my research. Twenty PSTs consented to take part in the study and signed the consent forms. (See letters of seeking permission in Appendix 1 and the ethical clearance certificate in Appendix 1.5)

My research had no potential risks, but I nevertheless made PSTs aware of the interviews and how much of their time could be requested for this. I also emphasised to the PSTs that their participation was voluntary and that they could withdraw from participation at any time they wished. As indicated earlier in the chapter, one volunteer did indeed opt to withdraw from participation and one more opted not to participate in Phase 2.

### 4.6.2 Anonymity and confidentiality

Research ethics emphasise that the research participants should be protected from any psychological, physical or social harm during their participation in a study (Maxwell, 2012; Cohen et al., 2011). Although there were no foreseeable risks associated with participation in this research, I made sure that I maintained the participants' anonymity by using pseudonyms in the writing of the thesis and in all the presentations and publications relating to this study. I concealed the name of the university and ensured that all the data collected was treated with confidentiality. The data was kept in a securely locked university office. The videos of interviews were transcribed and translated by professionals who were aware of the ethics pertaining to handling research data.

### 4.6.3 Positionality

Positionality is the situatedness of a researcher within a given study and is normally identified by locating him or her in relation to the subject, the participants and the research context and process (Sultana, 2007). Sultana (2007) claims that "it is critical to pay attention to positionality, reflexivity, the production of knowledge and the power relations that are inherent in research processes in order to undertake ethical research" (p. 380). This research depended on a productive and respectful working relationship with the FP mathematics method course lecturer who gave me access to the course. It is useful to note that the lecturer and I shared an interest in the role of video-based lesson analysis in PTE. The lecturer's interest was more of that of a practitioner interested in teaching and learning in the FP classroom, while mine was primarily for the purposes of this research. We navigated our roles carefully as I had been involved in some courses with the same lecturer and the same group of PSTs and I thus had to guard against taking on the role of a lecturer. I was careful to maintain my distance as a non-participant observer so that I did not interfere with the PSTs' decision to participate or not, or influence their reflections for my research.

### 4.6.4 Validity and Reliability

Validity and reliability determine whether the research measures that which it was intended to measure, and how trustworthy the research results are, respectively. In this section, I discuss how I ensured the truthfulness of my research in this study, by considering four important qualitative concepts: credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985).

#### *4.6.4.1 Credibility*

Ary et al. (2006) describe credibility as a measure of how well the researcher has established confidence in the findings based on the research design, participants and context. Triangulation and member checking are among the methods I used to ensure the credibility of my study. I used multiple sources of data and various methods of data collection, including observation, document collection and interviews. Multiple sources of data were used to build coherent justifications for each of the themes that resulted from my research. According to Cohen et al. (2011), triangulation lends credibility to the findings by incorporating multiple sources of data and theories. I gave the participants their interview transcriptions for member checking. The lecturer was also given the thesis to check if I presented what transpired in the lectures accurately. These assisted in clearing up some miscommunications and inaccuracies.

I used direct quotations from the participants in the presentation and analysis of data. Ary et al. (2006) refer to this as the use of low inference descriptors, which helps readers to experience the participants' world.

#### *4.6.4.2 Transferability*

Transferability is the extent to which the findings of a study can be applied or generalised to other contexts or other groups outside of the study that generated the findings (Rolfe, 2006). To ensure a degree of transferability for my study, I provided rich and detailed descriptions of the context so that potential readers of the study can make comparisons and judgements about similarities (Ary et al., 2006). I also provided evidence in the form of quotations from participants' observations and written reflections, to ensure that the evocation of settings, participants and findings were adequately detailed.

#### *4.6.4.3 Dependability*

Merriam (2009) claims that reliability is called dependability in qualitative research. According to Gray (2009), dependability pertains to the consistency of the research findings or the extent to which data and findings would be similar if the study were to be replicated. I clearly document how my study was conducted. I also include all the PSTs' written reflections and the interview transcriptions so that any researcher might position themselves to replicate the study.

#### *4.6.4.4 Confirmability*

Confirmability measures the extent to which the study's findings are supported by the data (Lincoln & Guba, 1985). It is also a measure of the extent to which the research is free of bias in respect of its procedures and its interpretation of results. In this study I remained true to the principles of interpretive research. To eliminate bias, I sent the interview transcripts to the research participants to ensure that they agreed with the transcriptions and translations that had been made and the thesis to the lecturer to confirm my data presentation and findings.

## 4.7 CONCLUSION

This chapter described how I carried out the investigation of the reflections of PSTs when they analyse video-recorded lessons to develop RP. I introduced the reader to the research orientation and methodology chosen for the study and the reasons for these choices. I discussed interpretivism as the research paradigm for this study, which followed a qualitative case study approach. I described and discussed the various data collection instruments, such as observations and interviews. I explained how the collected data was analysed using the tool that I adapted from the literature. I ended the chapter with some discussion of how ethical concerns were handled before and during the research. In the next Chapter I present, analyse and interpret the data collected during Phase 1.

# CHAPTER 5

# PRESENTATION AND ANALYSIS OF THE PRESERVICE TEACHERS' REFLECTIONS

## 5.0 INTRODUCTION

The previous chapter described the methodology employed in the collection and preparation of the data for analysis. In this chapter I present, analyse and interpret the data to answer the research questions:

1 What is the nature of the reflections that PSTs develop as they engage in video-recorded lesson analysis?
2 How does the nature of these reflections change over time, if at all?
3 What role is played by the Six Lens Framework as the reflective tool used to guide pre-service teachers' reflective practice?

As described in Chapter 4, data for this research was collected in two phases. This chapter focuses on the data collected during phase 1, when each of the 18/19 research participants wrote individual reflective responses after being stimulated by selected video-recorded mathematics lessons. Phase 1 consisted of three sessions during which the PSTs viewed and reflected on each of the three selected video-recorded lessons, as shown in Table 5.1, below. In this chapter I present and analyses the PSTs' written reflections in search of responses to the above research questions. Because of the quantity of the data to be presented in this chapter, I have divided it into three major parts, with each part responding to one of the three research questions as shown in Table 5.1 which provides an overview of this chapter.

Part 1, I present and analyse the three sets of PST reflections to establish the nature of the reflections they evinced as they analysed the video-recorded lessons. In Part 2, I compare the PSTs' reflections from session to session to establish if there were any changes in the reflections over time, and if so, what these changes were. In Part 3, in response to my third research question, I explore the role played by the SLF in influencing the PSTs' reflections by comparing how the PSTs reflected before and after using each of the six lenses.

*Table 5. 1: An overview of the three data analysis sections in the chapter*

| PART | | FOCUS | RESEARCH QUESTION ANSWERED |
|---|---|---|---|
| **Part 1** | | **The nature of PSTs' reflections. Presentation and analysis of PSTs' reflections** | RQ1: What is the nature of reflections that PSTs develop as they analyse video-recorded mathematics lessons? |
| 5.1 | 5.1.1 | Presentation and analysis of Session 1 reflections | |
| | 5.1.2 | Presentation and analysis of Session 2 reflections | |
| | 5.1.3 | Presentation and analysis of Session 3 reflections | |
| | 5.1.4 | Section conclusion | |
| **Part 2** | | **Comparing reflections between sessions** | RQ2. How does the nature of these reflections change over time, if at all? |
| 5.2 | 5.2.1 | Comparing S1, S2 and S3 summaries of reflections | |
| | 5.2.2 | Comparing the ten PSTs' reflections on 2 lenses from session to session | |
| | 5.2.3 | Section conclusion | |
| **Part 3** | | **Comparing lens by lens summaries of S3 PSTs' reflections** | RQ3. What role is played by the Six Lens Framework as the reflective tool used to guide pre-service teachers' reflective practice? |
| 5.3 | 5.3.1 | Mathematical and Meta-mathematical ideas | |
| | 5.3.2 | Tasks and activities | |
| | 5.3.3 | Explicit and implicit goals | |
| | 5.3.4 | Interactions with the students | |
| | 5.3.5 | Dilemmas and decision making | |
| | 5.3.6 | Teacher's beliefs | |
| | 5.3.7 | Section conclusion | |

PART 1

# WHAT IS THE NATURE OF THE REFLECTIONS THAT PRE-SERVICE TEACHERS DEVELOP AS THEY ENGAGE IN VIDEO-RECORDED LESSON ANALYSIS?

## 5.1 INTRODUCTION

This section investigates the nature of reflections PSTs develop when they analysed video-recorded lessons in Phase 1. The section seeks to respond to the first research question, which provides the heading above. The PSTs' reflections are presented in three sections, each focusing on the reflections written by individual PSTs in one of the three sessions of Phase 1 data collection. Table 5.2, below, extracted from Chapter 4, summarizes Phase 1 data collection.

*Table 5. 2: Overview of Phase 1 data collection*

| What is the nature of the reflections that pre-service teachers develop as they engage in video-recorded lesson analysis? | | | | | | |
|---|---|---|---|---|---|---|
| **PHASE 1 Data** | **Presented in Section** | **STIMULUS FOR REFLECTIONS IN EACH SESSION** | | **SOURCE OF DATA** | **NUMBER OF PARTICIPANTS** | **Number of Lenses per PST** |
| | | **3 VIDEO-RECODED LESSONS** | | Individual PST written reflections on other teachers' practices | | |
| | **5.1.1** | SESSION 1 21 February 2018 | Grade R lesson entitled 'The umbrella story' | | 18 | 2 |
| | **5.1.2** | SESSION 2 25 April 2018 | Grade 1 lesson entitled 'Ten-frames and dot cards' | | 19 | 3 |
| | **5.1.3** | SESSION 3 25 May 2018 | Grade 3 lesson entitled 'Bridging through ten' | | 19 | 6 |

As shown in Table 5.2, above, In the first section I present the 18 PSTs' session 1 (S1) reflections in full on a Grade R video-recorded lesson titled 'The umbrella story'. The reflections are presented along with the coding I assigned these reflections to give the reader a feel of both how the PSTs reflected and how I coded these reflections. In the second and third sections, I present only summaries of each PST's S2 and S3 reflections respectively, and their analysis. In these two sessions, the PSTs' reflections were much longer, and I therefore did not have the space to present them all in full. I however included a few samples in Appendices 3.1 (S2) and 3.2 (S3). I begin each section by providing a summary of the video-recorded lesson used as the stimulus for that PST reflection session.

### 5.1.1 Presentation and analysis of Session 1 (S1) PST reflections

This was the first of the three sessions the PSTs had on video-based reflection and thus the first session of data collection. 18 of my 19 research participants were part of the fifty-two PSTs who attended this lecture (one of the participants was absent on the day). After the lecturer had introduced the SLF as the tool the PSTs were to use to help them notice and reflect on the mathematical aspects of the lesson. The PSTs were seated in groups of four to five per group and each group was assigned two focal lenses of the SLF to guide their reflections. Different groups were assigned different pairs of lenses. The lecturer played a video of a Grade R lesson entitled ‘The umbrella story’. The thirty-minute video was shown twice. The first time, the lecturer asked the PSTs to watch and familiarize themselves with the lesson. The second time, she asked each individual PST to write their reflections on the lesson using the two lenses of the SLF assigned to them. Figure 5.1 provides a summary of the video-recorded lesson used as stimulus for the S1 PST reflections. In the summary, I use the words ‘child/children’ for the learner/s that was/were selected by the teacher to act out the story and the words ‘learner/learners’ for the rest of the class.

**'The umbrella story' video-recorded lesson, stimulus for PST reflection in session 1**

*The lesson focuses on the enactment of a story book the teacher is reading to the learners that has 5 children moving one by one from all standing under one small umbrella to standing under a big umbrella. The picture below is taken from page 3 of the book.*


*The teacher had set a small umbrella and a big umbrella in the front part of the classroom before the lesson began. She had also put out flash cards with numbers from zero to five, written in both symbols and words, and the words many, more, less and none. At the beginning of the lesson she selected five learners and instructed them to stand under the small umbrella. She asked one other learner to count the children under the small umbrella. The teacher asked four learners to pick flash cards that describe the scenario with regard to the number of children under each of the two umbrellas. One learner picked the [5/five] card and stood beside the small umbrella; another picked 'many' and also stood beside the small umbrella. Another learner picked up '0/zero' and stood beside the big umbrella and so did a learner who picked up 'none'. The teacher then began to read a story from the story book entitled 'The umbrella story'. In the story, one of the five children under the small umbrella complained that they were too many under the small umbrella yet there was no one under the big umbrella. One of the children under the small umbrella moved to the big umbrella in response to the complaint. The complaints and movements continued until there was no one under the small umbrella and all the five children were under the big umbrella. As the teacher read the story, she would pose after each complaint and instruct the children under the small umbrella to act out what she had read. The learners standing by the umbrellas were requested by the teacher to put back their flash cards after each movement, and new learners were selected to pick up new cards that presented the new scenario. The teacher assisted the learners who were not able to identify some words from the flash cards (advised them to use the phonics at the beginning of each word as a clue to identifying the words). The illustrations above portray the point in the story when there were three children under the small umbrella and two under the big umbrella. Two learners stand next to each umbrella holding up words that tell how many children are under each umbrella. In the second picture the teacher is holding the story book showing the page of the story book.*

*Figure 5. 1: Summary of the lesson used during session 1 and two screen shots of the learners enacting the umbrella story*

As noted earlier, 18 of the 19 research participants reflected on the 'umbrella story' video-recorded lesson described in Figure 5.1, above. Table 5.3 below show the four groups in which the 18 PSTs belonged and the assigned lenses to each group. For the sake of anonymity, the participants were given pseudonyms which I use throughout this research. Each of the 52 PSTs in the lecture was given a handout (see appendix 2.1) where Karsenty et al. (2015) provided information about each lens and some prompts for reflecting using different lenses. In this section I present excerpts from the handout relevant to the reflections being presented.

*Table 5. 3: PST research participants and the lenses they used during session 1*

| NAMES | LENSES | | NAMES | LENSES |
|---|---|---|---|---|
| ***GROUP 1***<br>Joy Lethu<br>Micky Charity | 1.Explicit and implicit goals<br>2.Interactions with the students | | ***GROUP 3***<br>Bonga Lee<br>Ronny Tiny | 1.Dilemmas & decision making<br>2.Beliefs |
| ***GROUP 2***<br>Dee Thula<br>Langa Liz<br>Marylyn | 1.Mathematical & meta-mathematical ideas<br>2. Tasks & activities | | ***GROUP 4***<br>Alice Lutho<br>Mandy Smith<br>Vee | 1.Mathematical & meta-mathematical ideas<br>2. Tasks & activities |

### *5.1.1.1 Presentation and analysis of PST Group 1's reflections*

As shown in Table 5.3, Micky, Joy, Charity and Lethu were in Group 1. They were asked to reflect on 'Explicit and implicit goals' (which I will refer to henceforth as 'Goals') and 'Interactions with the students' (which I will refer to as 'Interactions'). As mentioned earlier, each PST was given a handout outlining the six lenses of the SLF as formulated by Karsenty et al. (2015). Figure 5.2 shows the excerpt of the handout that focused on goals and interactions, the lenses this group was assigned to use.

| | | |
|---|---|---|
| **Explicit and Implicit Goals** | Attributing goals that may underlie the teacher's actions or decisions, on the basis of what was observed in the video. Rather than "scientifically verifying true goals", the aim is to sharpen awareness of different possible goals and negotiate the pros and cons of preferring certain goals over others. | • Try to identify the goals that you think the filmed teacher was attempting to achieve. Show evidence from the video to support your assertion.<br>• Did you notice a moment when the teacher's goals have changed, or a new goal was added? Why do you think this has happened? |
| **Interactions with Students** | Observing and analyzing if and how the filmed teacher: poses further questions to those of the task; listens to (or ignores) comments or difficulties raised by students; manages discussions; delegates responsibilities in the process of knowledge generation. | • How does the filmed teacher navigate students' responses during the mathematical activity? What kind of questions does she ask? Who gets permission to speak?<br>• Characterize the teachers' feedback to students |

*Figure 5.2: Six lens framework excerpt with lenses for explicit and implicit goals and interaction with students*

## Presenting and analysing Micky's S1 reflections

Micky's S1 reflections

***Explicit and implicit goals***

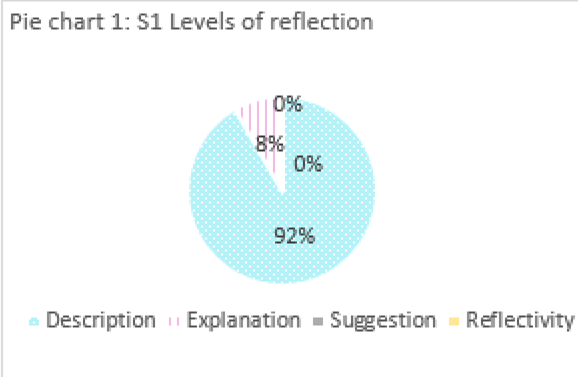
*1 She was enforcing the children knowledge of the numbers to 5 MD. 2 She also worked on children's knowledge of more, less, many and none MD*

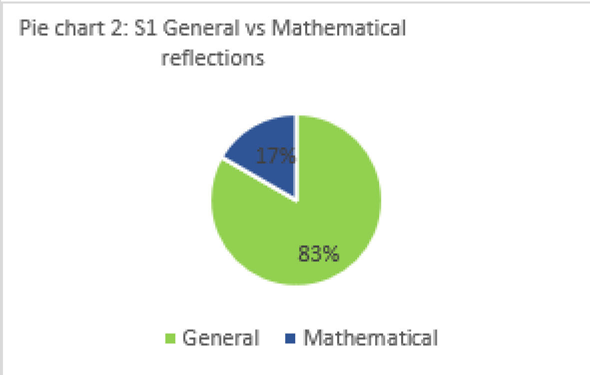
***Interactions***

*3 The teacher used questions $\text{GD}^{\rightarrow E}$ 4* ***to*** *encourage the students to interact GE. 5 She encouraged the students to help the struggling learner GD 6 She asked questions like "What does the word start with?" GD 7 Children were encouraged to interact GD 8 They were being involved in the story GD. 9 Children were either under the umbrella GD 10 or holding signs GD. 11 Children were not told off for mistakes GD 12 but rather helped GD*

Summaries of Micky's S1 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $\text{GD}^{\rightarrow E}$ | MD | $\text{MD}^{\rightarrow E}$ | GE | $\text{GE}^{*}$ | ME | $\text{ME}^{*}$ | GS | $\text{GS}^{\rightarrow E}$ | MS | $\text{MS}^{\rightarrow E}$ | GR | MR | |
| 8 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 9 | | 2 | | 1 | | 0 | | 0 | | 0 | | 0 | 0 | 12 |
| 11 | | | | 1 | | | | 0 | | | | 0 | | 12 |




Micky reflected using both lenses assigned to her group and wrote twelve coded ideas. Eleven of these twelve ideas were descriptions, only one was an explanation and there were no suggestions or ideas showing reflectivity. Nine out of the eleven descriptions were GDs and two were MDs. Only one of the GDs was followed by an explanation, resulting in the sole idea at level 2. Micky's reflections were therefore at the lower levels of the Reflection Model (FLRM) discussed in Chapter 4. As shown in pie chart 1, 92% of the reflections were at level 1 and only 8% at level 2. 83% of Micky's reflections were general while only 17% were mathematical (see pie chart 2).

## Presenting and analysing Charity's S1 reflections

*Charity's S1 reflections*

***Explicit and implicit goals***

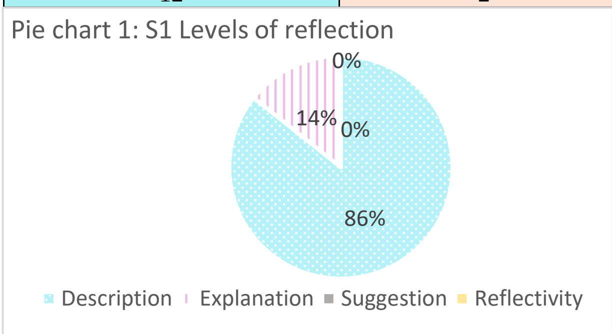
*1.The goal that was evident in the video was the teaching of new mathematical vocabulary such as more, less and none or many. MD 2. I also think she wanted them to get the sense of numbers 0-5, not just the symbols MD 3.but also the names of the numbers. MD. 4. Ultimately teaching them to subtract can also be regarded as another goal* $MD^{\rightarrow E}$ *5* ***because*** *the number of children under the small umbrella decreased. ME.*

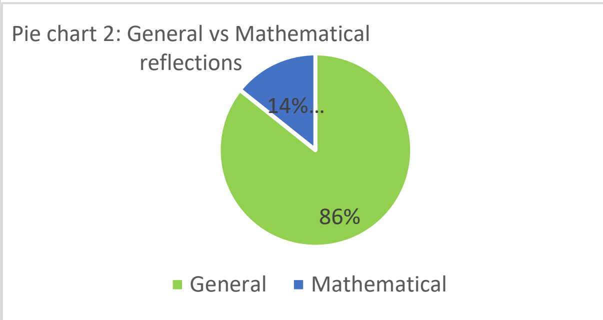
***Interactions with students***

*6. The teacher asked a lot of questions. GD. 7. She does not want them to shout out the answers. GD. 8. She rather instructs them to put up their hands. GD. 9. She gives every child a chance to answer. GD. 10. When the other students have already answered, she gives others a chance. GD. 11. The teacher also [told them she] wants them to respond by using full sentences. GD. 12. When the children are wrong, she does not shout at them GD 13 but helps them.* $GD^{\rightarrow E3}$*. 14. I think this is where the flow of ideas comes in 14b* ***because*** *the children now be more comfortable in answering questions.14c* ***This allows*** *the teacher to ask more questions relevant to the story* $GE^e$

*Summaries of Charity's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GD** | **$GD^{\rightarrow E}$** | **MD** | **$MD^{\rightarrow E}$** | **GE** | **$GE^e$** | **ME** | **$ME^e$** | **GS** | **$GS^{\rightarrow E}$** | **MS** | **$MS^{\rightarrow E}$** | **GR** | **MR** | |
| 7 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 8 | | 4 | | 1 | | 1 | | 0 | | 0 | | 0 | 0 | 14 |
| 12 | | | | 2 | | | | 0 | | | | 0 | | 14 |



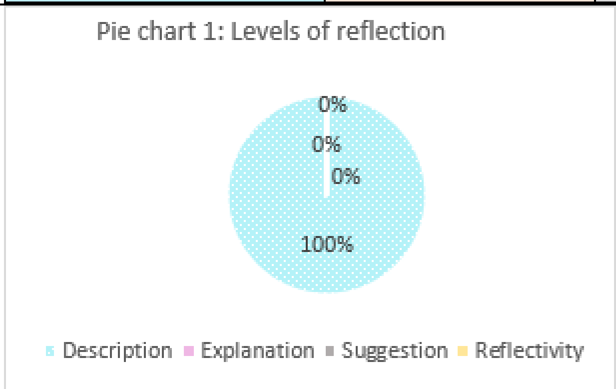



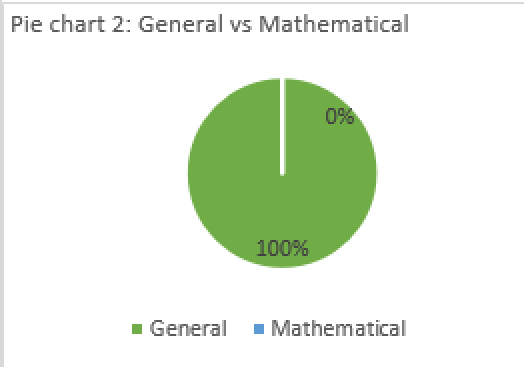

Charity wrote fourteen coded ideas using the two lenses assigned to her group. As shown in the summaries of coding above, twelve out of the fourteen ideas were descriptions, two were explanations and there were no suggestions or ideas displaying reflectivity. Eight out of the twelve descriptions were general and four were mathematical. One GD and one MD were followed by simple explanations, resulting in two explanations at level 2. Charity's reflections were thus at the lower levels of the FLRM: as shown in pie chart 1, 86% of her reflections were at level 1, 14% at level 2, with none at levels 3 and 4. 64% of her reflections were general and 36% mathematical (see her pie chart 2, above).

## Presenting and analysing Joy's S1 reflections

*Teacher's interaction with the learners is very good. GD 2. She speaks clearly and loudly for everyone to hear. GD. 3. The space where she's conducting the activity is small GD 4. but she managed to carry out the lesson effectively GD 5. Her decision making when struck by a dilemma is prompt, GD 6 she manages to respond positively GD. 7 She creates a fun learning environment. GD 8. She encourages the children by praising them when a correct answer is given GD.*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | $GE^e$ | ME | $ME^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 8 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 | |
| 8 | | | | 0 | | | | 0 | | | | 0 | | 8 |




Joy did not indicate the lenses with which she was reflecting. However, her group had been assigned the Goals and Interactions lenses. She wrote eight coded ideas that were all descriptions (see pie chart 1). There were no explanations, no suggestions and no reflectivity ideas. Thus, her reflections in S1 did not go beyond level 1 of the FLRM (see pie chart 1) and all were general as opposed to mathematical (as shown in pie chart 2).

**Presenting and analysing Lethu's S1 reflections**

*Lethu's S1 reflections*

**Goals**

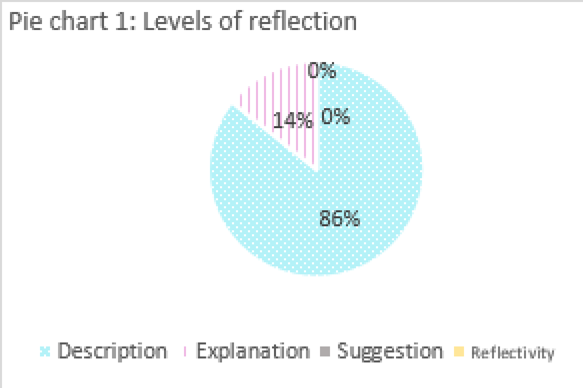
1. The teacher's goal is that the children are able to differentiate between more and less MD. 2. and also, children must be able to count in descending order. MD 3. This also means they are able to subtract MD 4 and add numbers. MD 5. Teacher also change to new goal GD 6 which was to encourage children to answer questions in full sentences GD 7. and answering the word more starting with which alphabet. GD→E 8. This was to encourage children to answer questions in full 8b **in order to** build their communication skills GEᵉ

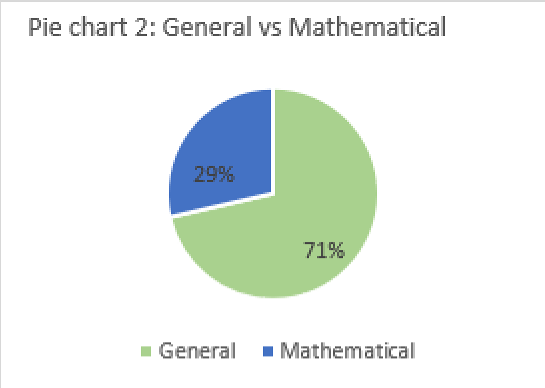
**Interactions**

9. She encourages children to respond in full sentences. GD 10. She also asks why questions GD→E 11 **to allow** children to reason their thinking. GE 12. A learner has to raise hand to talk. GD 13. Teacher allows student to retry if student got the answer wrong GD 14. and praise them if they got it right GD

*Summaries of Lethu's S1 reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GEᵉ | ME | MEᵉ | GS | GS→E | MS | MS→E | GR | MR | |
| 6 | 2 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 8 | | 4 | | 2 | | 0 | | 0 | | 0 | | 0 | | 14 |
| 12 | | | | 2 | | | | 0 | | | | 0 | | 14 |




Lethu wrote fourteen ideas using the two lenses assigned to her group. Twelve out of the fourteen ideas were descriptions and only two were explanations. There were no suggestions and no ideas displaying reflectivity. Eight of the twelve descriptions were general while four were mathematical. Two of the GDs were followed by explanations resulting in the two general explanations at level 2. No MD was followed by an explanation. Thus, all Lethu's reflections were at the lower levels of the FLRM, with 86% of the reflections at level 1 and 14% at level 2. No ideas were at levels 3 or 4 (see pie chart 1). Moreover, 71% of Lethu's reflections were general and only 29% were mathematical (see pie chart 2).

### *5.1.1.2 Presentation and analysis of PST groups 2 & 4's reflections*

I present the data from Groups 2 and 4 together because these two groups were assigned to reflect with the same lenses. The groups reflected on Mathematical and meta-mathematical ideas (MMI) and Tasks and activities (which from now on I will refer to as 'Tasks'). As shown in Table 5.3, in Group 2 there was Dee, Langa, Liz, Marylyn and Thula, while Group 4 comprised Alice, Lutho, Mandy, Smith and Vee. In Figure 5.3, below, I present the excerpt of the SLF handout relevant to these two groups.

| | | |
|---|---|---|
| 1.Mathematical & Meta-mathematical ideas | Scanning the space of relevant ideas, concepts and rocedures, as well as meta-mathematical ideas (e.g., one counter example is sufficient to refute a conjecture) that may be associated with the lesson's topic | • Which ideas did the filmed teacher bring forward in the lesson? Which ideas were left out? How can this decision be explained?<br>• Which meta-mathematical notions were evident in the lesson? |
| 2. Tasks & Activities | Conducting an "a posteriori task analysis": discussing features of the task and how it was enacted by the filmed teacher and students.<br>Noticing if and when it develops differently than expected. | • Observe and document how the task is introduced and carried out and how the teacher addresses students' reactions.<br>• What may be the benefits and pitfalls in bringing this task to class? |

*Figure 5. 3: Six lens framework excerpt on mathematical and meta-mathematical ideas and tasks and activities*

As with Group 1, I present coded written reflections, a summary of the coding, pie charts and the analysis for each of the PSTs in Groups 2 and 4.

### Presenting and analysing Dee's S1 reflections

*Dee's S1 reflections*

***Mathematical and meta-mathematical ideas***

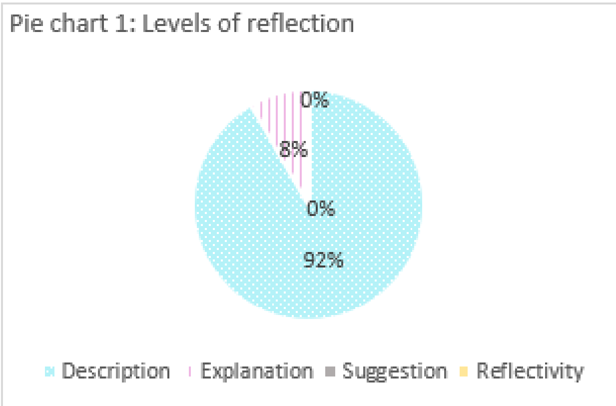
*1. I think the main idea the teacher wanted to teach was counting. MD. 2. There are other concepts that are emerging as she continues with the lesson MD. 3These concepts are many, few and less. MD. 4This is introduced later. MD. 5. She asks children which umbrella has many children. MD 6. The second concept is for starting on addition and subtraction. MD 7. [she did this by] Taking children from the umbrella that has many (subtraction) and adding them to the one that has few (addition) MD*

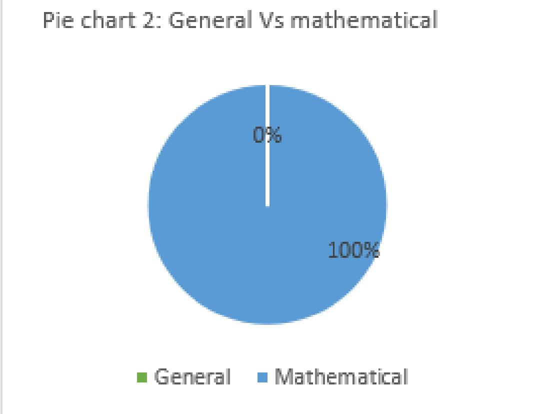
***Tasks and activities***

*8. The first task given to the children was to go under the umbrella $MD^{\to E}$ 9* ***so that*** *the children altogether may represent the number 5 ME. 10. The second one is when one child counts all the children under one umbrella. MD 11. The third one is when the children are asked to bring the number 5 and 0, MD 12. and pick out the words that has many MD*

*Summaries of coding Dee's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{c}$ | ME | $ME^{c}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 0 | 0 | 10 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 0 | | 11 | | 0 | | 1 | | 0 | | 0 | | 0 | | 12 |
| 11 | | | | 1 | | | | 0 | | | | 0 | | 12 |




Dee wrote twelve coded ideas using the two lenses assigned to her group. Eleven of the twelve were descriptions; there was one explanation and no suggestions or reflectivity. All eleven descriptions were mathematical, one of them followed by an explanation leading to the only mathematical explanation at level 2. Thus, Dee's reflections in this session were on the lower levels of the FLRM, with 92% at level 1, 8% was at level 2 and none at levels 3 and 4 (see pie chart 1). 100% of her reflections were mathematical, as shown in pie chart 2.

**Presenting and analysing Langa's S1 reflections**

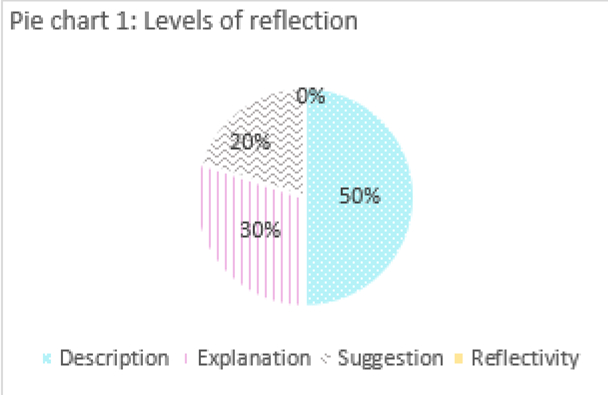
*Langa's S1 reflections*

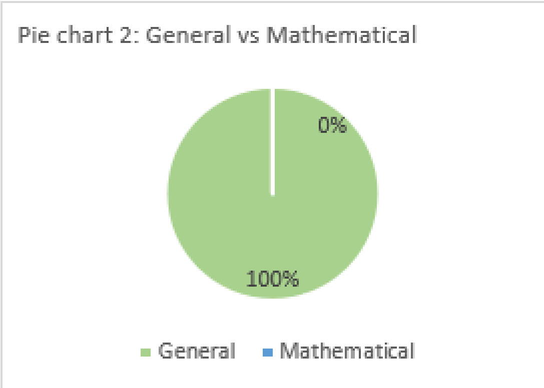
***[Mathematical and meta-mathematical ideas and tasks and activities]***

*I like the way she introduced the lesson. GD 2. She brought it to life. GD 3. She made it practical. $GD^{\rightarrow E}$ 4 **which** makes children participate. GE 5. I like the way she is in the vide $GD^{\rightarrow EB}$, 6 [because] it is what we get when we get to school. 6b. The children learn better when they are included, 6c doing the practical thing 6d as it will be stored in their long term memory. 6e. Children learn by touch, feel, & see. 6f. With them doing the story together 6g and participating in it 6h is a learning for them, according to me $GE^{e}$ 7. **She may had to** explain the role of rain in our lives GS 8 and why we should not get wet, $GS^{\rightarrow E}$, 9 **as to why** there were umbrellas in the story. GE 10. She brought the idea of verbal, kinetic, rhythmic learning style GD*

*Summaries of coding Langa's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 3 | 2 | 0 | 0 | 2 | $1^{EB}$ | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 10 |
| 5 | | 0 | | 3 | | 0 | | 2 | | 0 | | 0 | | 10 |
| 5 | | | | 3 | | | | 2 | | | | 0 | | 10 |




Langa did not indicate the lenses she was reflecting with. However, her group was assigned to reflect on Mathematical and meta-mathematical ideas and Tasks and activities, as indicated earlier in Table 5.3. She wrote ten coded ideas, five of which were descriptions, three were explanations and two were suggestions. No idea displayed reflectivity. Two of Langa's GDs and one GS were followed by explanations, resulting in the three explanations at level 2. Langa's reflections thus extended to level 3 but were mostly at the lower level of the FLRM, with 50% at level 1, 30% at level 2, 20% at level 3 and 0% at level 4 (as shown in pie chart 1). There were no mathematical reflections (see pie chart 2).

**Presenting and analysing Liz's S1 reflections**

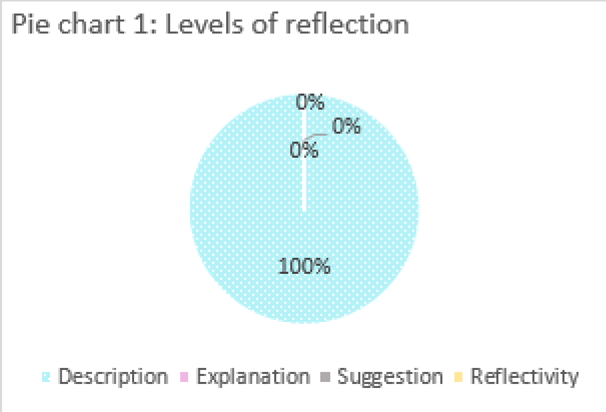
*Liz's S1 reflections*

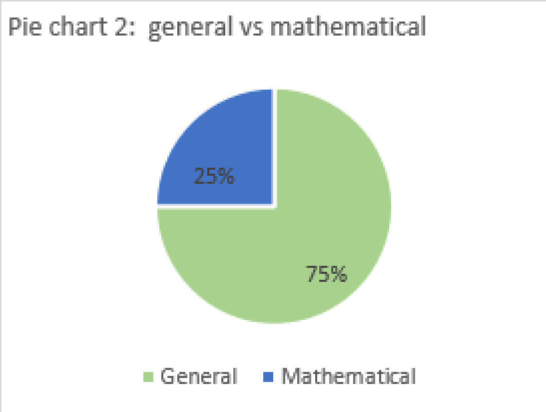
***Mathematics and meta-mathematical ideas***

*The teacher introduces the lesson by presenting two umbrellas. GD 2. One with many raindrops (bigger) GD 3 and one with fewer raindrops (smaller). GD 4. Learners are very interactive. GD 5. She also takes an opportunity to introduce number names MD 6 and digits. MD 7. The learners bring up the monkeys-tree story. GD 8. It is what they are familiar with concerning the activity at the moment. GD*

*Summaries of coding Liz's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^c | ME | ME^c | GS | GS→E | MS | MS→E | GR | MR | |
| 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 6 | | 2 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 | 8 |
| 8 | | | | 0 | | | | 0 | | | | 0 | | 8 |




Liz reflected using one of the two lenses assigned to the group (MMI) and wrote eight ideas, all of which were descriptions. There were no explanations, no suggestions and no ideas displaying reflectivity. Six of the descriptions were general, two were mathematical, and none were followed by explanation. Thus, 100% of Liz's reflections lay at the lowest level of the FLRM and were mostly general. As shown in pie chart 2, 75% of her reflections were general while only 25% were mathematical.

## Presenting and analysing Marylyn’s S1 reflections

*Marylyn’s S1 reflections*

***Mathematical and meta-mathematical ideas***

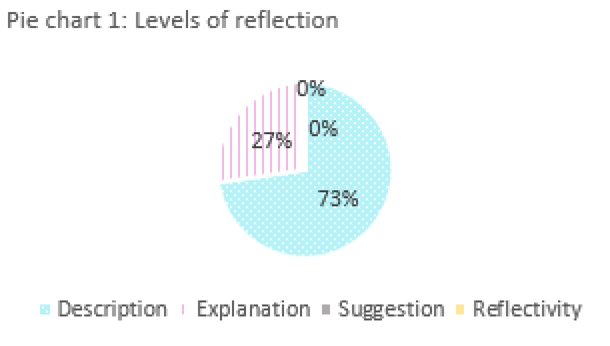
*1. The mathematical part of the lesson, the teacher is first using concrete (which are the learners) MD 2 to the abstract (the number) object $MD^{\to E}$ 3 **to better** the understanding of the task or activity. ME 4. She makes great use of questions and answers $GD^{\to E}$. 5. **This way** they get to explain the findings. GE. 6. Concepts are implemented GD*

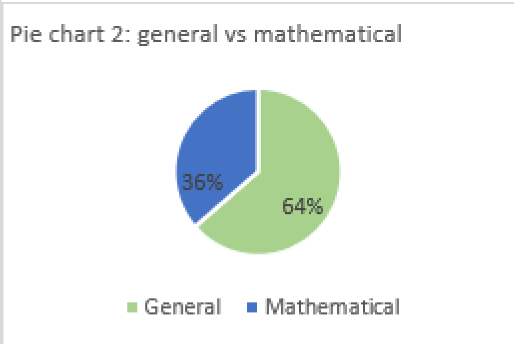
***Tasks and activities***

*7. The teacher introduces the subject using their prior knowledge GD 8 They did oral counting as a whole class MD 9. which shows that the activity will be a whole class activity. GD. 10 She uses two umbrellas $GD^{\to EE}$ 11 **so that** the learners can act out the story. 11b **In this** way learners are interacting with the story or task. $GE^{*}$*

*Summaries of coding*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 3 | $2(1^{E})$ | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 5 | | 3 | | 2 | | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 8 | | | | 3 | | | | 0 | | | | 0 | | 11 |




Marylyn reflected using both lenses assigned to her group and wrote eleven coded ideas. Eight of these eleven ideas were descriptions, three were explanations and there were no suggestions or ideas displaying reflectivity. Five of the eight descriptions were general and three were mathematical. Two of the GDs were followed by explanations resulting in the only two GEs at level 2. Thus, Marylyn’s reflections lay at the lower levels of the FLRM. As depicted in pie chart 1, 73% of her reflections were at level 1 and 27% at level 2. There were no reflections at levels 3 and 4. She recorded 58% general ideas and 42% mathematical (as shown in pie chart 2).

**Presenting and analysing Thula's S1 reflections**

*Thula's S1 reflections*

***Mathematical and meta-mathematical ideas***

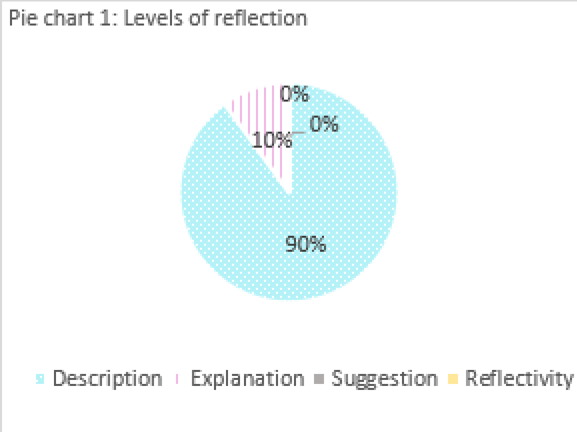
*1. I like the way the teacher gave the activity GD 2 and let them to participate in the task. GD 3. She explains the task very well GD 4. and she involves the learners GD 5. and give them a chance to make decisions for themselves GD*

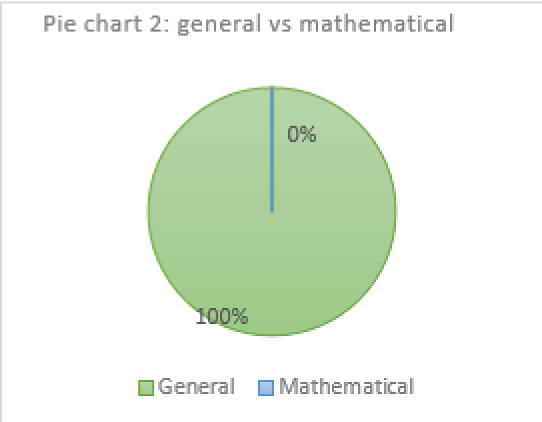
***Tasks and activities selected by the teacher***

*6. The activities that the teacher gives to the learners fulfils her goals GD all the learners were willing to participate during the lesson. GD 7. I think learners were enjoying the lesson GD 8 while they were learning at the same time. GD 9. Having umbrellas GD→E 10 made the lesson more easy for the learners GE*

*Summaries of Thula's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE' | ME | ME' | GS | GS→E | MS | MS→E | GR | MR | |
| 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 9 | | 0 | | 1 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 9 | | | | 1 | | | | 0 | | | | 0 | | 10 |




Thula reflected using both the lenses assigned to his group and wrote ten coded ideas. Nine of the ten were descriptions and one an explanation. There were no suggestions and no ideas displaying reflectivity. All nine descriptions were general, with one of them followed by an explanation, resulting in one GE. Thula's reflections were at the lower levels of the FLRM, with 90% of them at level 1 and 10% at level 2 (as shown in pie chart 1). All of Thula's ideas were all general (versus mathematical), as shown in pie chart 2.

## Presenting and analysing Alice's S1 reflections

*Alice's S1 reflections*

**Mathematical and meta-mathematical ideas**

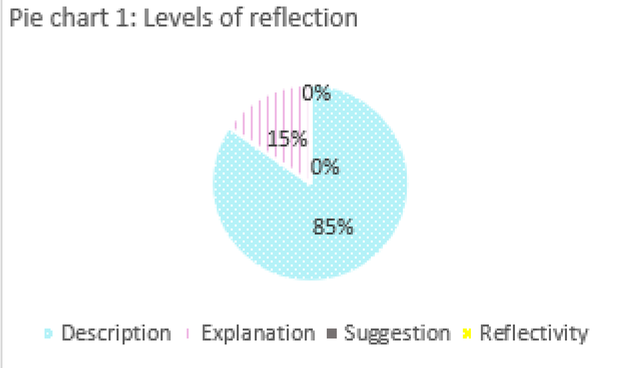
*1. The teacher dealt with subtraction MD 2. as well as addition MD. 3 and introduced mathematical terms such as "more" and "less" MD. 4. She used the actual umbrella GD→E 5* ***so that*** *the learners can visually see the concept. GE*

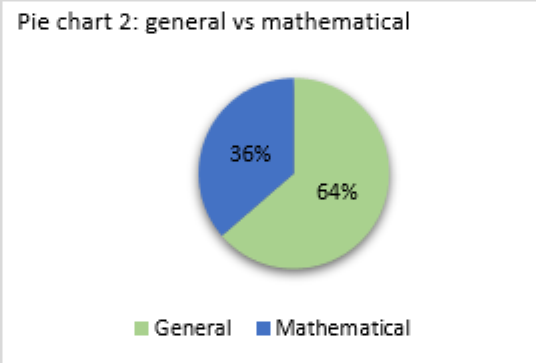
***Tasks and activities***

*6. The teacher used an actual umbrella GD→E 7.* ***to get*** *the learners involved in the lesson. GE 8. Each learner was given a chance to be involved in this lesson. GD 9. Learners were either under the umbrella, holding number cards (more/less) MD 10 or answering questions. GD 11. The teacher did not tell someone that they are wrong GD 12 but helped correct their answer. GD. 13 She also praised the learner when they got the answer right GD*

*Summaries of reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE' | ME | ME' | GS | GS→E | MS | MS→E | GR | MR | |
| 5 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 7 | | 4 | | 2 | | 0 | | 0 | | 0 | | 0 | | 13 |
| 11 | | | | 2 | | | | 0 | | | | 0 | | 13 |




Alice wrote thirteen coded ideas using the two lenses assigned to her group. Eleven of the thirteen ideas were descriptions and two were explanations. There were no suggestions or ideas displaying reflectivity. Seven of the eleven descriptions were GDs while four were MDs. Two of the seven GDs were followed by explanations resulting in two GEs, simple with no expansion. None of the mathematical descriptions was followed by an explanation. Alice's reflections were therefore all at the lower levels of the FLRM. As shown in pie chart 1, 85% of the reflections were at level 1 and the remaining 15% were at level 2. 64% of her reflections were general and only 36% were mathematical, as shown in pie chart 2.

## Presenting and analysing Lutho's S1 reflections

*Lutho's S1 reflections*

***Mathematical and meta-mathematical***

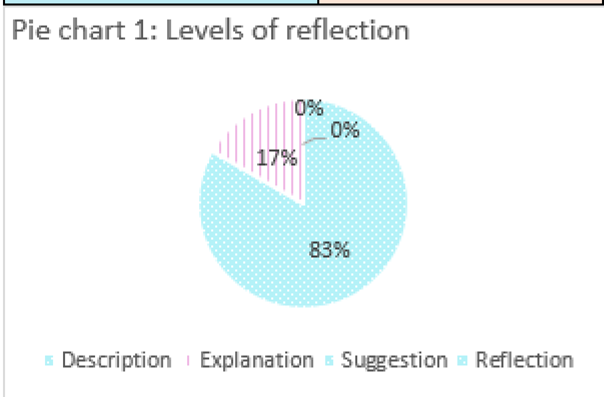
*1. The teacher brought the concept of addition and subtraction in the class. MD 2. She explained the concepts by using the words more, less, least, etc. MD 3. The meta mathematical notation evident were clarifying MD, 4 giving reason and justifying MD*

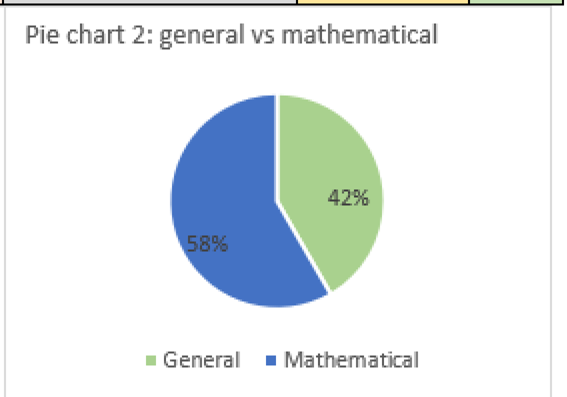
***Tasks and activities***

*5. She started by asking the learners what they see. GD 6. From then she involved language incorporated in maths. MD 7. She asked the children to count up to 5. MD 8. Then she elaborated on the number 5 firstly by using concrete apparatus which were the five children MD. 9. and then asking the learners on the mat questions $GD^{\to E}$ 10* ***so that*** *they may be involved in the lesson. GE. 11. Benefits – children are actively involved. GD. 12. Pitfalls – too many concepts are introduced at the same time GD*

*Summaries of Lutho's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 3 | 1 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 4 | | 7 | | 1 | | 0 | | 0 | | 0 | | 0 | | 12 |
| 11 | | | | 1 | | | | 0 | | | | 0 | | 12 |




Lutho wrote twelve coded ideas using both lenses assigned to the group. Eleven of the twelve ideas were descriptions and one was an explanation. There were no suggestions and no ideas demonstrating reflectivity. Seven of the eleven descriptions were mathematical and four were general. Only one GD was followed by an explanation, resulting in the sole GE. Lutho's reflections were at the lower levels of the FLRM (as shown in pie chart 1), with 83% at level 1 and 17% at level 2. There were no reflections at levels 3 and 4. 58% of her reflections were mathematical while 42% were general (see pie chart 2).

## Presenting and analysing Mandy's S1 reflections

*Mandy's S1 reflections*

***Mathematical and meta-mathematical ideas***

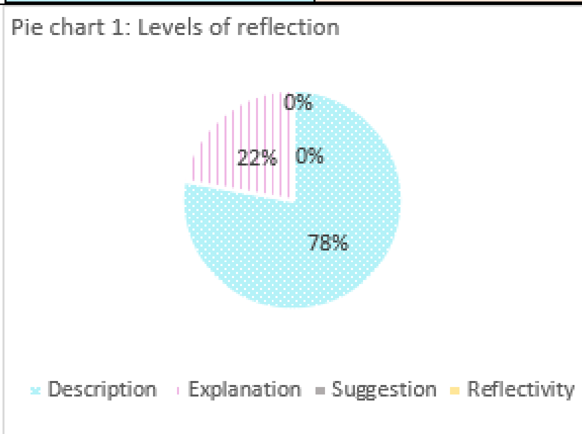
*1. My idea with this one is the idea behind more, less and many MD 2 and how they are differentiated through the lesson with the umbrella. MD 3. And the introducing of the mathematical terms of more, less, many and none, MD 4. and how they are placed together with the number of children MD*

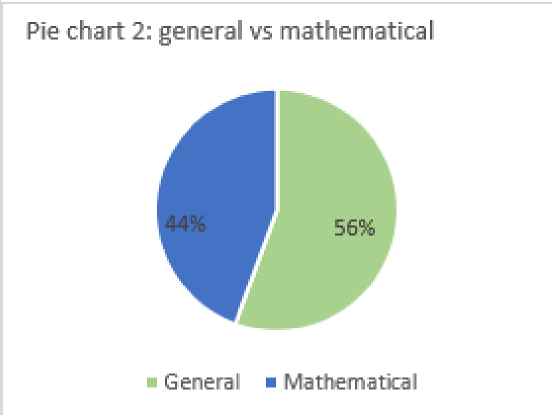
***Tasks and activities***

*5. The teacher made her lesson very active GD 6. while the learners were very actively involved in the lesson GD$^{\to E}$ 7* ***in order*** *for the teacher to put her point across in the lesson. GE 8. The idea to make the lesson more active is a life like representation GD$^{\to E}$ 9* ***to allow*** *the learners to grasp the aim of the lesson. GE*

*Summaries of reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{a}$ | ME | ME$^{a}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 1 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 3 | | 4 | | 2 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 7 | | | | 2 | | | | 0 | | | | 0 | | 9 |




Mandy reflected using both lenses assigned to her group and wrote nine coded ideas. Seven were descriptions and two were explanations. There were no suggestions and no ideas displaying reflectivity. Four of the seven descriptions were mathematical and three, general. Two of the three GDs were followed by an explanation leading to two GEs at level 2. Mandy's reflections were still at the lower levels of the FLRM, with 78% at level 1 and 22% at level 2. Her reflections were 56% general and 44% mathematical, as shown in pie chart 2.

## Presenting and analysing Smith’s S1 reflections

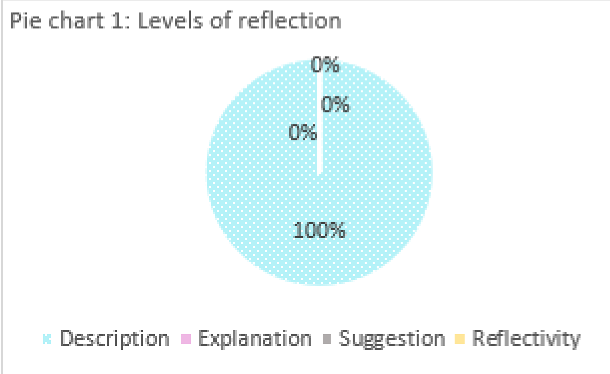
*Smith’s S1 reflections*

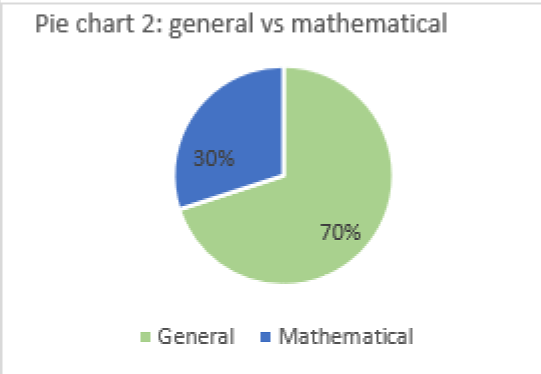
***META-MATHEMATICAL***

*The teacher painted the lesson out nicely according to the story being read. GD 2. It was very physical lesson plan GD 3 that allowed learners to participate either by standing under an umbrella GD 4 or collecting the number name. MD 5. There was a lot of repetition GD 6. and the story ran in a sequence. GD 7. The activity done moving the learners under the umbrella linked up to the stories read. GD 8. This activity incorporates maths MD 9. and getting familiar with number names. MD 10. The teacher allowed interaction which involved all learners GD.*

*Summaries of Smith’s S1 reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{-E}$ | GE | $GE^{c}$ | ME | $ME^{c}$ | GS | $GS^{-E}$ | MS | $MS^{-E}$ | GR | MR | |
| 7 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 7 | | 3 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 10 | | | | 0 | | | | 0 | | | | 0 | | 10 |




Smith reflected using one of the two lenses assigned to the group (MMI) and wrote ten coded ideas. All ten ideas were descriptions, meaning there were no explanations, suggestions or ideas displaying reflectivity (as shown in pie chart 1). Seven of the ten descriptions (70%) were general and three (30%) were mathematical (pie chart 2). All of Smith’s reflections (100%) were therefore located at the lowest level of the FLRM.

## Presenting and analysing Vee's S1 reflections

*Vee's S1 reflections*

***Mathematical and meta-mathematical ideas***

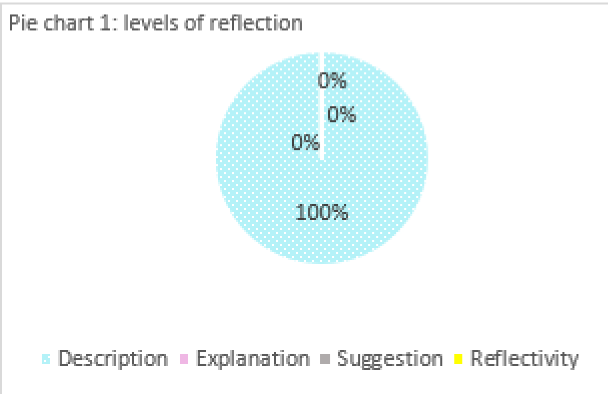
*1. The idea of counting onwards and backwards. MD 2. Less and more. MD 3. Addition and subtraction MD. 4. Learners are able to recognize numbers MD 5. and they represent (numbers) in words and numerical. MD 6. They have a sense of number operations MD 7. and understand the vocabulary GD*

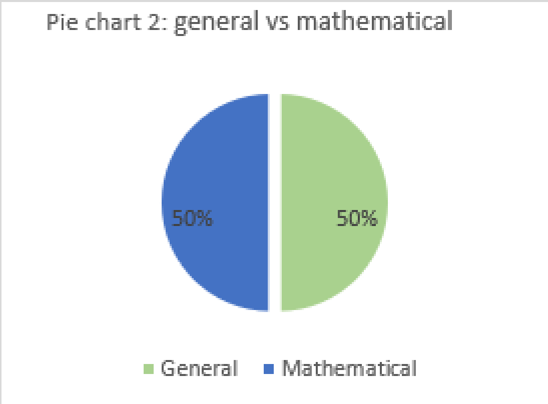
***Tasks and activities***

*8. The teacher introduces the tasks by first introducing the materials GD 9 and new terminology for the learners. GD 10. The task is done step by step GD 11 and [she gives] clear instruction. GD 12. Mostly the tasks need involvement of the learners GD. 13. The activity is both read (vocabulary) GD 14 and mathematical sums which are appreciate for grade 3 learners. MD.*

*Summaries of Vee's S reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^s | ME | ME^s | GS | GS→E | MS | MS→E | GR | MR | |
| 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 7 | | 7 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 14 | | | | 0 | | | | 0 | | | | 0 | | 14 |




Vee reflected using both of the lenses assigned to her group and recorded fourteen ideas. All were descriptions, as displayed in pie chart 1. There were no explanations, suggestions or ideas displaying reflectivity. Thus all her reflections were at level 1, the lowest level of the FLRM (see pie chart 1). Half (50%) of the reflections were mathematical and half general (see pie chart 2).

### 5.1.1.3 Presentation and analysis of PST Group 3's reflections

Group 3 comprised Bonga, Lee, Ronny and Tiny. This group was assigned the lenses: Dilemmas and decision-making (DDM) and Beliefs about mathematics teaching (which I will call Beliefs from now onwards). Figure 5.4 shows an excerpt from the handout with notes on the DDM and Beliefs lenses that Group 3 of the PSTs used for reflection.

| | | |
|---|---|---|
| Dilemmas and decision-making | Uncovering situations of dilemma (i.e., when there is no evident optimal course of action) that the filmed teacher seemed to have faced during the lesson. Discussing the decisions taken in order to resolve these dilemmas, and their consequent trade-offs. | • Did you notice a dilemma during the lesson? What did the teacher decide to do? Are there alternatives you can think of for this decision? • What may be the constraints and affordances of the teacher's choice, and of the suggested alternative paths? |
| Beliefs about mathematics teaching | Eliciting orientations, beliefs and values that may be attributed to the filmed teacher on the basis of the video. Unpacking implicit messages that may be conveyed to students through the teacher's communications and actions. | • What may be the filmed teacher's views about the nature of mathematics as a discipline? • How does the teacher perceive her role? What may be her ideas about what "good mathematics teaching" is? What does she think about the students' role as learners? |

*Figure 5. 4: Six lens framework excerpt on dilemmas and decision-making and beliefs about mathematics teaching*

Below I present the written reflections of each member of PST Group 3, summaries of the coding, pie charts and analysis of their reflections.

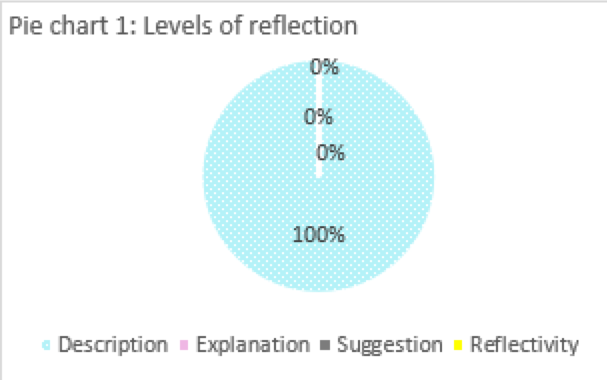
**Presenting and analysing Bonga's S1 reflections**

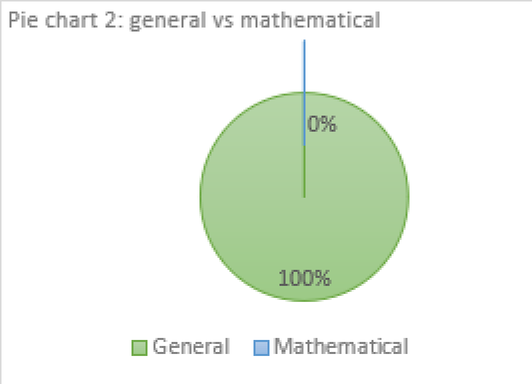
*Bonga's S1 reflections*

*The children were familiar with the story GD 2. therefore, it was fun GD. 3. She asked questions GD 4. and all the children wanted to answer GD. 5. Then she told them she needs one learner and she will choose a learner who is making noise and not following rules GD. 6. She also had problems with a learner that did not know the right answer GD. 7. She used the children to correct each other GD 8. and wanted them to take turns when speaking GD 9 or working. GD*

*Summary of Bonga's S1 reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$\to^{E}$ | MD | MD$\to^{E}$ | GE | GE$^{c}$ | ME | ME$^{c}$ | GS | GS$\to^{E}$ | MS | MS$\to^{E}$ | GR | MR | |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 9 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 9 | | | | 0 | | | | 0 | | | | 0 | | 9 |




Bonga did not indicate the lenses he was using for reflection. However, his group had been asked to reflect using DDM and Beliefs. He wrote nine coded ideas that were all general descriptions. As shown in pie chart 1, there were no explanations, no suggestions and no instances of reflectivity. Thus, Bonga's reflections were all at the lowest level 1 of the FLRM. As pie chart 2 depicts, 100% of his reflections were general, since there were no mathematical ideas.

## Presenting and analysing Lee's S1 reflections

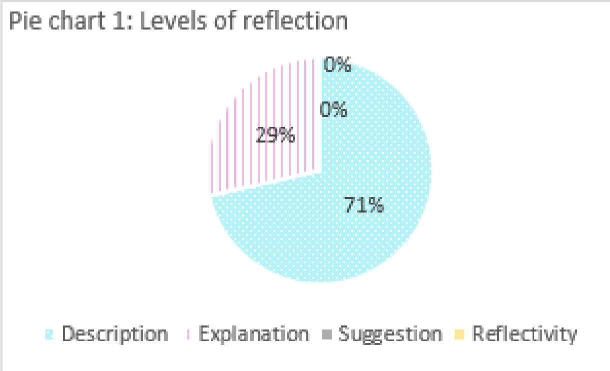
***Lee S1 reflections***

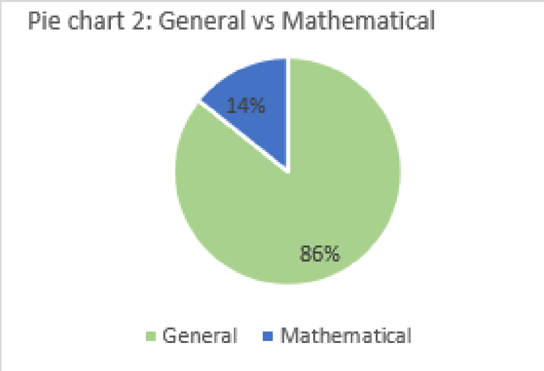
***Decision making***

*1. What I have noticed in the video is that the teacher makes a decision very quick GD 2 and acts on them. GD. 3 Learners are allowed to decide on their own answers GD 4 For example the boy that decided to take many instead of more. MD. This shows us the decision making that are taken by the teacher explain when she had to choose who will give her answer. UN. 5. She also decides to involve all the learners in different way GD. 6. she took decision as the boss of the classroom. GD$^{\to E}$ 7 She took decisions basically for management behaviour 7b and classroom discipline GE$^{e}$*

***Summaries of Lee S1 reflections***

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 4 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 5 | | 1 | | 1 | | 0 | | 0 | | 0 | | 0 | 0 | 7 |
| 6 | | | | 1 | | | | 0 | | | | 0 | | 7 |




Lee wrote seven coded ideas using one of the two lenses assigned to the group. Six out of the seven ideas were descriptions, two were explanations and there were no suggestions and no reflectivity. Five out of the six descriptions were general, one of them followed by an explanation. One of the six descriptions was mathematical but not followed by any explanation. Lee also recorded one idea that was not clear enough for me to code. Lee's reflections were at the lower levels of the FLRM, 71% at level 1 and 29% at level 2 (see pie chart 1). The reflections were comprised mostly of general ideas (86%) rather than mathematical ones (14%) (as shown in pie chart 2).

## Presenting and analysing Ronny's S1 reflections

*Ronny's S1 reflections*

***Dilemmas and decisions***

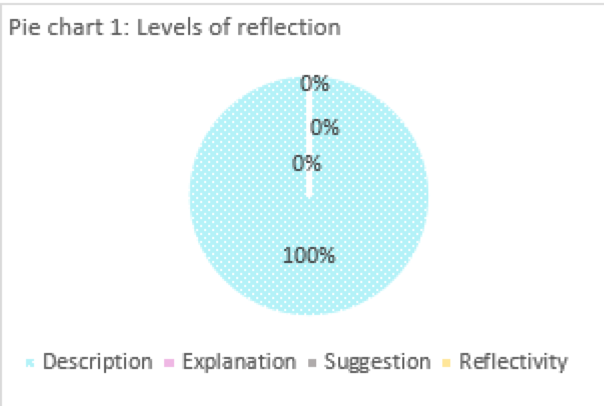
*1. In the video there are not really big dilemmas. GD 2. The only dilemmas there are is that all the children wanted to participate GD 3 and answered at the same time GD 4. so she just had to do a bit of class management GD*

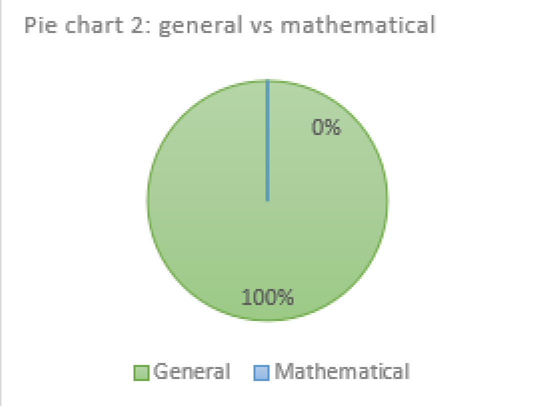
***Beliefs***

*5. The teacher has a very positive belief to the children. GD 6. She has a very big inquiry based approach to teaching GD 7. and makes the children alive most of the session. GD*

*Summaries of Ronny's S1 reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{-E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{-E}$ | MS | $MS^{-E}$ | GR | MR | |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 7 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 0 | 7 |
| 7 | | | | 0 | | | | 0 | | | | 0 | | 7 |




Ronny reflected using both of the lenses assigned to his group and wrote down seven ideas. All the ideas were descriptions, meaning that there were no explanations, suggestions or ideas demonstrating reflectivity. His reflections were all therefore at the lowest level of the FLRM, as shown in pie chart 1. 100% were general reflections and there were no mathematical reflections (see pie chart 2).

## Presenting and analysing Tiny's S1 reflections

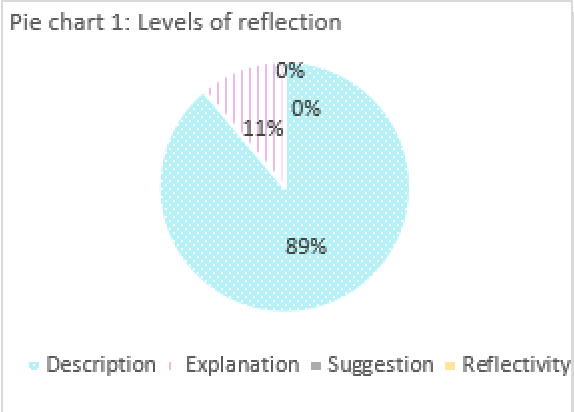
*Tiny's S1 reflections*

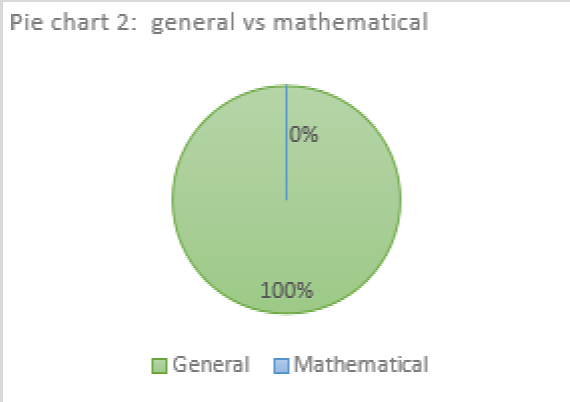
***Dilemmas and Decisions***

*A dilemma during the lesson was that all the children were wanting to participate and answer. GD 2. The teacher had to make a decision on how to deal with it GD 3 and being fair to the learners GD 4. The teacher handled the situation well GD 5. and was able to keep the children quiet $GD^{\rightarrow E}$ 6 by saying they won't participate if they talk. GE 7. The teacher got the children involved in the lesson. GD 8. She was very positive towards the children GD.*

*Summaries of Tiny's reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | GE' | ME | ME' | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 6 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 7 | | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | 0 | 8 |
| 7 | | | | 1 | | | | 0 | | | | 0 | | 8 |



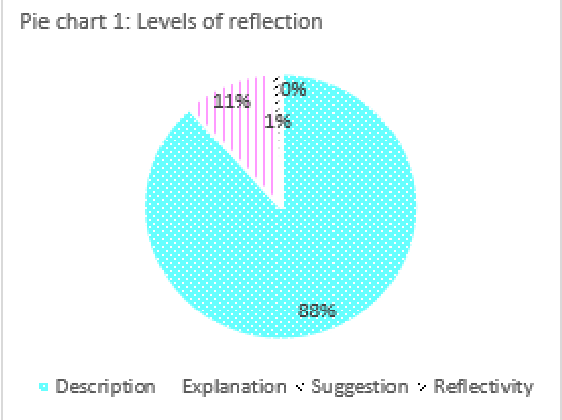

Tiny reflected using one of the two lenses assigned to her group (DDM) and wrote eight coded reflections. Seven of the eight ideas were descriptions; there was one explanation and no suggestions and no reflectivity. Tiny's reflections thus fell on the lower levels of the FLRM, with 89% of her reflections at level 1 and 11% at level 2 (pie chart 1). All her reflections were general, as shown in pie chart 2

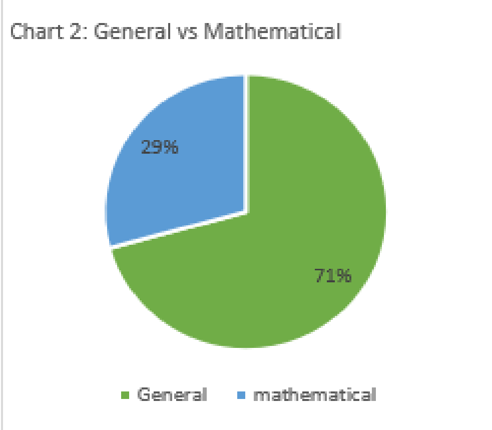
### *5.1.1.4 General overview of session one reflections*

In the above section I presented and analysed the 18 PSTs' S1 reflections with the aim of identifying the nature of the reflections they wrote down as they analysed the Grade R Umbrella story video-recorded lesson. In this section I provide an overview of the PSTs' S1 reflections in order to draw some general conclusions about the reflections of PSTs as they engaged in their first reflective practice lesson. Table 5.4 provides summaries of the coding of all eighteen PSTs' written reflections in S1.

*Table 5. 4: Overview summaries of the 18 PSTs' S1 reflections*

| Name of PST | Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{c}$ | ME | $ME^{c}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | Total |
| Alice | 5 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Bonga | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Charity | 7 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Dee | 0 | 0 | 10 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Joy | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Langa | 3 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 10 |
| Lee | 4 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Lethu | 6 | 2 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Liz | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Lutho | 3 | 1 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Mandy | 1 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Marylyn | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Micky | 8 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Ronny | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Smith | 7 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Thula | 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Tiny | 6 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Vee | 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Total | 98 | 16 | 49 | 3 | 12 | 5 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 188 |
| | 114 | | 52 | | 17 | | 3 | | 2 | | 0 | | 0 | 0 | 188 |
| | 166 | | | | 20 | | | | 2 | | | | 0 | | 188 |




Analysis of Session 1 reflections

As seen in the summaries in Table 5.4, above, the 18 PSTs produced a total of 188 coded ideas, of which 166 were descriptions, 20 were explanations, and only two were suggestions. There were no ideas demonstrating reflectivity. The only two suggestions of a general nature (GS) came from the same PST. Of the 166 descriptions, 114 were GDs, with 16 of them followed by explanations. Only 52 of the 166 descriptions were mathematical (MDs) and a mere three of these were followed by explanations. One of the two suggestions was followed by an explanation. There were only 20 explanations (level 2) in total. Thus the 18 PSTs' reflections were largely coded at the lowest level of the FLRM. As shown in pie chart 1, 88% of the PSTs' reflections were at level 1, 11% were at level 2 and 1% were at level 3. As indicated in pie chart 2, 71% of the PSTs' reflections were general and 29% were mathematical. Thus, PSTs' reflections in this first S1 were mostly descriptive and general.

In Figure 5.5 the individual pie charts of the 18 PSTs are presented to provide a quick overview of the nature of the reflections in which they engaged during S1. The dominating blue colour (representing level 1, description) in the individual pie charts shows that the PSTs were generally reflecting at the lower levels of the FLRM during S1. For six out of the 18 PSTs, all their reflections were categorised at level 1. Although 11 of 18 PSTs wrote explanations for some of the classroom events they identified, the proportion of explanations among their ideas was low, ranging from 0% to 30%. Also, as mentioned earlier, only one PST (Langa) made two suggestions, both of them general and linked to the introduction of the story rather than to the mathematical unfolding of concepts in the lesson. Thus, Langa wrote *She [the teacher]* ***may had to*** *explain the role of rain in our lives GS 8 and why we should not get wet,* $GS^{\rightarrow E}$, *9* ***as to why*** *there were umbrellas in the story.*

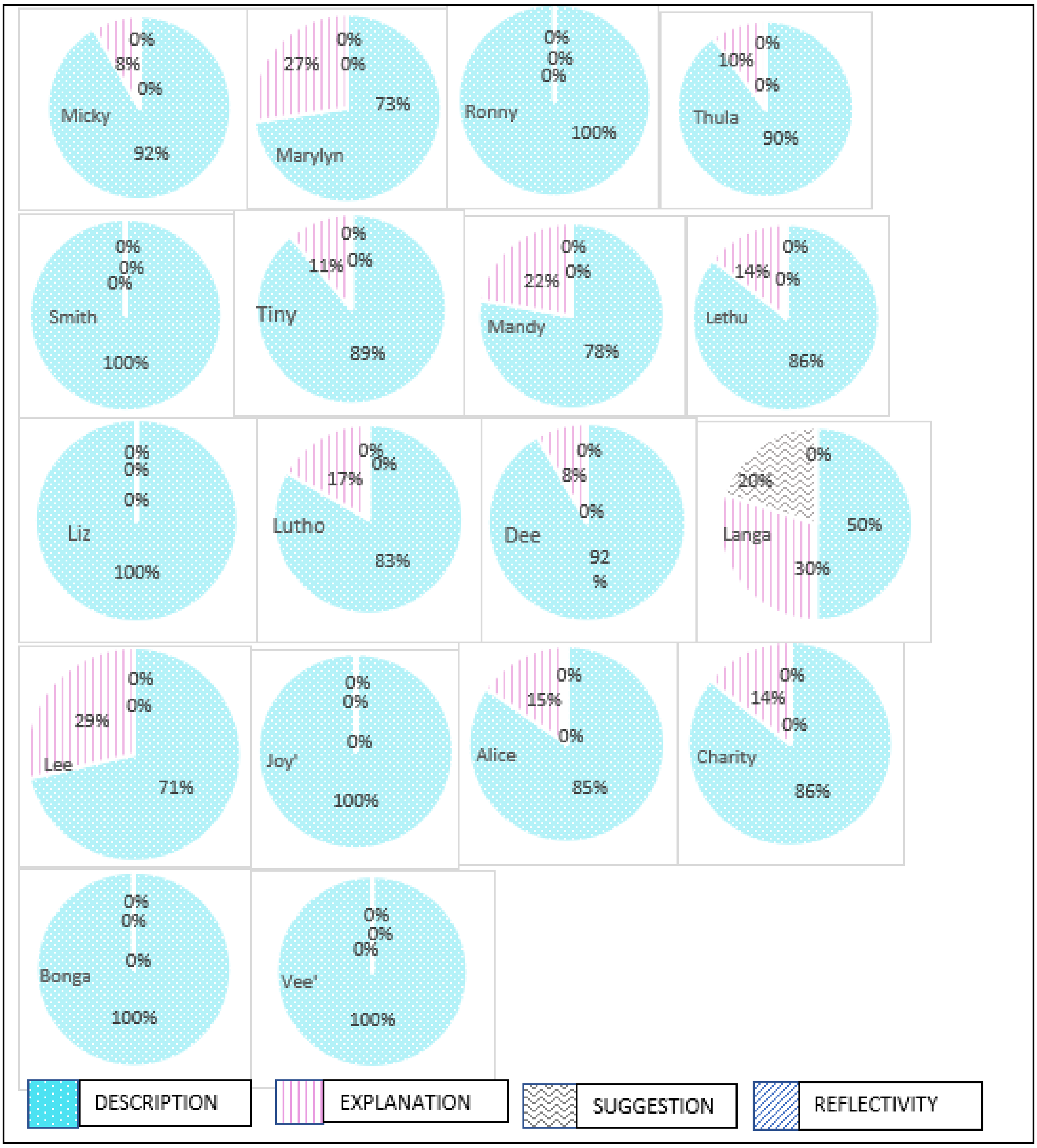



*Figure 5. 5: Overview summary of PSTs' S1 levels of reflection*

In a similar way, in Figure 5.6, below, I put together the pie charts of all 18 PSTs to show the relative proportions of general and mathematical reflections. The predominance of the green colour representing general reflections indicates that the majority of their reflections were general.

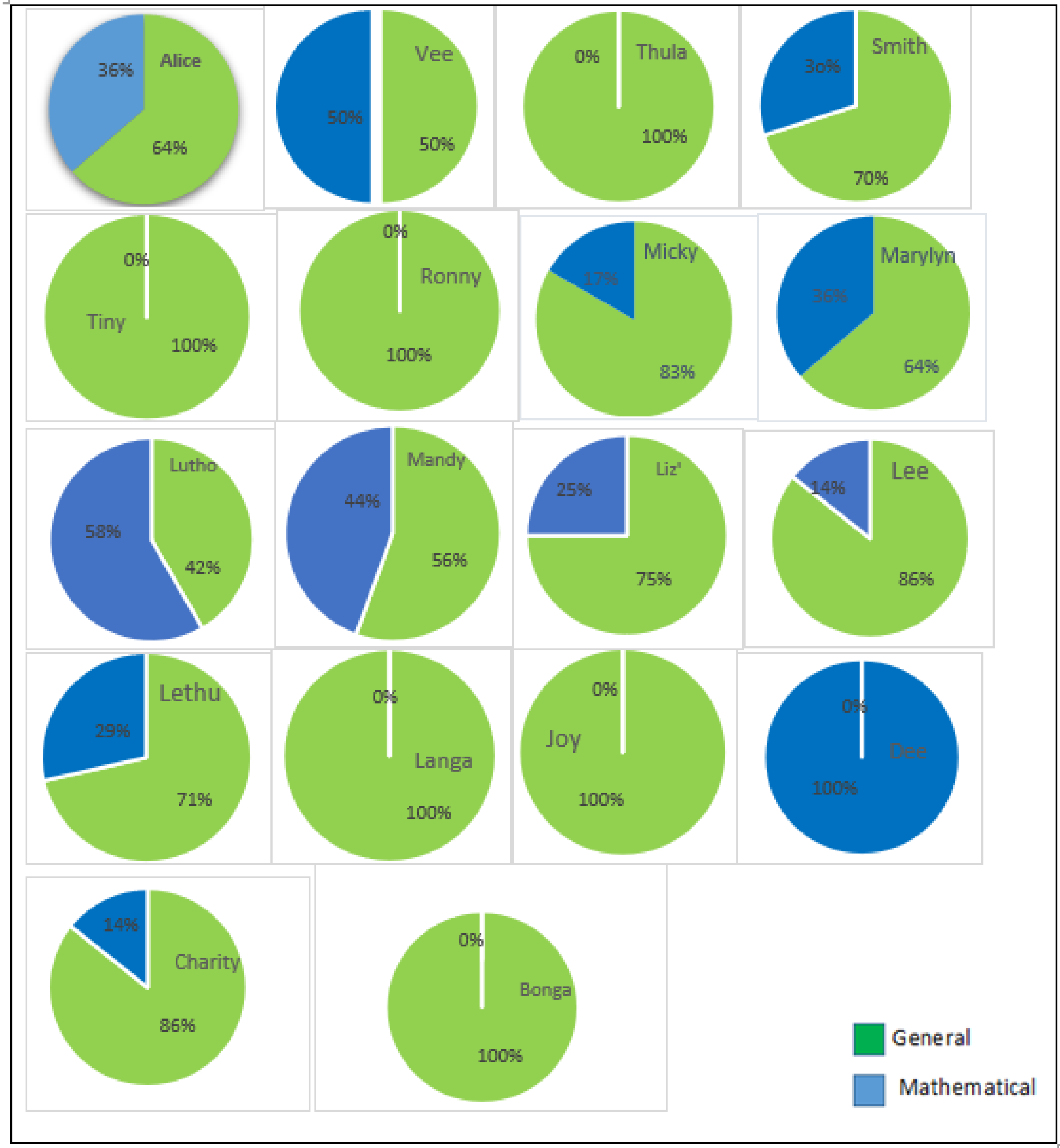



*Figure 5. 6: Overview summaries of S1 PSTs' reflections: general versus mathematical*

As seen in Figure 5.6, six of the 18 PSTs recorded ideas that were 100% general while only one PST wrote reflections that were 100% mathematical. The remainder (11 out of 18) wrote down reflections that were both the general and mathematical. General reflections dominated proportionately except in the cases of Vee and Lutho, who achieved 50% and 58% mathematical reflections, respectively. To conclude this section, it is safe to say that PSTs' S1 reflections were at the lower levels of the FLRM and were mostly descriptive (at level 1) and general.

#### *5.1.1.5 Session 1 summary remarks*

In this section I presented and analysed the 18 PSTs' written reflections for S1. During this session, PSTs reflected using the two lenses assigned to each group. Analysis of their written reflections showed that most their reflections were at the lower level of the FLRM. As indicated in section 5.1.1.4 above, 88% of the 18 PSTs' reflections were at level 1, 11% were at level 2 and only 1% was at level 3. There were no reflections (0%) at level 4. The PSTs' reflections were generally descriptive, with only 11% of these descriptions being followed by explanation. The only PST who made suggestions did not make any suggestions capable of improving the teaching and learning of mathematics. Overall analysis of the reflections revealed that 71% were general and only 29% were mathematical. In the next section I present the S2 reflections, with the aim of establishing the nature of the reflections in which PSTs engaged in their second experience of analysing video-recorded mathematics lessons to develop their reflective practice.

### 5.1.2 Presentation and analysis of Session 2 data

In this section, considerations of space prevent me from presenting the PSTs' reflections in full. Rather, I present tabled summaries of the coding of the 19 PSTs' written reflections for S2 and provide excerpts from their full written reflections. (A sample of S2 reflections is found in Appendix 3.1). The coding summary tables are accompanied by two pie charts for a quick visual representation of the coded PSTs' reflections according to levels and in terms of general versus mathematical.

The stimulus for this second session's reflections was a Grade 1, five-and-a-half-minute long video-recorded mathematics lesson snippet entitled 'K1 Ten frames and dot cards' found on YouTube. (I did not obscure the faces of people in the video because it is freely accessible.) I begin the section by providing a brief summary of this video-recorded lesson to orientate the reader since all the reflections in this section relate to it. At the end of the section I provide a visual overview of all 19 PSTs' S2 reflections. In Figure 5.7, below, appears a brief summary of the Grade 1 lesson snippet that was used as a stimulus for PSTs' written reflections.

*Learners are sitting on the mat at the front of the classroom with the teacher sitting in front of them on a chair, holding a deck of cards. The teacher tells learners not to yell out their answers but put a thumb on their chest to indicate they have an answer and would like to talk. She pulls out one card (see picture 1) from the deck of flash cards she is carrying, shows it to all the learners and puts it away. She asks the learners what they have seen and how they have seen it. Learners give answers and justify their responses. She pulls out another card (like the one in picture 2, below), shows it to the learners and puts it away. She asks the learners what they saw. Learners give responses and the teacher asks them to explain how they saw the 'ten' from the ten frames. She then pulls out a third card (like the one in picture 3, below) and again shows it to the learners, puts it away and asks them what they saw and how they saw it. Learners respond and explain how they got the answers. She pulls out a fourth card (see picture 4) and again asks the learners to share what they have seen and how they have seen it. Learners respond accordingly.*

Picture 1

Picture 2

Picture 3

Picture 4

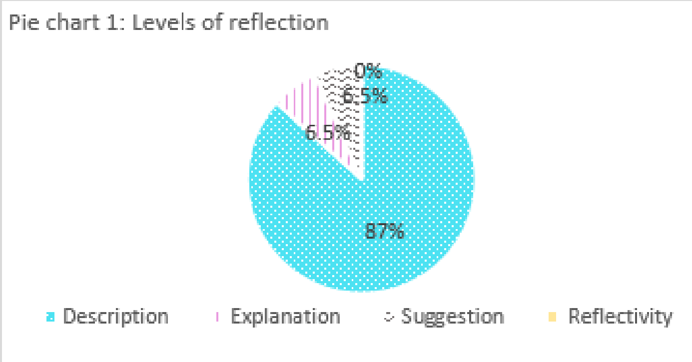
*Figure 5. 7: Summary of the Grade 1 lesson with screenshots of the teacher in the lesson showing learners the ten frames and dot cards*

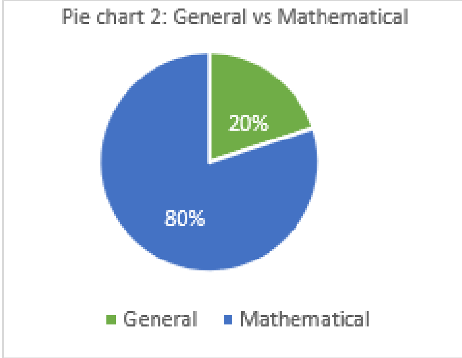
On the day when the S2 data was generated and collected, the lecturer began the lecture with a quick run through of the SLF which she had introduced during S1. She gave out the printed slides (Appendix 2.2) she was using to remind the PSTs about SLF. The lecturer introduced the video-recorded lesson snippet and played it twice. She played it for the first time to familiarise the PSTs with the lesson. On the second play, she asked the PSTs to reflect individually on the lesson using the three SLF lenses that she assigned them. The lenses assigned to all the PSTs were MMI, Tasks, and Goals. The PSTs were also reminded that they should refer to the SLF handout they were given during S1. Since I reproduced this handout in the above section when presenting S1 reflections, I will not present it again (but see Appendix 2.1). Below I present the individual PST's S2 written reflections and their analysis.

**Summary and analysis of Alice's S2 reflections**

Summary of coding Alice's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 3 | 0 | 9 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 15 |
| 3 | | 10 | | 0 | | 1 | | 0 | | 1 | | 0 | | 15 |
| 13 | | | | 1 | | | | 1 | | | | 0 | | 15 |



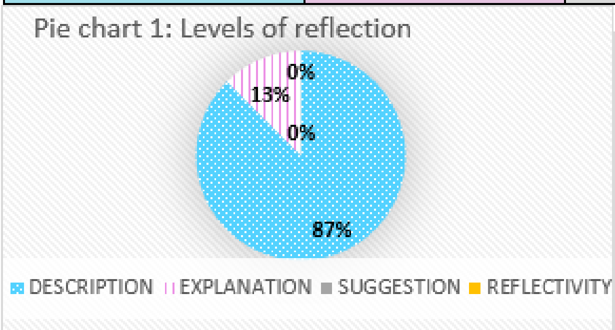



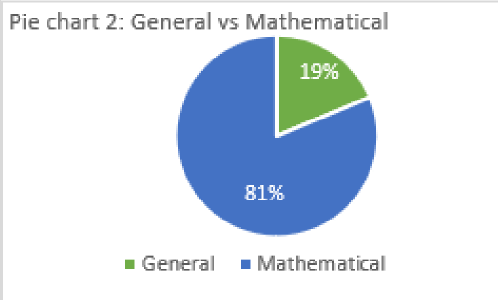

Alice only used two lenses (MMI and T&A) instead of the three lenses assigned to the class. She wrote 15 coded ideas. Of these 15 ideas, 13 were descriptions, one was an explanation and one was a simple mathematical suggestion (MS). For the suggestion Alice wrote *One **could have** introduced adding and subtracting numbers in the 10 frames* (Alice S2. C12). As seen in the coding summary table, above, there were no reflective ideas. Three out of Alice's thirteen descriptions were GDs and only one of these was followed by an explanation, though without analysis. An example of a GD: *Teacher asked what they saw on the cards* (Alice S2. C13). The following is one of three GDs which showed some level of analysis: *Learner could have been repeating what their friends said without actually knowing the answer* (Alice S2. C15). At the same time Alice wrote ten MDs, only one of which was followed by an explanation. In this case she wrote, *The learners had to recognise the numbers on the cards without counting. I think **this would** help them to see numbers clearly* (Alice S2. C9 & C10). The first idea was coded as MD followed by an explanation, while the second was coded as a simple explanation. This was the only explanation written by Alice. Thus, as shown in pie chart 1, Alice's reflections were at the lower levels of FLRM, with 86% of her reflections at level 1, and 7% at each of levels 2 and 3. None of Alice's reflections were coded at level 4. However, 75% of her reflections were mathematical and only 25% general (see pie chart 2).

**Summary and analysis of Bonga's S2 reflections**

Summary of coding Bonga's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→$^{E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 1 | 1 | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| 2 | | 12 | | 1 | | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| 14 | | | | 2 | | | | 0 | | | | 0 | | 16 |



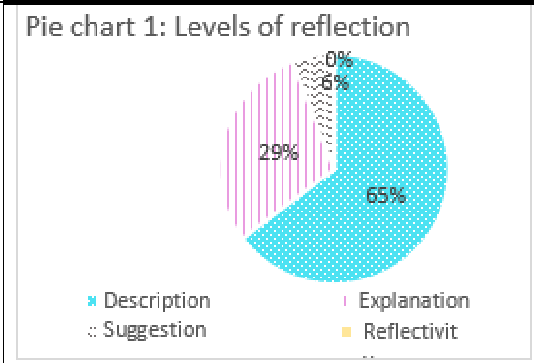



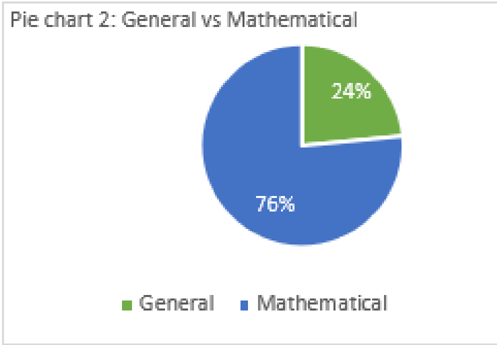

Bonga wrote sixteen coded ideas using all three lenses assigned to the class. Fourteen of the sixteen ideas were descriptions, two were explanations, and there were no suggestions or reflectivity. Two of the fourteen descriptions were GDs and one of these GDs was followed by an explanation. He wrote *There were moments when the goal shifted* ***because*** *the children could not reason their answers* (Bonga C14 & C15). The first idea was a GD while the second idea was an explanation. Twelve of the fourteen descriptions were MDs and only one was followed by an expanded explanation: *The teacher had to get the learners to count* ***in order to be able*** *to assess learners and recognise more numbers* (Bonga C10 & C11). I coded the first idea MD while the last two were explanations. Thus, Bonga's reflections were at the lower levels of the FLRM. As shown in pie chart 1 above, 87% of Bonga's reflections were at level 1 while only 13% were at level 2. He did not record any ideas at levels 3 and 4. However, 81% of Bonga's ideas were mathematical and only 19% were general (see pie chart 2).

## Summary and analysis of Charity’s S2 reflections

Summary of coding Charity’s reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | GE* | ME | ME* | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 2 | 1 | 5 | 3 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 17 |
| 3 | | 8 | | 1 | | 4 | | 0 | | 1 | | 0 | | 17 |
| 11 | | | | 5 | | | | 1 | | | | 0 | | 17 |



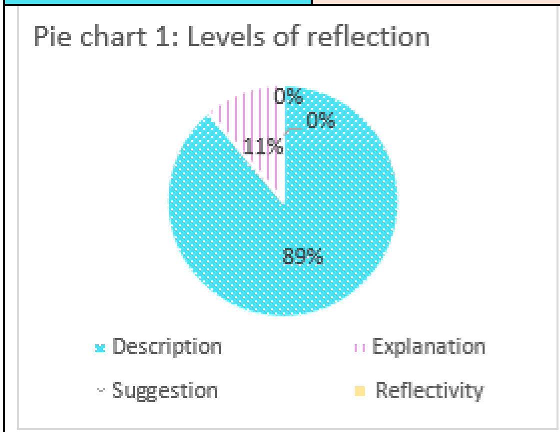

Charity wrote seventeen coded ideas using all three lenses assigned to the class. Eleven out of the seventeen ideas were descriptions, five were explanations and one was a suggestion. She did not record any idea that displayed reflectivity. Three of the eleven descriptions were GDs and one of these GDs was followed by a simple explanation: *She also asked the learners to justify their answer* ***because*** *asking the learners how they came up with those answers make them understand”* (Charity S2. C8 & C9). On the other hand, eight out of the eleven descriptions were MDs. Three of these MDs were followed by explanations, and one of these explanations was expanded with three ideas. She wrote: *[one of the MMI was] mental maths= subtising*[5]*:* $MD^{\to E}$ *4 because the teacher showed the learners dots on cards and they had to look at it and tell the teacher the answer instantly.* She also came up with one MS followed by an explanation when she wrote: *The teacher could also have focused on some bonds* $MS^{\to E}$ *6* ***because*** *one of the learners incorporated bonds of 10* (Charity S2. C5 & C6). Thus, Charity’s reflections stretched across the first three levels of the FLRM although they were mostly at the lower levels of the model. As shown in pie chart 1, 65% were at level 1, 29% at level 2 and 6% at level 3. There were no reflections at level 4. Analysis of general reflections versus mathematical showed that 76% of the reflections were mathematical and 24% were general (see pie chart 2).

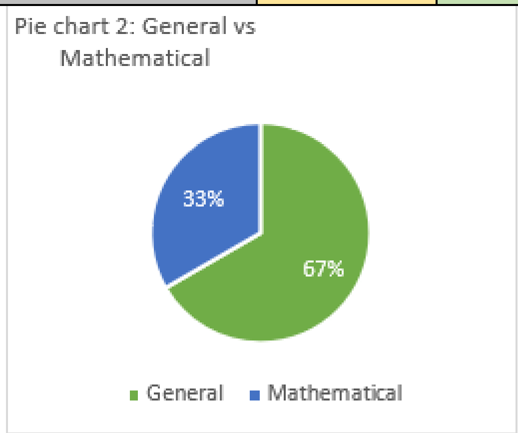
[5] Ability to see the number of items without counting them.

**Summary and analysis of Dee's S2 reflections**

Summary of coding Dee's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS→E | MS | MS→E | GR | MR | |
| 4 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 5 | | 3 | | 1 | | 0 | | 0 | | 0 | | 0 | 0 | 9 |
| 8 | | | | 1 | | | | 0 | | | | 0 | | 9 |



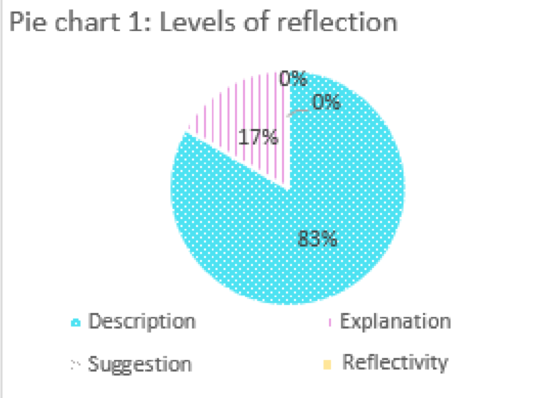



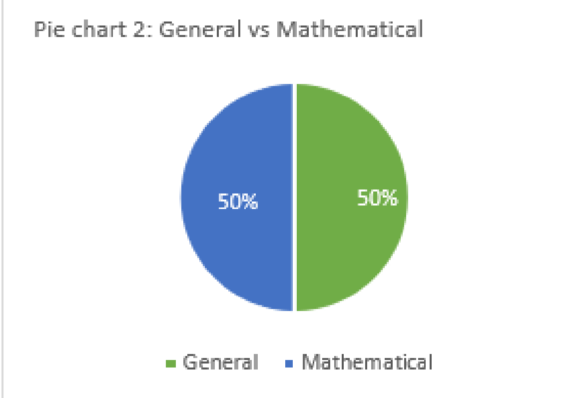

Dee wrote nine coded ideas using two of the three assigned lenses (MMI & Tasks). Eight of the nine were descriptions, and one was an explanation. There were no suggestions or ideas that showed reflectivity. Three of the eight descriptions were MDs, such as *The main idea the teacher is teaching is recognising the number of dots by subtising*[1] (Dee S2. C1). None of these MDs was followed by an explanation. The other five were descriptions were GDs and only one of these was followed by an explanation. She wrote: ... *but used different sources to expand on the lesson.* ***She did this so that*** *she could easily see the learners who had grasped the content 9b and those who still needed more time GE*$^{e}$ (Dee S2. C8 & C9). Thus, Dee's reflections were at the lower levels of the FLRM. As shown in pie chart 1, 89% of Lee's reflections were at level 1 and only 11% at level 2. There were no ideas at levels 3 and 4. At the same time, 67% of Dee's reflections were general and 33% were mathematical (see pie chart 2).

**Summary and analysis of Dumie's S2 reflections**

Summary of coding Dumie's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^e$ | ME | ME$^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 2 | 2 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 4 | | 6 | | 2 | | 0 | | 0 | | 0 | | 0 | 0 | 12 |
| 10 | | | | 2 | | | | 0 | | | | 0 | | 12 |



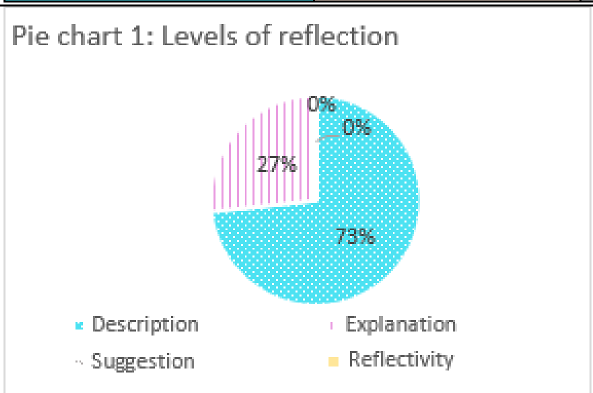



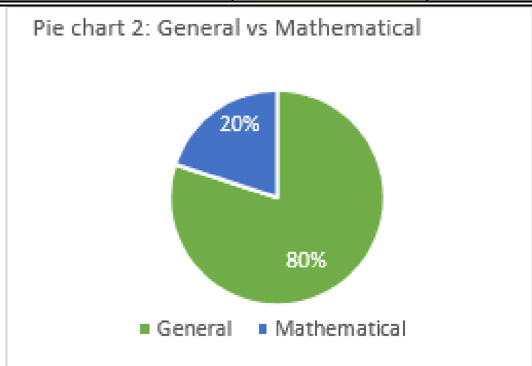

Dumie recorded twelve coded ideas using two of the three lenses assigned to the class, MMI and Tasks. Ten out of the twelve ideas were descriptions and only two were explanations. There were no suggestions and no ideas displaying reflectivity. Four of the ten descriptions were GDs and two of these were followed by explanations, for example: *They were able to give reason why they chose their answer.* ***By doing*** *that they are able to correct* themselves (Dumie S2. C6 & C7). Six out of the ten descriptions were MDs that were not followed by explanations, for example: *The teacher was teaching the learners to compare numbers* (Dumie S2. C1). Dumie's reflections were thus all at the lower levels of the FLRM. As shown in pie chart 1, 83% of his reflections were at level 1 and 17% were at level 2. There were no reflections at levels 3 and 4. In pie chart 2 we see that 50% of his reflections were mathematical and 50% general.

**Summary and analysis of Joy's S2 reflections**

Summary of coding Joy's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | |
| 6 | 3 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 9 | | 2 | | 3 | | 1 | | 0 | | 0 | | 0 | | 15 |
| 11 | | | | 4 | | | | 0 | | | | 0 | | 15 |

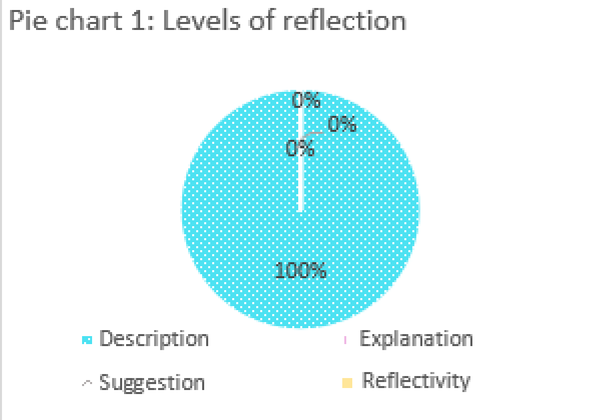


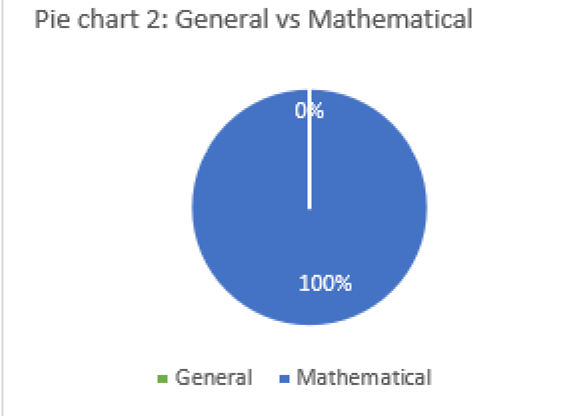




Joy wrote fifteen coded ideas using all three lenses assigned to the class. Eleven of the fifteen ideas were descriptions and four were explanations. There were no suggestions and no ideas displaying reflectivity. Nine of the eleven descriptions were GDs, three of them followed by explanations. An example: *The questioning was done* ***as a way of*** *involving and engaging the children* (Joy S2. C7 & C8). Only two of the eleven descriptions were MDs and only one of these MDs was followed by an explanation: *The children were asked of different ways of calculating* ***so that*** *they understand that there is not only one way of calculating* (Joy S2. C3 & C4). Thus, Joy's reflections were at the lower levels of the FLRM. As seen in pie chart 1, 73% of her reflections were at level 1 and 27% at level 2. There were no reflections at levels 3 and 4. At the same time, 80% of Joy's reflections were general and only 20% were mathematical (see pie chart 2).

## Summary and analysis of Langa’s S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 0 | | 10 | | 0 | | 0 | | 0 | | 0 | | 0 | | 10 |
| 10 | | | | 0 | | | | 0 | | | | 0 | | 10 |



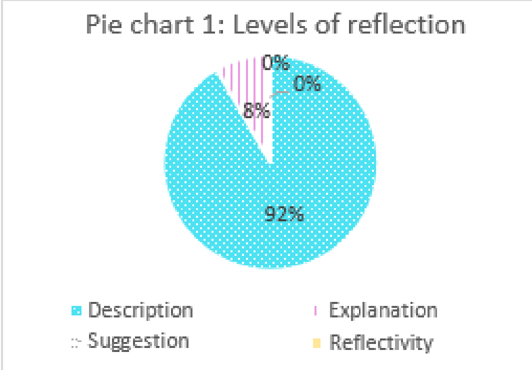



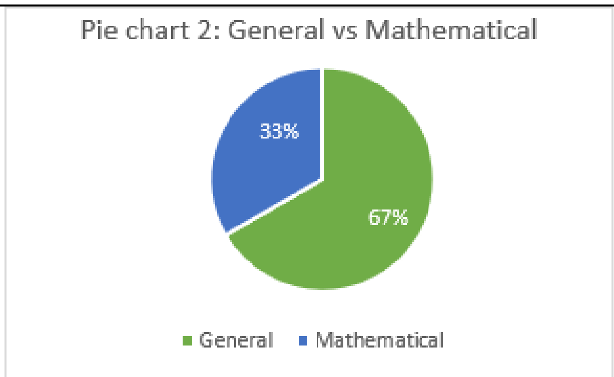

Langa wrote ten coded ideas using all the three lenses assigned to the class. All the ideas were MDs, in a list that began with an opening statement: *The mathematical processes being developed on the video are mental maths* (Langa S2. C1). The list of different mathematical concepts and ideas was interjected with one idea that Langa illustrated with an example, as follows: …*as well as using different kinds of mathematical strategies* ***such as*** *the use of one of the mathematical strands which is strategic competence where learners were participating using their own thinking for solving the problem* (Langa S2. C3). Langa did not provide any explanations or suggestions, or display reflectivity. All Langa’s reflections were therefore at the lowest level of the FLRM. As seen in pie chart 1, 100% of his reflections were at level 1, and 100% were mathematical (see pie chart 2).

**Summary and analysis of Lee's S2 reflections**

Summaries of Lee's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^e | ME | ME^e | GS | GS→E | MS | MS→E | GR | MR | |
| 6 | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 7 | | 4 | | 1 | | 0 | | 0 | | 0 | | 0 | | 12 |
| 11 | | | | 1 | | | | 0 | | | | 0 | | 12 |



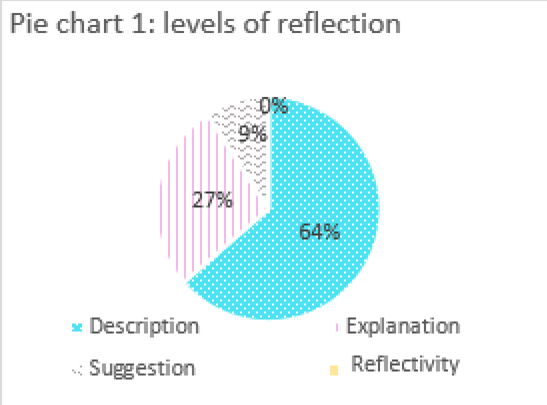



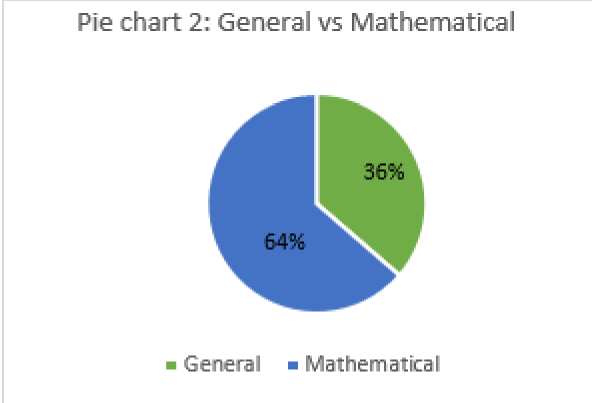

Lee wrote twelve coded ideas using two of the three lenses assigned to the class. Eleven of the twelve ideas were descriptions and one an explanation. There were neither suggestions nor any ideas that displayed reflectivity. Seven out of the eleven descriptions were GDs and only one was followed by an expanded explanation. This is when she wrote: *The teacher wanted them to justify* ***because*** *the teacher kept asking learners what they are saying, if [they say]10 then the learners will have to reason why they say it is that answer* (Lee S2. C5 & C6). Four of the eleven descriptions were MDs and none was followed by an explanation; for instance: *The teacher wanted learners to add on to what number they already have.* Thus, Lee's reflections were at the two lowest levels of the FLRM, with 92% of them at level 1 and only 8% at level 2 (see pie chart 1). As indicated in pie chart 2, above, 67% of Lee's reflections were general and 33% were mathematical.

## Summary and analysis of Lethu's S2 reflections

Summaries of Lethu's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 4 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 11 |
| 4 | | 3 | | 0 | | 3 | | 0 | | 1 | | 0 | | 11 |
| 7 | | | | 3 | | | | 1 | | | | 0 | | 11 |



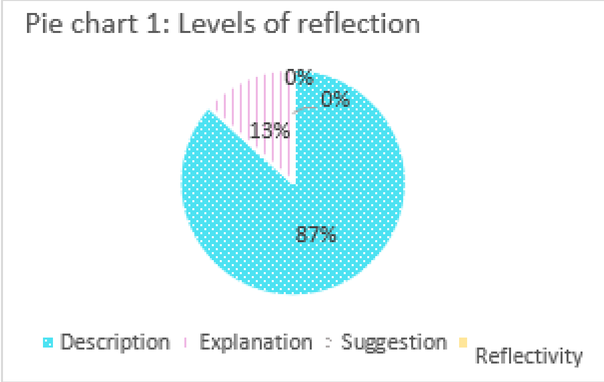



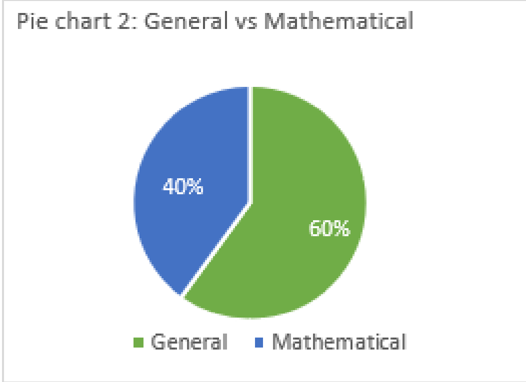

Lethu wrote eleven coded ideas using all three lenses assigned to the class. Seven of the eleven ideas were descriptions, three of them explanations. One idea was a suggestion, but none demonstrated reflectivity. Four of the seven descriptions were GDs, such as: *She showed them flash cards and then asked what they saw* (Lethu S2. C5 & C6). None of the GDs was followed by an explanation. Three of the seven descriptions were MDs and two of these were followed by explanations: one with two ideas and the other with three. The MD followed by an expanded explanation with three ideas was as follows: *… and each learner had to explain how they saw the number.* ***This*** *developed learners' process skills because some could say I saw 5 and 2 more which made 7 or I saw 4 and 1 more which made 5. So, the learners could use what they already knew to work out what they see* (Lethu S2. C7 & C8). The sole suggestion ventured by Lethu was an MD followed by a simple explanation. He wrote *I would have focused on one number e.g. 10 then show learners cards with different dot formation but all add up to 10.* ***That way*** *they will also learn bonds of 10.* (Lethu S2. C3 & C4). Thus, while Lethu's reflections spanned three levels of the FLRM, they were mostly at the lower levels of the model. As shown in pie chart 1, 64% of the reflections were at level 1, 23% at level 2, with only 1% at level 3. There were no reflections at level 4. Furthermore, 64% of Lethu's reflections were mathematical while 36% were general (see pie chart 2).

**Summary and analysis of Liz's S2 'reflections**

Summaries of Liz's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD\rightarrow^{E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{\bullet}$ | ME | $ME^{\bullet}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 9 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 9 | | 4 | | 0 | | 2 | | 0 | | 0 | | 0 | 0 | 15 |
| 13 | | | | 2 | | | | 0 | | | | 0 | | 15 |



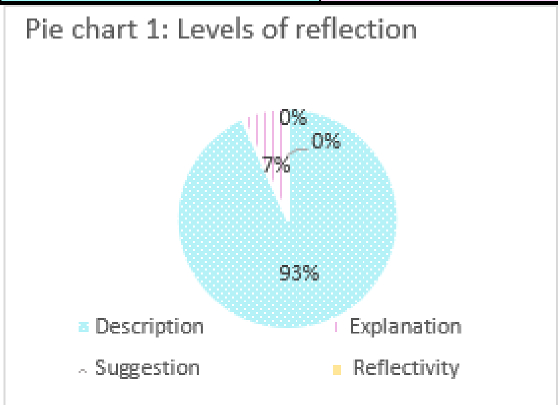



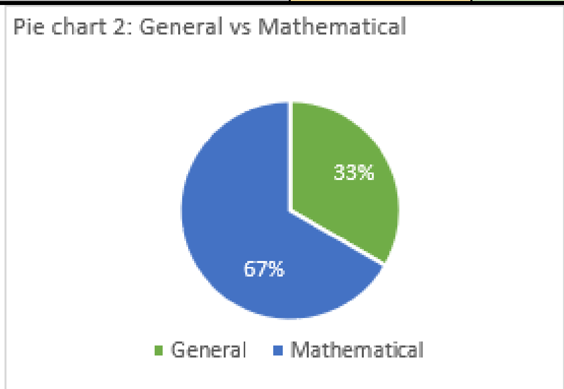

Liz wrote fifteen coded ideas using the three lenses assigned to the class. Thirteen of the fifteen ideas were descriptions and only two were explanations. There were no suggestions and no ideas displaying reflectivity. Nine of the thirteen descriptions were GDs, such as: *Task was to help learners reason their answer/ decisions* (Liz S2. C6). None of the GDs was followed by an explanation. On the other hand, four out of the twelve descriptions were MDs and two of these were followed by explanations. For example, *the task was… and sharing how many dots they have seen.* ***This allows*** *for full interaction between the learners* (Liz S2. C8 & C9). Thus, Liz's reflections were all at the lower levels of the FLRM, with 87% of them at level 1 and only 13% at level 2. As seen in pie chart 1, there were no reflections at levels 3 and 4.  As indicated by the pie chart 2, 60% of the reflections were mathematical and 40% were general.

## Summary and analysis of Lutho's S2 reflections

Summaries of Lutho's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | GE* | ME | ME* | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 5 | 0 | 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 5 | | 9 | | 0 | | 1 | | 0 | | 0 | | 0 | 0 | 15 |
| 14 | | | | 1 | | | | 0 | | | | 15 | | |



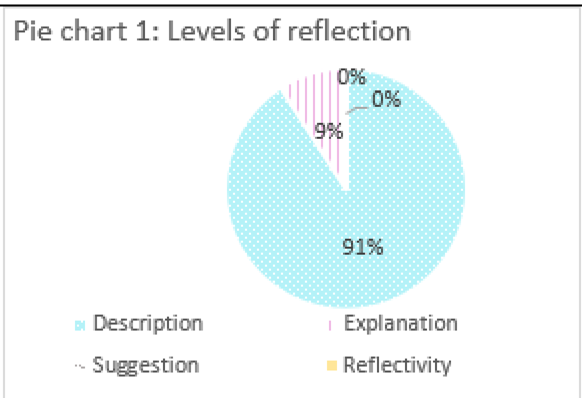



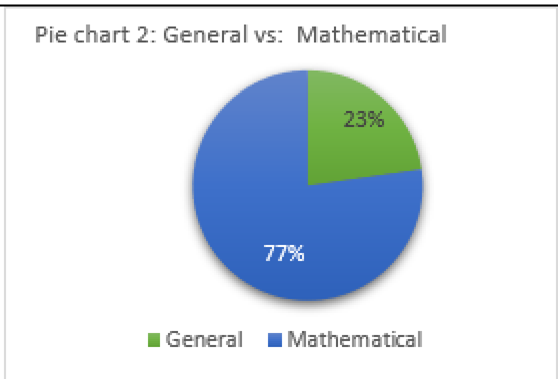

Lutho wrote fifteen coded ideas. Fourteen of the fifteen were descriptions and only one at the level of explanation. There were neither suggestions nor any ideas displaying reflectivity. Five of the fourteen descriptions were GDs, such as: *The task did not change during the lesson* (Lutho S2, C9). None of the GDs was followed by an explanation. The remaining nine of the fourteen descriptions were MDs and one of these was followed by an explanation, the only reflection at level 2: *The teacher had to get leaners to… and to recognise numbers* ***in order to*** *be able to assess the learners* (Lutho S2. C10 & C11). Thus, Lutho's reflections were at the lower levels of the FLRM. As shown in pie chart 1 above, 93% of her reflections were at level 1 and only 7% at level 2. There were no reflections at levels 3 and 4. However, 69% of Lutho's reflections were mathematical while 31% were general.

## Summary and analysis of Mandy's S2 reflections

Summaries of Mandy's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{\bullet}$ | ME | $ME^{\bullet}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 5 | 0 | 13 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| 5 | | 15 | | 0 | | 2 | | 0 | | 0 | | 0 | 0 | 22 |
| 20 | | | | 2 | | | | 0 | | | | 0 | | 22 |



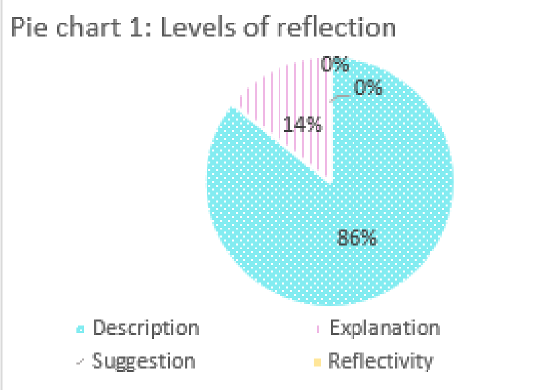



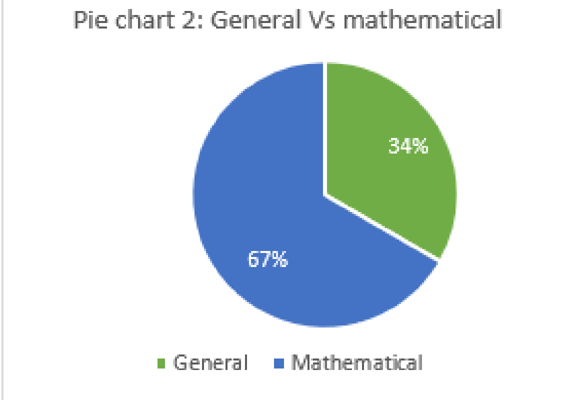

Mandy recorded 22 ideas, making use of all three lenses assigned to the class. Twenty of the twenty-two were descriptions and two were explanations. There were no suggestions and no ideas that demonstrated reflectivity. Five out of twenty-two descriptions were GDs, such as: *The learners justified answers* (Mandy S2. C10). None of the GDs was followed by an explanation. Fifteen out of twenty-two descriptions were MDs and two of these were followed by explanations, resulting in the two reflections at level 2. An example of such an MD and its explanation is the following: *The task was… and letting them calculate by themselves* ***so as to*** *help the learners become independent in calculating* (Mandy S2. C15 & C16). Thus, Mandy's reflections were at the lower levels of the FLRM. As displayed in pie chart 1, 91% of the reflections were at level 1 and only 9% at level 2. There were no reflections at levels 3 and 4. Seventy-seven per cent of Mandy's reflections were mathematical, while 23% were general (see pie chart 2).

## Summary and analysis of Marylyn's S2 reflections

Summaries of Marylyn's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{\circ}$ | ME | $ME^{\circ}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 5 | 1 | 10 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| 6 | | 12 | | 0 | | 2 | | 0 | | 0 | | 0 | 0 | 21 |
| *18* | | | | *3* | | | | *0* | | | | *0* | | *21* |



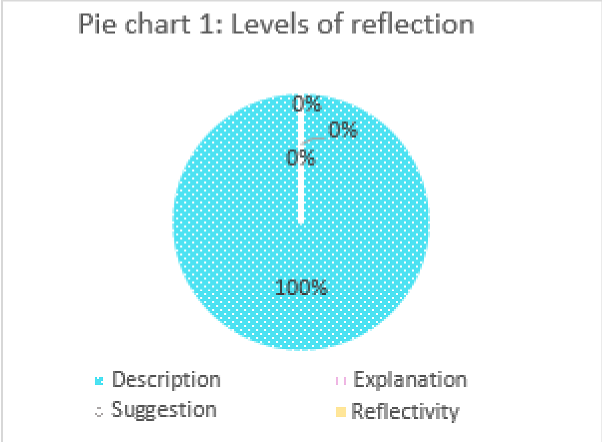



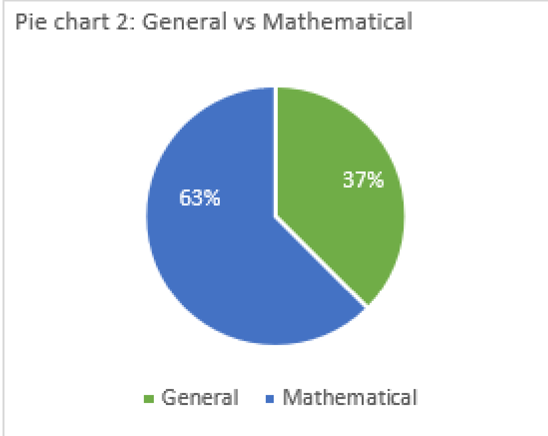

Marylyn wrote twenty-one coded ideas using all three lenses assigned to the class. Eighteen of the twenty-one ideas were descriptions and three were explanations. There were no suggestions and no ideas displaying reflectivity. Twelve of the eighteen descriptions were MDs, two of them followed by explanations. An example of the latter: *The processes that their teacher uses to teach are flash cards of numbers in different patterns* ***in order*** *for the learners to reason on the number* (Marylyn S2. C6 & C7). Six of the eighteen descriptions were GDs, one of which was followed by an explanation, as follows: *She asked the learners to reason their answer of how they got to the answer they have* ***so that*** *they can find out if it is correct* (Marylyn, S2. C15 & C16). Marylyn's reflections were at the lower levels of the FLRM, with 86% at level 1 and only 14% at level 2. There were no reflections at levels 3 and 4 (as shown by pie chart 1). A proportion of 67% of her reflections were mathematical while 33% were general (see pie chart 2).

## Summary and analysis of Micky's S2 reflections

Summaries of Micky's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 3 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 3 | | 5 | | 0 | | 0 | | 0 | | 0 | | 0 | | 8 |
| 8 | | | | 0 | | | | 0 | | | | 0 | | 8 |



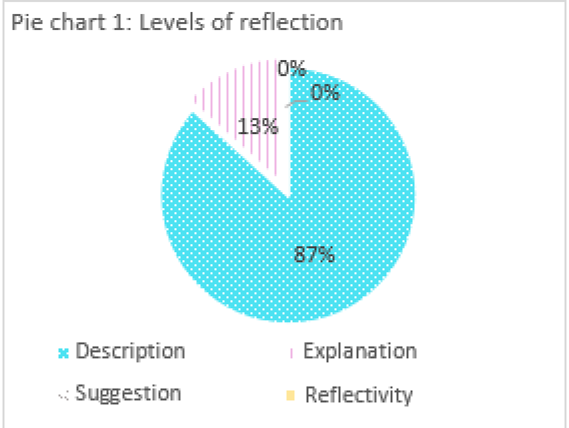



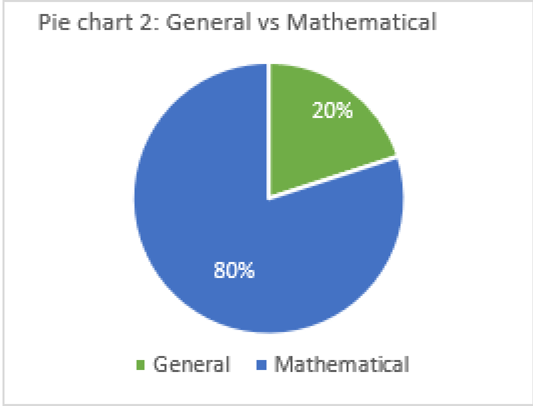

Micky wrote eight coded ideas using the three lenses assigned to the class. All eight ideas were descriptions. There were no explanations, no suggestions and no ideas demonstrating reflectivity. Five of the eight were simple MDs without ensuing explanations, such as: *children got to explain their different [calculation] methods* (Micky S2. C3). There were three GDs which were also not followed by explanations, for example: *Teacher ask children to explain their answers* (Micky S2. C8). All Micky's reflections were therefore at level 1, the lowest of the four levels of the FLRM (see pie chart 1). Sixty-three per cent of Micky's reflections were mathematical while 37% were general (see pie chart 2).

**Summary and analysis of Ronny's S2 reflections**

Summaries of Ronny's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 1 | 1 | 10 | 1 | 1 | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 2 | | 11 | | 1 | | 1 | | 0 | | 0 | | 0 | 0 | 15 |
| 13 | | | | 2 | | | | 0 | | | | 0 | | 15 |



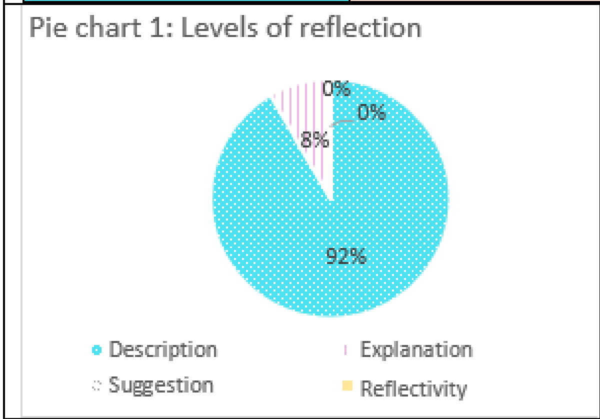



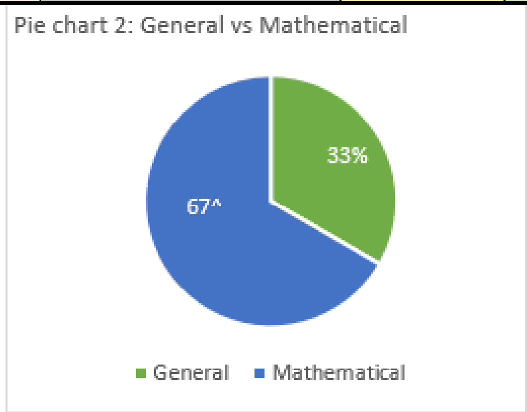

Ronny recorded fifteen coded ideas using all three lenses that the class was assigned. Thirteen out of the fifteen were descriptions and two were explanations. There were no suggestions and no ideas displaying reflectivity. Two of the thirteen descriptions were GDs, one of them followed by an explanation: "*Justification also plays a big part of her lesson **because** thinking usually helps the children to justify their thoughts* (Ronny S2. C8 & C9). Eleven of the thirteen descriptions were MDs. One of the MDs was followed by an expanded explanation, as follows: *Children are tasked to identify number picture that link to one-one correspondence. **This** creates an immediate connection for the children to connect with their outside world 11b and enable them to relate to games that they play at home* (Ronny S2. C10 & C11). Although the explanation may not seem to relate directly to the classroom occurrence described, Ronny explained one-to-one correspondence as a means of helping learners make connections with the real world. Ronny's reflections were thus at the lower levels of the FLRM. As shown in pie chart 1, 87% of his reflections were at level 1 and 13% at level 2. There were no reflections at levels 3 and 4. Also, 80% of his reflections were mathematical while only 20% were general (as indicated in pie chart 2).

**Summary and analysis of Smith's S2 reflections**

Summaries of Smith's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | GEe | ME | ME* | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 8 | 0 | 12 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 8 | | 14 | | 0 | | 2 | | 0 | | 0 | | 0 | | 24 |
| 22 | | | | 2 | | | | 0 | | | | 0 | | 24 |

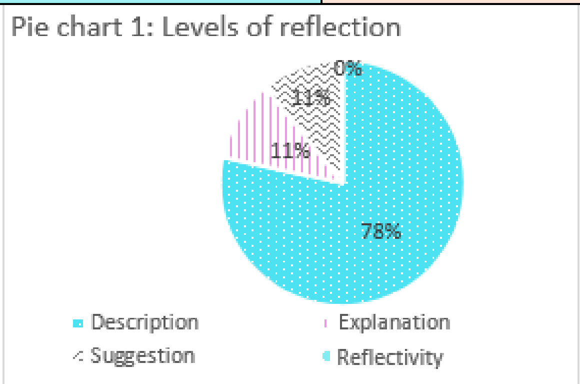


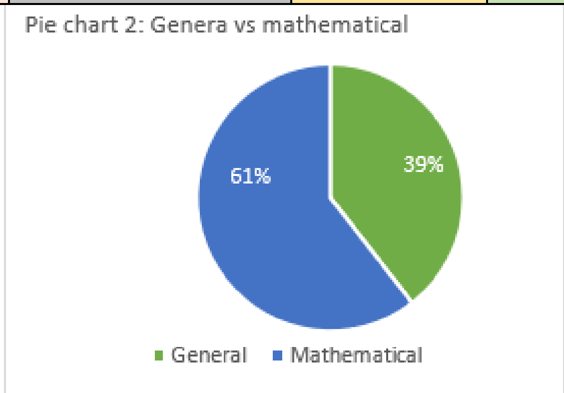




Smith wrote as many as twenty-four coded ideas using the three lenses assigned to the class. Twenty-two of the twenty-four were descriptions and two were explanations. There were no suggestions and no ideas displaying reflectivity. Fourteen of the twenty-one descriptions were MDs and only two of these were followed by explanations, resulting in the two level 2 reflections. One such example is: *The reason for the cards to become more difficult* $MD^{\to E}$ *24* ***is that*** *learners also need to be pushed to progress* (Smith S2. C23 & C24). Eight of the twenty-two descriptions were GDs, for example: *Learners responded to teacher's questions* (Smith S2. C14). None of the GDs was followed by any explanation. Thus, Smith's reflections were at the lower levels of the FLRM. As seen in pie chart 1, 92% of the reflections were at level 1 and only 8% at level 2. There were no reflections at levels 3 and 4. Pie chart 2 reveals that 67% of Smith's reflections were mathematical and 33% were general.

**Summary and analysis of Thula's S2 reflections**

| Summaries of Thula's S2 reflections | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{s}$ | ME | $ME^{s}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 13 | 1 | 14 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 37 |
| 14 | | 15 | | 1 | | 3 | | 0 | | 4 | | 0 | | 37 |
| 29 | | | | 4 | | | | 4 | | | | 0 | | 37 |



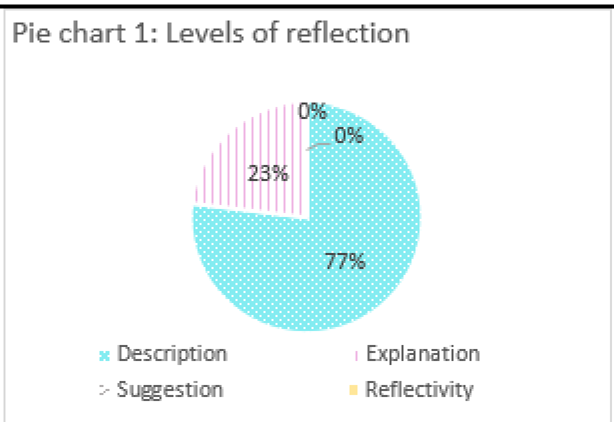



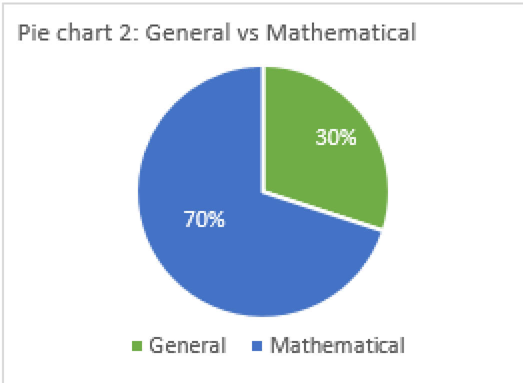

Thula wrote 37 coded ideas using the three lenses assigned to the group. Twenty-nine of the thirty-seven ideas were descriptions, four were explanations and another four were suggestions. There were no ideas displaying reflectivity. Fourteen of the twenty-nine descriptions were GDs, one of which was followed by an explanation: *some learners are already bored because they know how to justify already* (Thula S2. C19 & C20). On the other hand, 15 of the 29 descriptions were MDS, one of them followed by an explanation: *Task demanded critical looking/ observing **so as to** estimate number of dots correctly* (Thula S2. C30 & C31). Both MSs were also followed by explanations, for example: *[The teacher should have]* ***left out*** *counting of 5 & 10 and more or less [because there was] too much for children* (Thula S2. C12, C13 & C14). Thus, Thula's reflections extended across the first three levels of the FLRM, although the majority were at the lowest level. As seen in pie chart 1, above, 78% of her reflections were at level 1, 11% at level 2 and 11% at level 3. There were no reflections at level 4. Sixty-two per cent of her reflections were mathematical while 38% were general (see pie chart 2).

**Summary and analysis of Tiny's S2 reflections**

Summaries of Tiny's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVIT | | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{c}$ | ME | $ME^{c}$ | GS | $GS^{\to c}$ | MS | $MS^{\to E}$ | GR | MR | |
| 3 | 0 | 4 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 3 | | 7 | | 0 | | 3 | | 0 | | 0 | | 0 | | 13 |
| 10 | | | | 3 | | | | 0 | | | | 0 | | 13 |



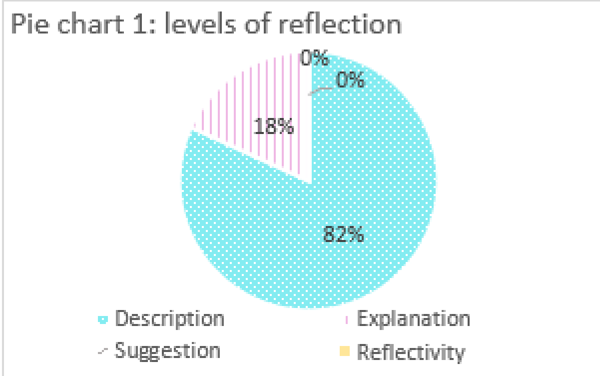



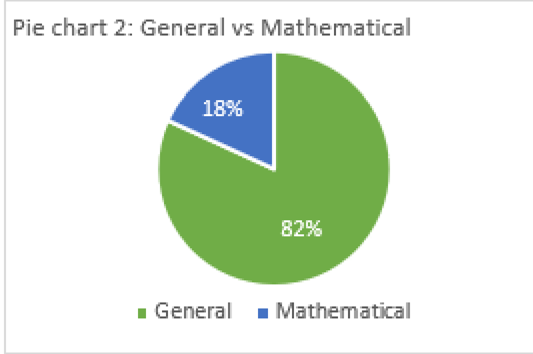

Tiny wrote thirteen coded ideas using the three lenses assigned to the class. Ten of the thirteen ideas were descriptions, three were explanations, and there were no suggestions or ideas displaying reflectivity. Three out of the ten descriptions were GDs such as: *and the children were finding different ways in getting their answers* (Tiny S2. C5). None of the GDs was followed by any explanation. On the other hand, seven out of the eight descriptions were MDs, and three of these seven were followed by explanations. One example: *The teacher used the 10 frames* ***to*** *help the children get more of an understanding* (Tiny S2. C6 & C7). Tiny's reflections were thus at the lower levels of the FLRM, with 77% at level 1, 23% at level 2 and no reflections at levels 3 and 4 (see pie chart 1). As shown in pie chart 2 above, 77% of Tiny's reflections were mathematical and 23% were general.

**Summary and analysis of Vee's S2 reflections**

Summaries of Vee's S2 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 5 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 7 | | 2 | | 2 | | 0 | | 0 | | 0 | | 0 | 0 | 11 |
| 9 | | | | 2 | | | | 0 | | | | 0 | | 11 |



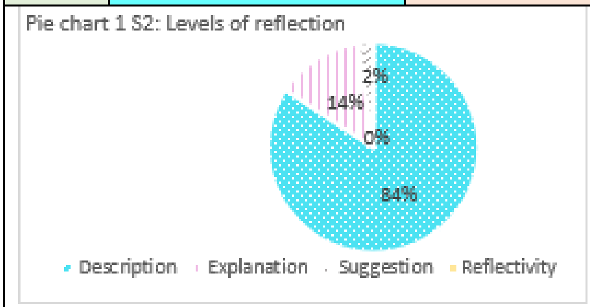

Vee wrote eleven coded ideas using only one (MMI) of the three lenses assigned to the class. Nine of the eleven ideas were descriptions, two out of eleven were explanations, and there were no suggestions and no ideas displaying reflectivity. Seven of the nine descriptions were GDs, two of them were followed by expanded explanations, for example: ... *and were comfortable to share their answer. Sharing of ideas **could have allowed** learners to have different strategies 9b and perspective* (Vee S2. C8 & C9). Both of her explanations showed some levels of analysis. However, only two out of the nine descriptions were MDs, such as: *Learners are being taught to recognise numbers in different representations* (Vee S2. C1). None of the MDs was followed by a rationale. Vee's reflections were therefore at the lower levels of the FLRM, with 82% at level 1 and 18% at level 2. There were no reflections at levels 3 and 4 (see pie chart 1). Eighty-two per cent of Vee's reflections were general while only 18% were mathematical (see pie chart 2).

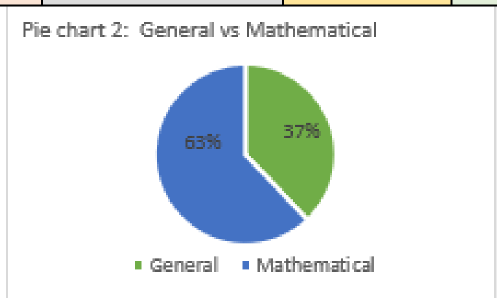
### *5.1.2.1 General overview of Session 2 reflections*

In the above section I presented summaries of the 19 PSTs' individual written reflections and their analysis. These summaries and analyses answer my research question one, which sought to illuminate the nature of the reflections in which PSTs engage as they analyse video-recorded lessons. This section provides an overview of the S2 reflections. Table 5.5, below, provides a summary of the coding for the reflections of the entire group of 19 PSTs.

*Table 5.5: Overview of the PSTs' S2 reflections*

| Name of PST | Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | $GD^{+}$ | MD | $MD^{+}$ | GE | $GE^{+}$ | ME | $ME^{+}$ | GS | $GS^{+}$ | MS | $MS^{+}$ | GR | MR | |
| Alice | 3 | 0 | 9 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 15 |
| Bonga | 1 | 1 | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| Charity | 2 | 1 | 5 | 3 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 17 |
| Dee | 4 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Joy | 6 | 3 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| Langa | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Lee | 6 | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Lethu | 4 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 11 |
| Liz | 9 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| Lutho | 5 | 0 | 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| Mandy | 5 | 0 | 13 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 |
| Marylyn | 5 | 1 | 10 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| Micky | 3 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Ronny | 1 | 1 | 10 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| Smith | 8 | 0 | 12 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| Thula | 13 | 1 | 14 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 37 |
| Tiny | 3 | 0 | 4 | 3 | 0 | O | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Dumie | 2 | 2 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Vee | 5 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Total | 85 | 14 | 130 | 22 | 9 | 5 | 20 | 6 | 0 | 0 | 3 | 4 | 0 | 0 | 298 |
| | 99 | | 152 | | 14 | | 26 | | 0 | | 7 | | 0 | 0 | 298 |
| | 251 | | | | 40 | | | | 7 | | | | 0 | | 298 |




As seen in the summaries above, the 19 PSTs recorded a total of 298 coded ideas. Of these, 251 were descriptions, 40 were explanations, 7 were suggestions and none displaying indicators of reflectivity. Most of the PSTs' reflections were therefore at the lower levels of the FLRM, with 84% of the reflections being at level 1, 14% at level 2, and 2% at level 3. There were no reflections at level 4 (see pie chart 1). A comparison of general and mathematical reflections showed that 63% of the reflections were mathematical and 37% were general (see pie chart 2). In Figures 5.8 and 5.9, below, I provide visual summaries of the whole group of participants' reflections.

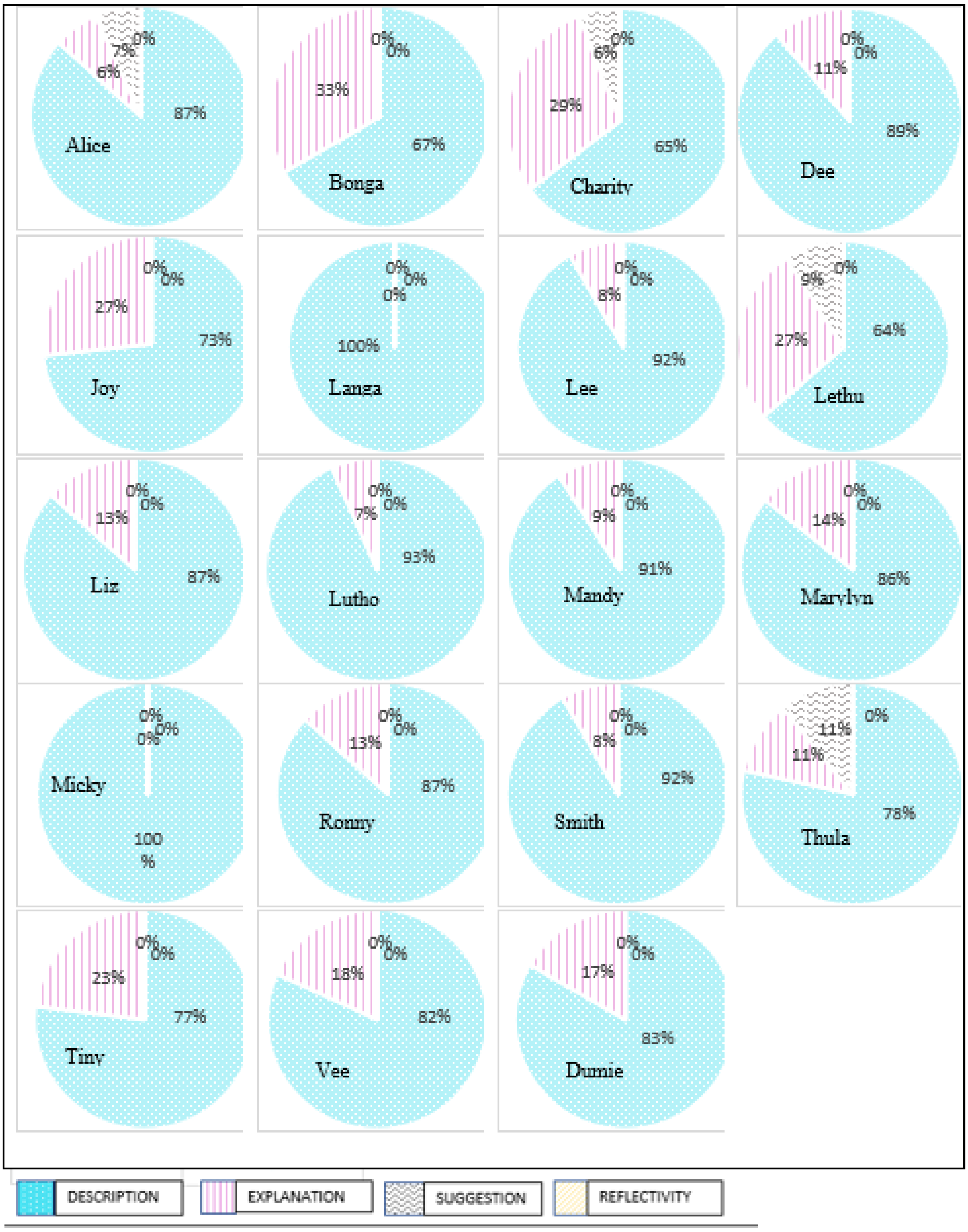



*Figure 5. 8: Overview of PSTs' S2 levels of reflection*

As seen in the Figure 5.8 above, the dominating blue colour representing descriptions indicates a predominance of level 1 reflections. A majority (17 out of 19) of the PSTs did have some ideas that were coded at level 2 reflection, although the percentage of level 2 reflections for each PST was generally very low (ranging between 0% and 33%). Two of the 19 PSTs' reflections were entirely at level 1. Four of the 19 PSTs recorded reflections coded at level 3, although the proportion of these was below 11% of their total coded reflections. These findings tally with those of Azimi, Kuusisto, Tiri and Hatami's (2019), who report that their PSTs' reflections were improving with each session of reflection. In the first session of my data collection (S1), only one PST had level 3 reflections, while in S2 four of the 19 PSTs are now reflecting at this level. Figure 5.9, below, indicates the proportions of general versus mathematical reflections.

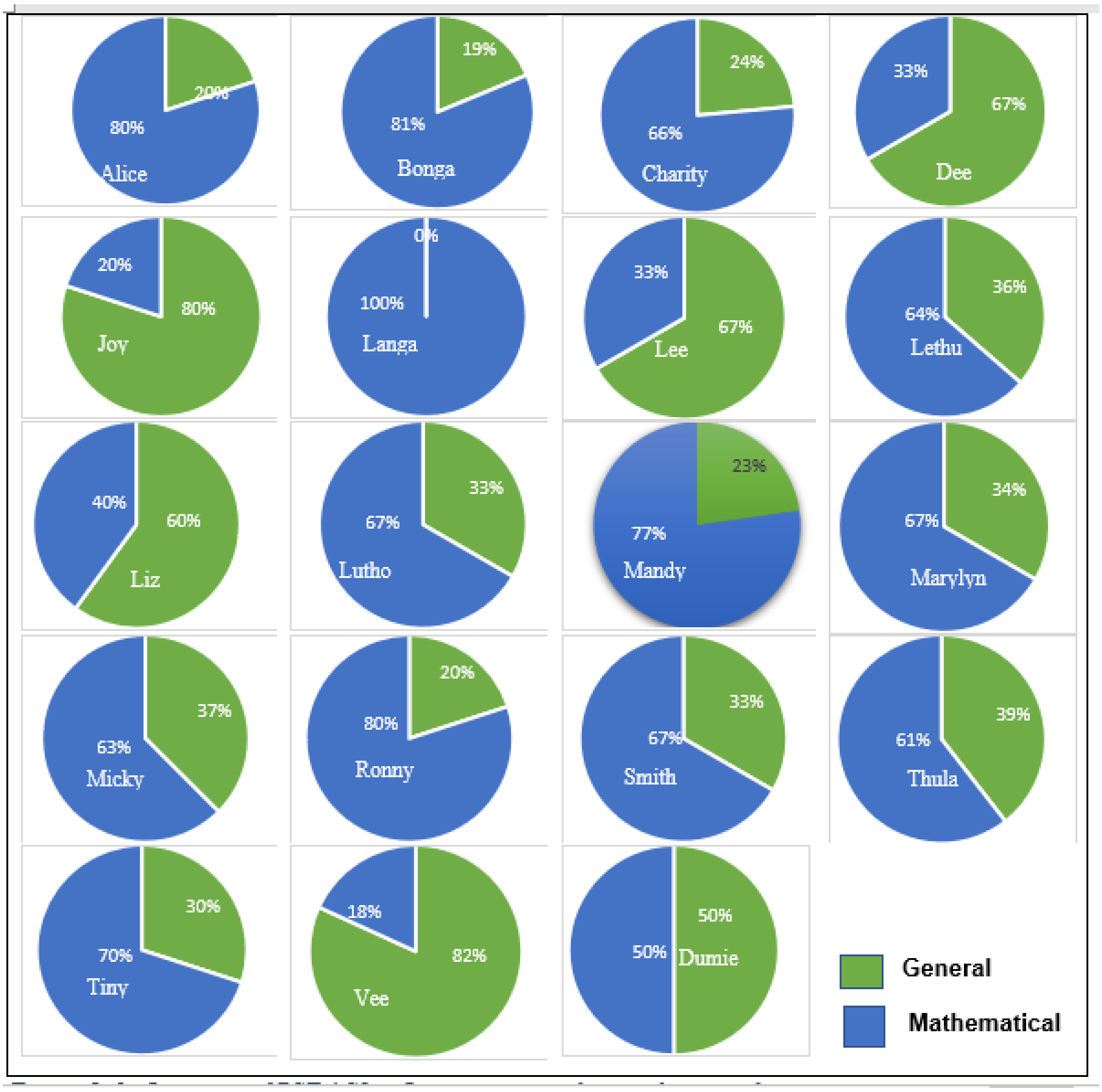



*Figure 5. 9: Overview of PSTs' S2 reflections: general vs mathematical*

When considering the rates of general reflection as opposed to mathematical, I found that most of the PSTs were becoming more mathematical than general. The dominating blue versus green colour in Figure 5.9 demonstrates that most 63%, of the S2 reflections were mathematical Unlike in S1, in S2 no PST wrote reflections that were 100% general. All 19 PSTS had a combination of general and mathematical reflections, with mathematical reflections dominating in most cases. Only five PSTs of the 19 wrote reflections that were more general than mathematical. This means that 14 PSTs recorded reflections that were coded as 50% and more mathematical, with one PST writing reflections that were 100% mathematical. In S1 71% of the reflections were general and only 29% were mathematical. In contrast, in S2 63% were mathematical and 37% general.

Generally speaking, there was a shift from S1 to S2 both to higher levels of reflection and towards a sharper mathematical focus. However, I will address these shifts in detail in section 5.3. The next section presents summaries and analysis of the third session of PST reflections.

### 5.1.3 Presentation and analysis of S3 reflections

The third session took the form of an assignment in which the PSTs were required to reflect on the selected video-recorded lesson using all the six lenses of the SLF. For this session, the lecturer played the video of a 12.46-minute-long excerpt from a lesson presented by one of her colleagues at a local primary school. The colleague was visiting the school solely for the purpose of doing some mental Maths sessions with a Grade 3 class. The lecturer set up the video recording of this mental Maths session in such a way that it ran from beginning to end before restarting to play again in an ongoing loop. The video ran for the two hours of the lecture time. The PSTs came in to write, submit the assignment when they were done and leave. Although the lecturer was in the room for the two hours of the lecture, she did not explain anything to the PSTs but was there to monitor the exercise and to receive the assignments after each PST was finished. Since the PSTs were reflecting using all six lenses of the SLF, their reflections were lengthy and would have made this chapter extremely long and tiring to read. Therefore, to avoid overloading the chapter I put some samples of the PSTs' S3 reflections in Appendix 3.2 and only present summaries of coding these reflections and my analysis of the reflections, as I did with the S2 data. I begin by presenting a summary in Figure 5.10 of the video-recorded lesson on which PSTs reflected in S3, in order to provide the reader with some necessary context.

*The lesson begins with the teacher explaining to the learners that she will be having mental maths sessions with them for ten minutes over the coming days, that is, each day the learners will do mental maths with her for only ten minutes. She then does a recap of the previous mental maths session with the leaners and reminds them that they should not use unit counting to solve the problems. She writes one of the problems they did on the previous day (37+8) on the board and asks the learners to explain how they solved the problem with the aid of a number line. She writes on the board what the learners are saying as they explain how they solved the problem (see picture 1). She gives them another problem (68+5) and asks them to solve the problems using the number lines in their heads. When learners give answers, she asks them to explain how they solved the problem, describing all the steps they took as they were doing this. She probes learners to explain in detail how the problems were solved while she writes on the board what the learners are saying. She emphasises the helpfulness of a number line and the bonds of ten in solving mathematical problems mentally. She plays the pop fiz game where she gives a number and the learners state the number that needs to be added to the teacher's number to get 10, e.g. if she says 7 the learners say 3, if she says 2 the learners say 8. They do fizz pop for the bonds of 10, then move to the bonds of 30. She then asks the learners to use a number line in their heads to give the next 10 of the numbers that she gives them. She emphasizes they are not doing rounding off but the next ten. But with the first problem that she gives them, the learners round off, so she explains illustrating with a number line how to find the next 10. She does three examples on the board, then asks three oral questions. The teacher then writes two problems (29+9, 84+8) on the board and asks the learners to solve the problems using the bonds of ten and a number line in their heads. She asks them to solve the problems mentally first then illustrate in their workbooks how they solved the problems. When learners give answers, she asks them to explain how they got the answers. The lesson ends with the teacher telling the learners that they will do more mental maths on the following day.*

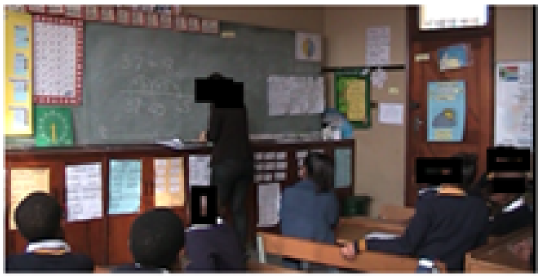


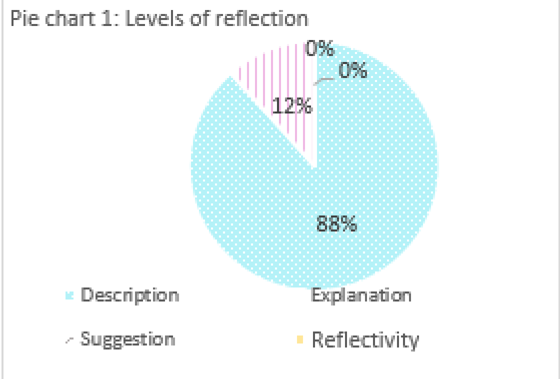
*Figure 5. 10: Summary of the session 3 video-recorded lesson and two screen shots of lesson sections*

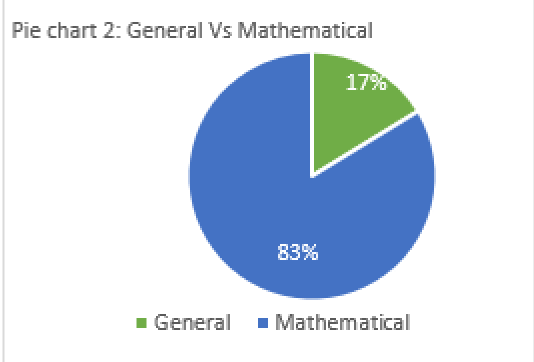
Below I present summaries of the coding of each of the 19 PSTs' reflections, together with a few examples taken the PSTs' reflections to give the reader a sense of how they reflected. The summaries and analyses are presented in alphabetical order of the PSTs' names. The section will end with an overview of the S3 PSTs' reflections and concluding remarks about the nature of the PSTs' reflections.

**Summary and analysis of Alice's S3 reflections**

Summaries of Alice's S3 reflections

| LEVEL 1 DESCRIPTION | | | | LEVEL 2 EXPLANATION | | | | LEVEL 3 SUGGESTION | | | | LEVEL 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^e | ME | ME^e | GS | GS→E | MS | MS→E | GR | MR | |
| 7 | 0 | 26 | 5 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| 7 | | 31 | | 0 | | 5 | | 0 | | 0 | | 0 | | 43 |
| 38 | | | | 5 | | | | 0 | | | | 0 | | 43 |



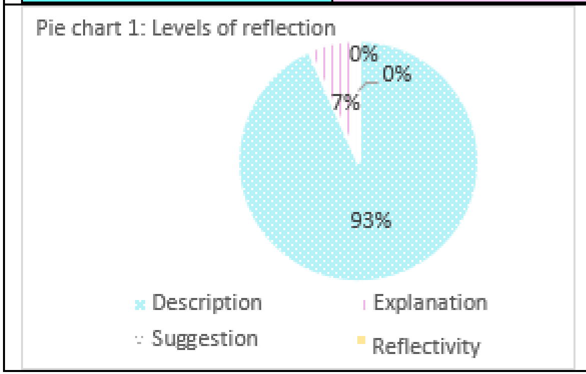



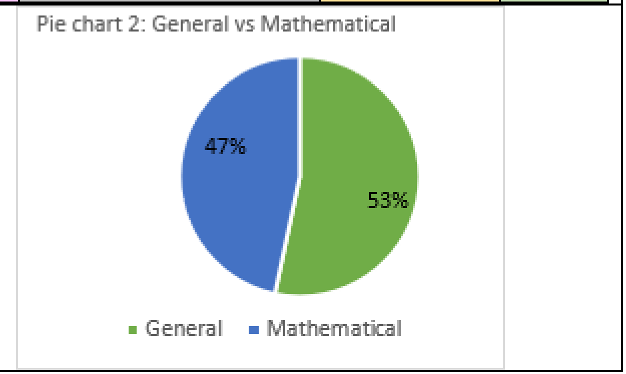

Alice wrote 43 coded ideas using five of the six lenses of the SLF. She did not write anything using the DDM lens. Thirty-eight of the 43 coded ideas were descriptions and 5 were explanations. There were neither suggestions nor any ideas that displayed reflectivity. Seven of the 38 descriptions were GDs such as: *The teacher asked learners how they got to their answer* (Alice S3. C7). None of these GDs was followed by any explanation. On the other hand, 31 descriptions were MDs and five of these were followed by explanations, resulting in the only five reflections at level 2. One of the explanations was expanded with two ideas: *The class had to use a number line* ***to*** *help them think of how many to the nearest ten and then adding the rest of the number* (Alice S3. C2 & C3). Thus, Alice's S3 reflections were at the lower levels of the FLRM, with 88% at level 1 and 12% at level 2. As seen in pie chart 1, there were no reflections at levels 3 and 4. However, 83% of Alice's S3 reflections were mathematical, while only 17% were general (see pie chart 2).

## Summary and analysis of Bonga's S3 reflections

Summaries of Bonga's S3 reflections

| LEVEL 1 DESCRIPTION | | | | LEVEL 2 EXPLANATION | | | | LEVEL 3 SUGGESTION | | | | LEVEL 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 20 | 2 | 19 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| 22 | | 20 | | 2 | | 1 | | 0 | | 0 | | 0 | | 45 |
| 42 | | | | 3 | | | | 0 | | | | 0 | | 45 |



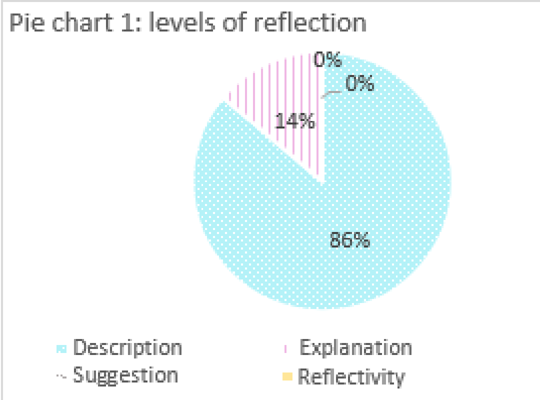



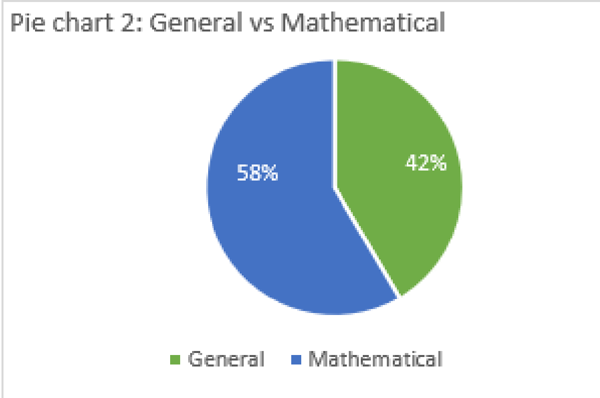

Bonga appeared to use only the MMI and DDM lenses. He recorded 45 coded ideas, 42 being descriptions and only three, explanations. There were no suggestions and no ideas that demonstrated reflectivity. Twenty-two of the 42 descriptions were GDs, two of which were followed by explanations. For example, he wrote: S*he gives a lot of examples* ***to*** *try to make them understand* (Bonga S3. C22 & C23). Bonga wrote 20 MDs, one of which was followed by an explanation. He wrote: … *then she gave a sum from previous day* ***for*** *progression purposes"* (Bonga S3. C2 & C3). Bonga's reflections were therefore at the lower levels of the FLRM, with 93% of the reflections being at level 1 and only 7% at level 2. There were no reflections at levels 3 and 4 (as shown in pie chart 1). Forty-seven per cent of his reflections were mathematical, while 53% were general (see pie chart 2)

## Summary and analysis of Charity's S3 reflections

Summaries of Charity's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\neg E}$ | MD | $MD^{\neg E}$ | GE | GE* | ME | ME* | GS | $GS^{\neg E}$ | MS | $MS^{\neg E}$ | GR | MR | |
| 19 | 4 | 28 | 5 | 4 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | | 33 | | 4 | | 5 | | 0 | | 0 | | 0 | 0 | 0 |
| 56 | | | | 9 | | | | 0 | | | | 0 | | 65 |



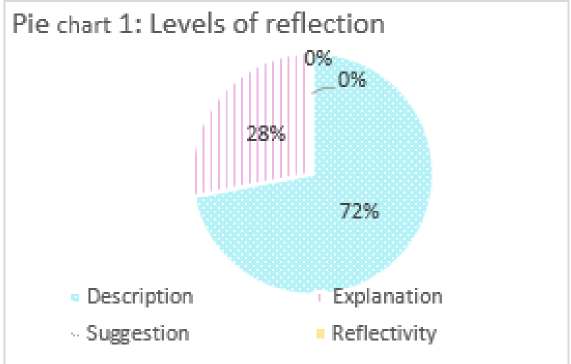



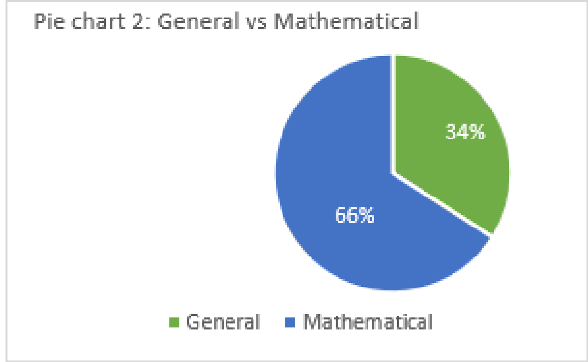

Charity wrote 65 coded ideas using all six lenses of the SLF. Fifty-six of the 65 ideas were descriptions, 9 were explanations and there were no suggestions and no ideas displaying reflectivity. Of the 56 descriptions, 23 were GDs while 33 were MDs. Four out of the 23 GDs were followed by explanations, such as: *The teacher asked "why" questions a lot* ***because*** *she wanted the learners to justify their answers"* (Charity S3. C41 & C42). On the other hand, five of the 33 MDS were followed by explanations, including this expanded explanation: *She gave the learners a sum that they did the day before* ***so that*** *the learners could remember and use that as a foundation that they can build on for this current lesson* (Charity S3. C13 & C14). Thus, Charity's reflections lay at the lower levels of the FLRM, with 86% at level 1 and 14% at level 2. As mentioned earlier, there were no reflections at levels 3 and 4. Charity's reflections were 58% mathematical and 42% general.

**Summary and analysis of Dee’s S3 reflections**

Summaries of Dee’s reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{-E}$ | MD | MD$^{-E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{-E}$ | MS | MS$^{-E}$ | GR | MR | |
| 10 | 3 | 15 | 8(1$^{E5}$) | 3 | 0 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | | 23 | | 3 | | 8 | | 0 | | 0 | | 0 | | 47 |
| 36 | | | | 14 | | | | 0 | | | | 0 | | 47 |



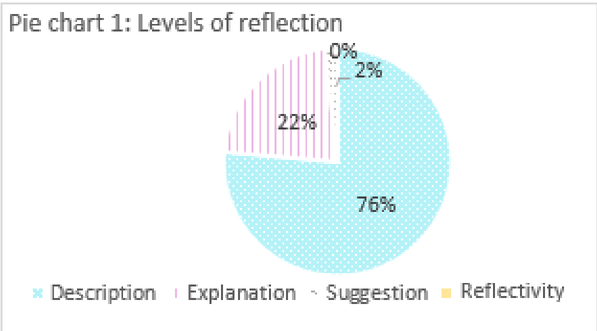



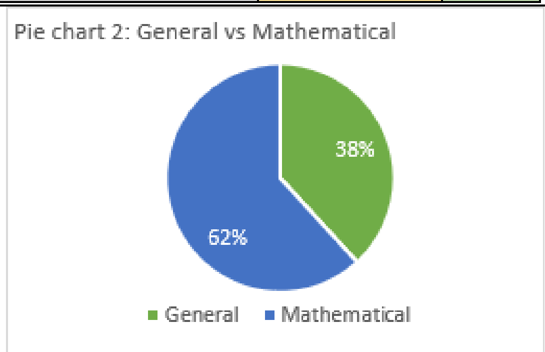

Dee wrote 47 coded ideas using all six lenses of the SLF. Out of 47 ideas, 36 were descriptions, 14 were explanations, and there were no suggestions or reflectivity. Thirteen out of the 36 descriptions were GDs and three of these were followed by explanations, such as: *[the teacher]… solves the problem on the board* ***so that*** *the whole class can learn from her and their mistakes* (Dee S3. C36 & 37). On the other hand, 23 out of 36 were MDs and eight of them were followed by explanations. In this example, the MD is followed by an expanded explanation: *The task then shifted from using the number line to practice adding from bonds of 10’s orally, by playing a game called “pop fizz.” when I say “pop,” you say “fizz” “pop,” “fizz” “18,” “20.” The reason the teacher did this was to get back to the mental mathematical side of things and for the children not to use the number incorrectly anymore but mentally and orally* (Dee S3. C16 & C17). Dee’s reflections were at the lower levels of the FLRM, with 72% of the reflection being at level 1 and 28% at level 2. There were no reflections at levels 3 and 4, as shown in pie chart 1. Dee recorded 66% mathematical reflections and 34% general (see pie chart 2).

## Summary and analysis of Dumie's S3 reflections

Summaries of Dumie's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GSS | GES | MSS | MES | GR | MR | |
| 9 | 6 (1$^{E}$) | 22 | 5(1$^{E3}$) | 5 | 1 | 4 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 55 |
| 15 | | 27 | | 6 | | 6 | | 0 | | 1 | | 0 | | 55 |
| 42 | | | | 12 | | | | 1 | | | | 0 | | 55 |



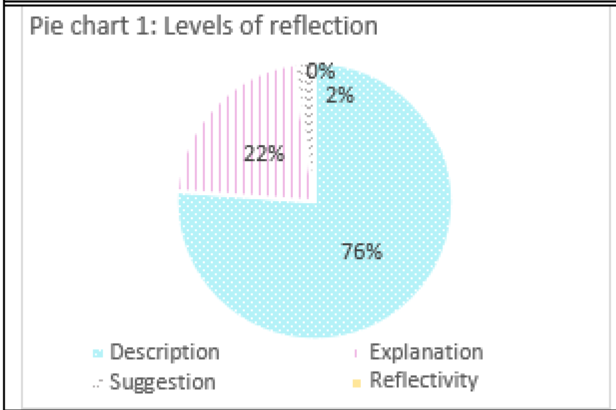



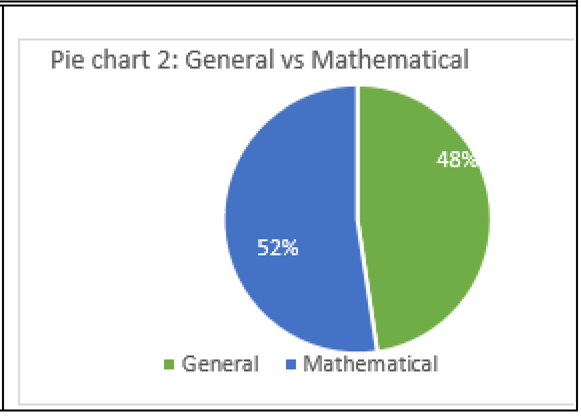

Dumie wrote 55 coded reflections using all the six lenses of the SLF as assigned. Of the 55 ideas, 42 were descriptions, 12 were explanations, and one was a suggestion. There were no ideas displaying reflectivity. The only suggestion was a MS which was followed by an expanded explanation: ***I would have used*** *the mental math strategy for teaching* ***because*** *it is very useful to develop number sense, and problem solving* (Dumie S3. C51 & C52). Fifteen of the 42 descriptions were GDs and six of these were followed by explanations. For example: *The teacher keeps using questions* ***so that*** *learners can be able to engage with he* (Dumie S3. C31 & C32). On the other hand, 27 out of the 42 descriptions were MDs and five of them were followed by explanations, with one of the explanations being expanded with two ideas: *The teacher is sort of using a strategy of adding the number to the existing number which could be a problem* ***because*** *what about those who want to come up with different strategies. For example, some student might notice that the possible to count in 2s in some maths problems* (Dumie S3. C47, 48 & 49). Dumie's reflections therefore spanned three of the four levels of the FLRM, but were concentrated at the lower levels, with 76% of the reflections at level 1, 22% at level 2, only 2% at level 3 and no reflections at level 4 (see pie chart 1). Dumie wrote 62% mathematical reflections and 38% general ones (see pie chart 2).

**Summary and analysis of Joy's S3 reflections**

Summaries of Joy's reflections

| Level 1 DESCRIPTION | | | | Level2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | GE* | ME | ME* | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 16 | 2 | 7 | 7 | 2 | 0 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 42 |
| 18 | | 14 | | 2 | | 7 | | 0 | | 1 | | 0 | | 42 |
| 32 | | | | 9 | | | | 1 | | | | 0 | | 42 |



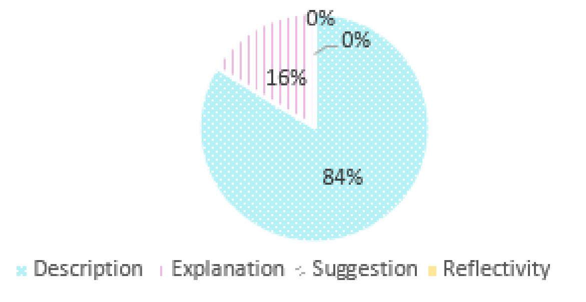

Joy wrote down 42 coded ideas using all six lenses of the SLF. Thirty-two out of 42 ideas were descriptions, nine were explanations, one a suggestion. There were no ideas that displayed reflectivity. The suggestion was a MS: *The teacher should continue using these number lines tasks* ***because*** *the learners can visualise what is required of them* (Joy S3. C18 & C19). Eighteen of the 32 descriptions were GDs and two of these were followed by simple explanations; for example: *therefore, she seems to be aware of the use of the good language* $GD^{\to E}$ *9* ***because*** *it makes clear instruction* (Joy S3. C8 & C9). Joy recorded 14 MDs, seven of them also followed by explanations, resulting in a total of nine reflections at level 2. One example of an MD followed by an explanation is: *She uses the next ten's technique to encourage the friendly number method* (Joy S3. C5 & C6). Joy's reflections reached across the first three levels of the FLRM, although concentrated towards the bottom of the model, with 76% being at level 1, 22% at level 2, 2% at level 3 and no reflections at level 4 (see pie chart 1). Joy wrote down 52% mathematical reflections and 48% general ones (see pie chart 2).

### Summary and analysis of Langa's S3 reflections

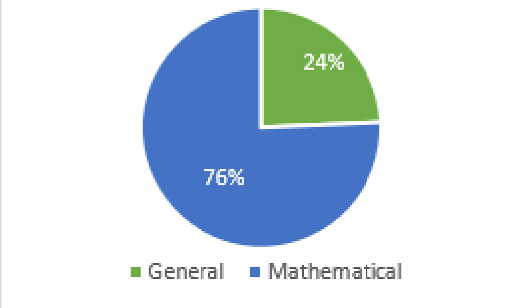
Summaries of Langa's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{\theta}$ | ME | ME$^{\theta}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 5 | 2 | 20 | 4 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| 7 | | 24 | | 2 | | 4 | | 0 | | 0 | | 0 | | 37 |
| 31 | | | | 6 | | | | 0 | | | | 0 | | 37 |

Pie chart 1: Levels of reflection




Pie chart 2: General vs Mathematical

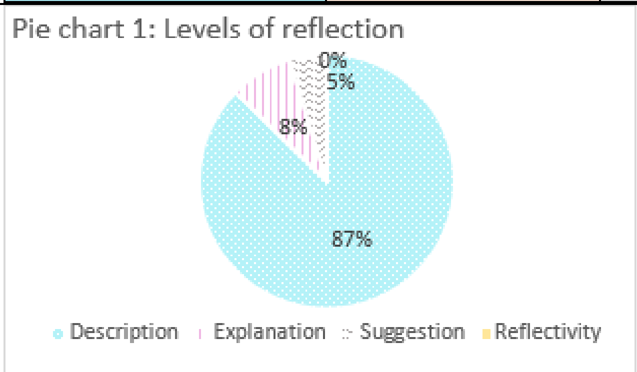


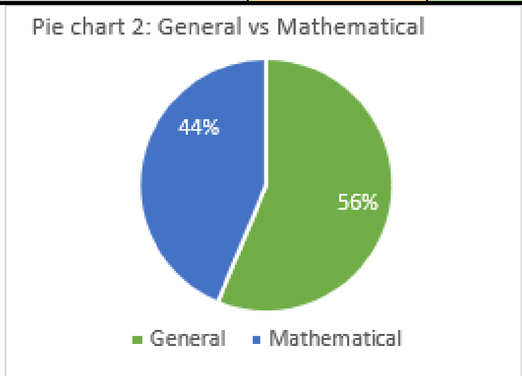

Langa recorded 37 coded reflections using four of the six lenses of the SLF. He did not reflect on Goals and Interactions. Of the 37 coded ideas, 31 were descriptions and six were explanations, there being no suggestions or ideas displaying reflectivity. Seven of the 31 descriptions were GDs, two of them followed by simple explanations. For example: *She then had to explain the activity again for learners* ***so that*** *they can understand what is expected of them* (Langa S3. C31 & C32). On the other hand, 24 out of the 31 descriptions were MDs and four of the MDs were also followed by simple explanations. One such example is: *Learners were shown how to use number-line so as to solve the sums easily* (Langa S3. C9 & C10). Langa's reflections were largely at the lower levels of the FLRM, with 84% of his reflections being at level 1, 16% at level 2 and none at levels 3 and 4 (see pie chart 1). Seventy-six per cent of Langa's reflections were mathematical and 24% were general (see pie chart 2).

**Summary and analysis of Lethu's S3 reflections**

Summaries of Lethu's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE° | ME | ME° | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | |
| 25 | 4 | 25 | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 63 |
| 29 | | 26 | | 4 | | 1 | | 2 | | 1 | | 0 | 0 | 63 |
| 55 | | | | 5 | | | | 3 | | | | 0 | | 63 |



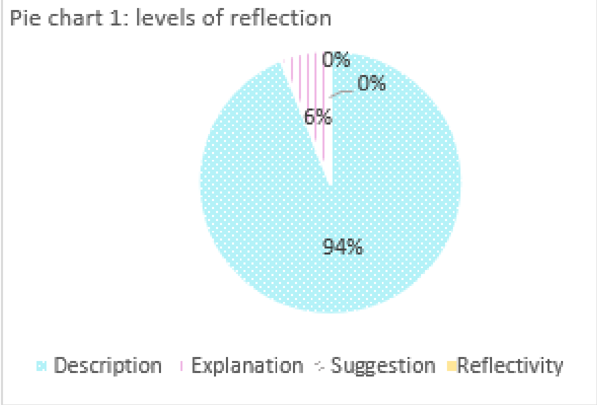



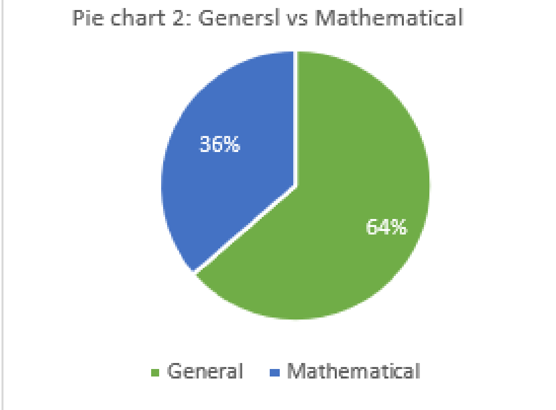

Lethu wrote down 63 coded reflections using all six lenses of the SLF. Of the 63, 55 were descriptions, five were explanations, three were suggestions and there were no ideas displaying reflectivity. Twenty-nine of the 55 descriptions were GDs, and four of these were followed by simple explanations. One such example is: *Her possible reasons for denuding on the goal was maybe she could see that her learners were struggling* (Lethu S3. C31 & C32). Twenty-six of Lethu's 55 descriptions were MDs, only one followed by a simple explanation: *She used questioning **so as to** test their number sense of mental maths* (Lethu S3. C12 & C13). Lethu also wrote two GSs and one MS. One of the GSs was followed by a simple explanation: *She should have slowed down **so that** slow learners can also understand* (Lethu S3. C55 & C56). The MS. however, was not followed by an explanation. She wrote: *She [the teacher] could have given them a worksheet with more sums* (Lethu S3. C47). While Lethu's reflections extended across the first three levels of the FLRM, most were at the lower levels of the FLRM, with 87% at level 1, 8% at level 2 and only 5% at level 3. There were no reflections at level 4 (see pie chart 1). Forty-four per cent of Lethu's reflections were mathematical and 56% were general (see pie chart 2).

**Summary and analysis of Liz's S3 reflections**

Summaries of Liz's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | |
| 19 | 1 | 10 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 20 | | 11 | | 1 | | 1 | | 0 | | 0 | | 0 | | 33 |
| 31 | | | | 2 | | | | 0 | | | | 0 | | 33 |



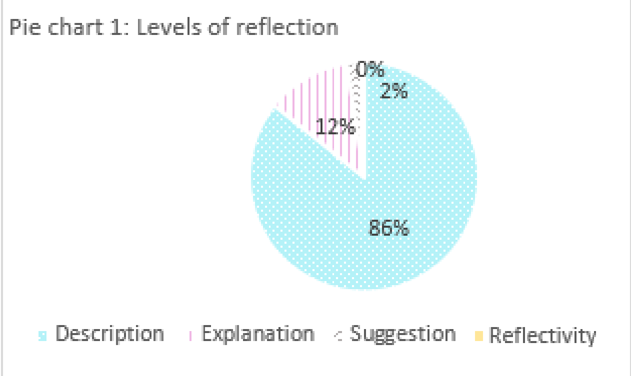



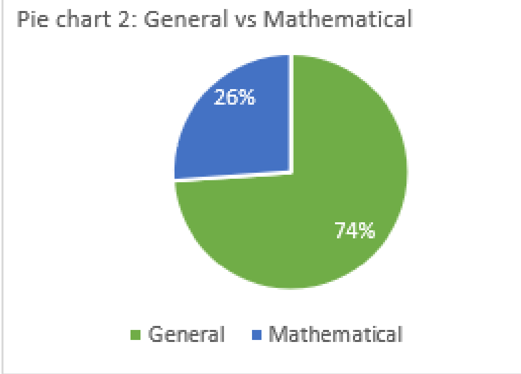

Liz wrote 33 coded reflections using all six lenses of the SLF. Thirty-one out of 33 coded ideas were descriptions and only 2 were explanations. There were no suggestions and no ideas demonstrating reflectivity. Twenty of the 31 descriptions were GDs and only one of these was followed by a simple explanation: *She [the teacher] ask them questions like "how did you get the answer?" "why?"* ***to*** *push them to justify* (Liz S3. C6 & C7). Also, only 11 of the 33 descriptions were mathematical, with one followed by a simple explanation: *She gives them different maths problems to do mental maths on their heads* ***so as to*** *teach them mathematical ideas* (Liz S3, C3 & C4). Thus, Liz's reflections were at the lower levels of the FLRM, with 94% of the reflections at level 1, only 6% at level 2, and no reflections at levels 3 and 4 (see pie chart 1). A minority of 36% of Liz's reflections were mathematical, while 64% were general (see pie chart 2).

**Summary and analysis of Lutho's S3 reflections**

Summaries of Lutho's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE° | ME | ME° | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 23 | 3 | 9 | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 42 |
| 26 | | 10 | | 4 | | 1 | | 1 | | 0 | | 0 | | 42 |
| 36 | | | | 5 | | | | 1 | | | | 0 | | 42 |



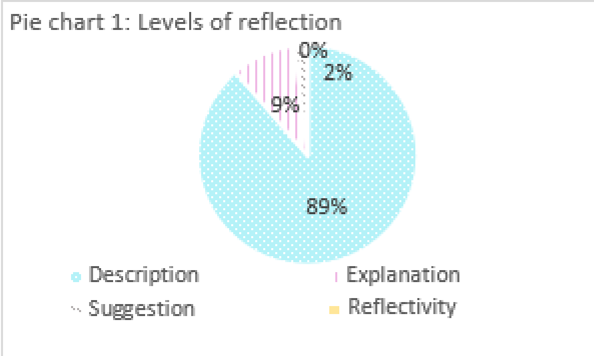



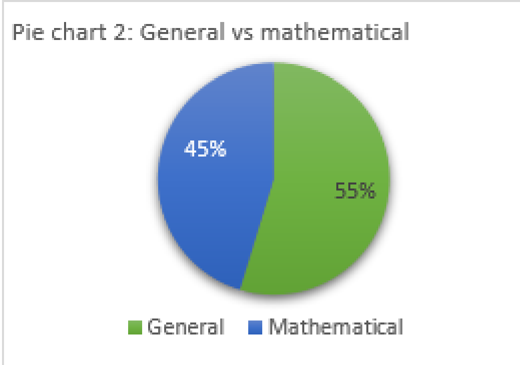

Lutho wrote 42 coded reflections using all six lenses of the SLF. Thirty-six of the 42 were descriptions, five were explanations, only one was a suggestion and there were no ideas under reflectivity. Among the 36 descriptions, 26 were GDs, three of them followed by a simple explanation such as: ***Her** [the teacher] **possible reasons*** for denuding on the goal was maybe she could see that her learners were struggling" (Lutho S3. C31 &C32). On the other hand, only 10 out of the 42 descriptions were MDs and only one of these was followed by an explanation: *She then used a number line 38 **so as to** rectify this problem* (Lutho S3. C37 & C38). Lutho made only one GS followed by an explanation, writing: *Other strategies such as using a spider diagram **could have** made her lesson more interesting and easier* (Lutho S3. C3 & C4). Thus, while Lutho's reflections spanned three levels of the FLRM, her reflections were mostly at the lower levels of the FLRM, with 86% of the reflections being at level 1, 8% at level 2, 5% at level 3 and none at level 4 (see pie chart 1). Twenty-six per cent of Lutho's reflections were mathematical and 74% were general (see pie chart 2).

**Summary and analysis of Mandy's S3 reflections**

Summaries of Mandy's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE° | ME | ME° | GS | GS→E | MS | MS→E | GR | MR | |
| 26 | 1 | 16 | 4 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 53 |
| 27 | | 20 | | 1 | | 4 | | 1 | | 0 | | 0 | | 53 |
| 47 | | | | 5 | | | | 1 | | | | 0 | | 53 |



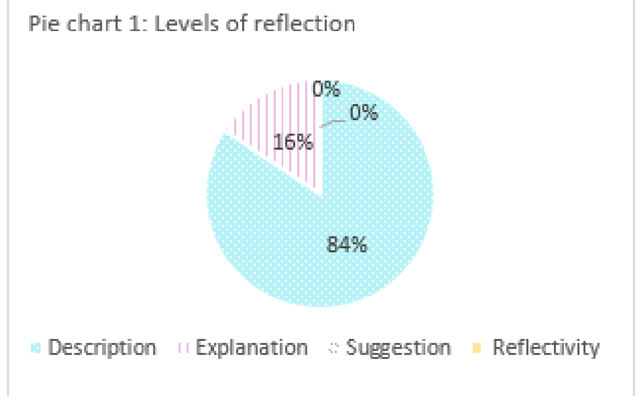



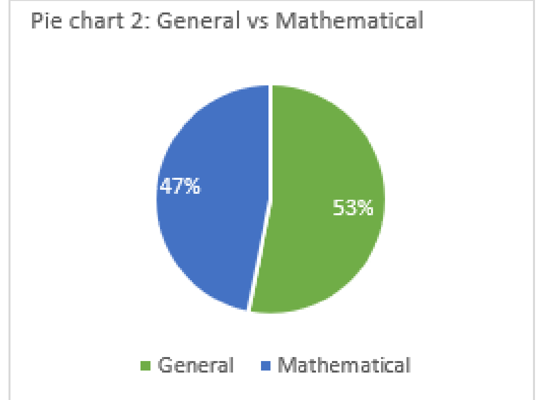

Mandy wrote 53 coded reflections using all six lenses of the SLF. As many as 47 of the 53 were descriptions, five were explanations, only one was a suggestion, while there were no ideas demonstrating reflectivity. Twenty-seven of the 47 descriptions were GDs and one these was followed by a simple explanation, where Mandy wrote: *She asked the learners how they got their answer* ***so as to*** *promote discussion* (Mandy S3. C26 & C39). On the other hand, 20 out of the 47 descriptions were MDs and four of the MDs were followed by simple explanations, such as: *The heart of the lesson is addition, specifically bonds of 10* ***because*** *the fizz pop game was on bonds of 10* (Mandy S3. C1 & C2). Thus, Mandy's reflections stretched across the first three levels of the FLRM but were mostly at the lower levels, with 89% at level 1, 9% at level 2, only 2% at level 3 and no reflections at level 4 (see pie chart 1). On the other hand, 45% of Mandy's reflections were mathematical while 55% were general (see pie chart 2). Mandy is one of the eight PSTs who recorded less than 50% mathematical reflections.

**Summary and analysis of Marylyn's S3 reflections**

Summaries of Marylyn's reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 9 | 4 | 13 | 1 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | 32 |
| 13 | | 14 | | 4 | | 1 | | 0 | | 0 | | 0 | | 32 |
| 27 | | | | 5 | | | | 0 | | | | 0 | | 32 |



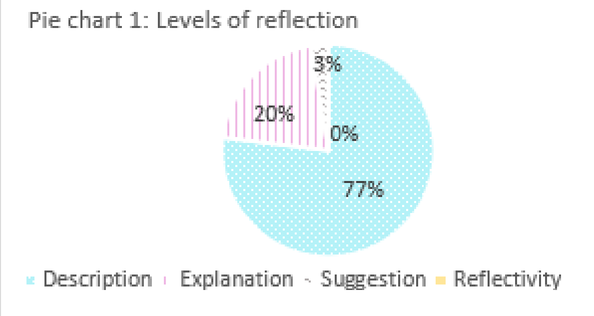



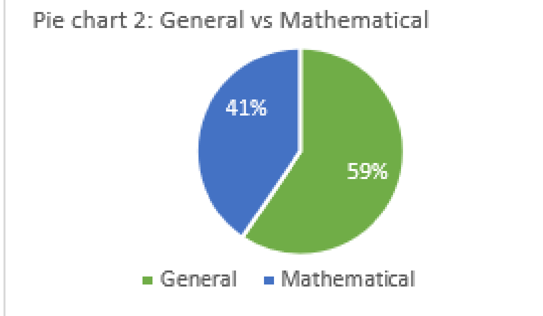

Marylyn wrote 32 coded reflections using all six lenses of the SLF, 27 of which were descriptions and five, explanations There were no suggestions nor ideas displaying reflectivity. Thirteen of the 27 descriptions were GDs and four of the 13 GDs were followed by simple explanations, such as: *The activity is teacher and learners centred **because** she did not allow them to work with other learner* (Marylyn S3. C24 & C25). Of the 27 descriptions, 14 were MDs, one of them followed by a simple explanation: *The teacher uses open-ended questions MD→$^{E}$ 18 **to** promote the meta-mathematical idea she had* (Marylyn S3. C17 & C18). While the description sounds more general than mathematical, it was coded as mathematical because its explanation was mathematical. Marylyn's reflections were at the lower levels of the FLRM, with 84% at level 1 and only 16% at level 2. As seen in pie chart 1, there were no reflections at levels 3 and 4. Further analysis showed that 47% of Marylyn's reflections were mathematical while 53% were general (see pie chart 2). This makes Marylyn one of the eight PSTs whose mathematical reflections weighed in at less than 50%.

### Summary and analysis of Micky's S3 Reflections

Summaries of Micky's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | 39 |
| 13 | 4 | 9 | 4 | 3 | 1 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 39 |
| 17 | | 13 | | 4 | | 4 | | 1 | | 0 | | 0 | | 39 |
| 30 | | | | 8 | | | | 1 | | | | 0 | | |



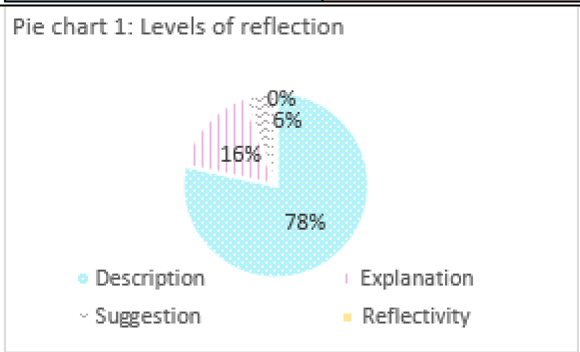



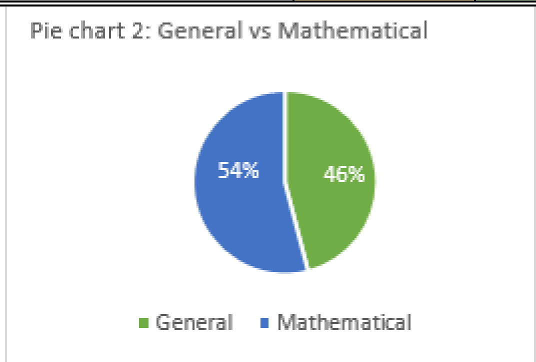

Micky wrote 36 coded reflections using all six lenses of the SLF. Thirty of these were descriptions and eight were explanations. There was only one suggestion and no ideas displaying reflectivity. Seventeen of the 30 descriptions were GDs and three of these were followed by simple explanations, one expanded to include three ideas: *The chorus answering may cause a problem $GD^{\to E}$ 35* ***because*** *the children may parrot each other. This means that a student may not understand, and the teacher may not know* (Micky S3. C34 & 35). After this analysis Micky made a suggestion for improving future instruction. She wrote that: ***She [the teacher] could*** *in the future ask specific children rather than doing chorus answering* (Micky S3. C36). This was Micky's only suggestion. Micky engaged this incident critically. She identified the incident, described and provided an explanation for it and went further to suggest what could be done in future to improve instruction. She did not, however, analyse the incident from different perspectives, which meant that this reflection could not be coded as level 4 (reflectivity). Micky also wrote 13 MDs and four of these were followed by simple explanations, such as: *She used the concept of the number line but not a concrete one, rather a number line in their head.* ***This and the other activities are used to*** *make the bonds of 10 easier* (Micky S3. C20 & C21). Thus, Micky's reflections spanned three levels of the FLRM but were mostly at the lower levels, with 77% of the reflections being at level 1, 20% at level 2, and 3% at level 3. There were no reflections at level 4 (see pie chart 1). Only 41% of Micky's reflections were mathematical and 59% were general (see pie chart 2). She is also therefore among the eight PSTs who recorded less than 50% mathematical reflections.

**Summary and analysis of Ronny's S3 reflections**

Summaries of Ronny's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^e | ME | ME^e | GS | GS→E | MS | MS→E | GR | MR | |
| 13 | 1 | 12 | 3 | 1 | 1 | 4 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 37 |
| 14 | | 15 | | 2 | | 4 | | 1 | | 1 | | 0 | 0 | 37 |
| 29 | | | | 6 | | | | 2 | | | | 0 | | 37 |



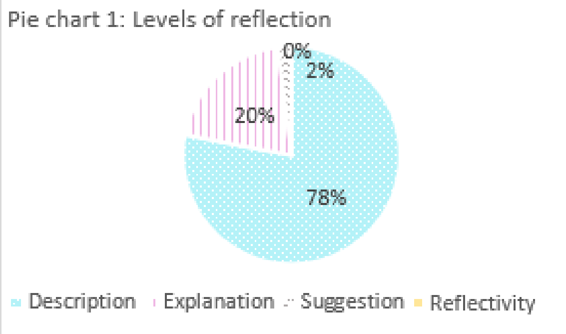



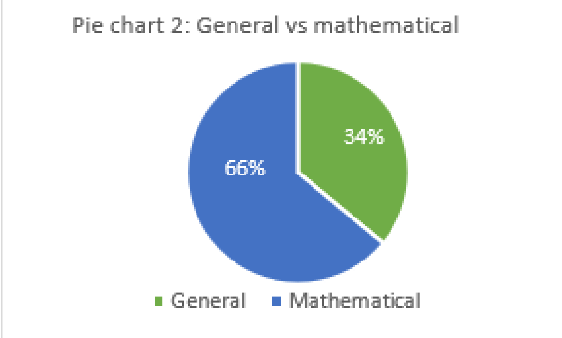

Ronny wrote 37 coded reflections using all six lenses of the SLF, 29 of them descriptions, six explanations and two suggestions. There were no ideas displaying reflectivity. Of the 29 descriptions, 14 were GDs, one of them followed by an expanded explanation with three ideas. He wrote: *She also wants the learners to work independently* ***because*** *they had to solve the problems alone. For example, when she asked them to have a picture on their minds. Each child got to think GE*$^{e2}$ (Ronny S3. C2 & C3). On the other hand, 15 of the 29 descriptions were MDs and three of these were followed by simple explanations, for example: *Teacher poses questions such as, What is the answer? How did you do it? What is the next ten?* ***to make*** *learners actively participate* (Ronny S3. C24 & C25). As mentioned above, Ronny also made two suggestions, one GS and one MS. The GS was: *Don't isolate learners from their strategies, this will make them dislike school* (C28 & C29); and the MS suggestion was: *Learners should do maths using their own strategies because this helps them to understand maths better* (Ronny S3. C31 & C32). As noted, both suggestions were followed by explanations. Ronny's reflections therefore spanned three levels of the FLRM but were mostly at the lower levels, with 78% at level 1, 16% at level 2, 6% at levels 3 and none at level 4 (see pie chart 1). Fifty-four per cent of Ronny's reflections were mathematical and 46% were general (see pie chart 2).

## Summary and analysis of Smith's S3 reflections

Summaries of Smith's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE° | ME | ME° | GS | GS→E | MS | MS→E | GR | MR | |
| 8 | 4 | 23 | 5 | 3 | 1 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 50 |
| 12 | | 28 | | 4 | | 5 | | 1 | | 0 | | | | 50 |
| 40 | | | | 9 | | | | 1 | | | | 0 | | 50 |



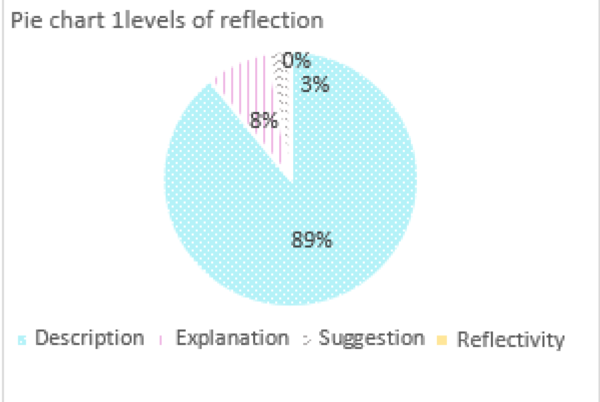



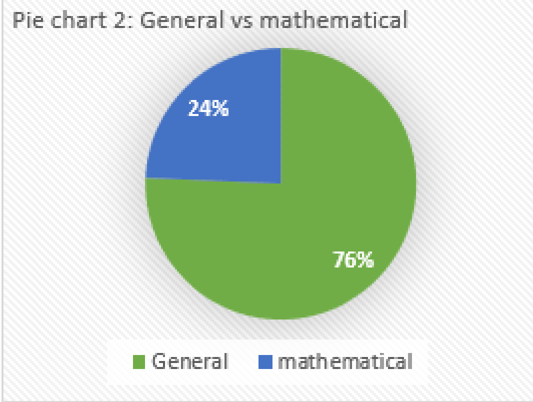

Smith wrote 50 coded reflections using all six lenses of the SLF. Forty out of 50 were descriptions, nine were explanations and there was only one suggestion. There were no ideas displaying reflectivity. Twelve of the 40 descriptions were GDs, four of them followed by explanations One of these had an expanded explanation with two ideas: *She [the teacher] would try to explain all methods for learners to try. **By this**, the teacher is helping the learner, the learner would get the correct answer* (Smith S3. C49 & C50). On the other hand, 28 out of the 40 descriptions were MDs, five of which were followed by explanations. There were three simple explanations and two expanded explanations. For example: *The benefit of the number line cannot go wrong, because it is easy to follow* (Smith S3. C28 & 29). Smith also wrote one MS with an explanation attached: *Learners must not rely on number line. It could take time with big sums* (Smith S3. C22 & C23). Smith's reflections therefore reached across three levels of the FLRM but were mostly at the lower levels, with 78% at level 1, 20% at level 2, only 2% at level 3 and no reflections at level 4 (see pie chart 1). Two-thirds (66%) of Smith's reflections were mathematical while 34% were general (see pie chart 2).

**Summary and analysis of Thula's S3 reflections**

Summaries of Thula's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 21 | 3 | 9 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 37 |
| 24 | | 9 | | 3 | | 0 | | 1 | | 0 | | 0 | | 37 |
| 33 | | | | 3 | | | | 1 | | | | 0 | | 37 |



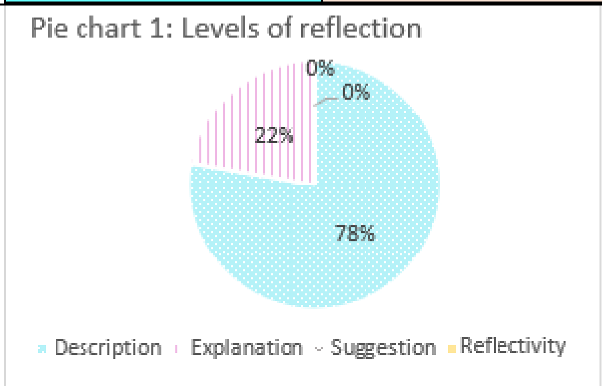



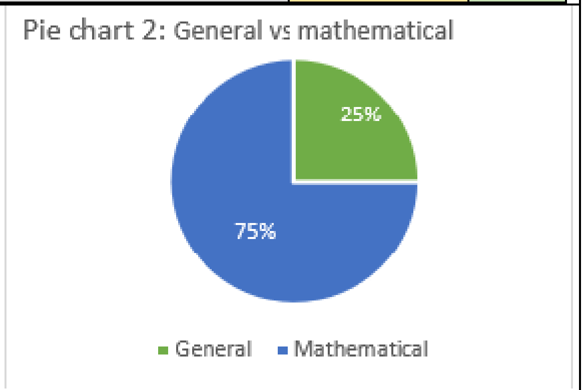

Thula wrote 37 coded reflections using all six lenses of the SLF, 33 of which were descriptions, three were explanations and one was a suggestion. There were no ideas that displayed reflectivity. Of the 33 descriptions, 24 were GDs, three of them followed by explanations. One such example of a GD with a rationale is: … *but there are some learners who are left behind* ***because*** *she [the teacher] doesn't attend to the learners' needs* (Thula S3. C29 & C30). On the other hand, only nine of the 33 descriptions were MDs, for example: *She teaches them how to count on and count back* (Thula S3. C13). No MD was followed by an explanation. Thula wrote one GS: *The teacher should involve all the learners in the lesson* (Thula S3. C17), but this had no explanation attached. Thus, while Thula's reflections spanned the first three levels of the FLRM, they were mostly at the lower levels, with 89% of them at level 1, 8% at level 2 and only 3% at level 3. There were no reflections at level 4 (see pie chart 1). Seventy-six per cent of Thula's reflections were mathematical while 24% were general (see pie chart 2).

## Summary and analysis of Tiny’s S3 reflections

Summaries of Tiny’s S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 4 | 2 | 17 | 5 | 2 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 36 |
| 6 | | 22 | | 3 | | 5 | | 0 | | 0 | | 0 | | 36 |
| 28 | | | | 8 | | | | 0 | | | | 0 | | 36 |



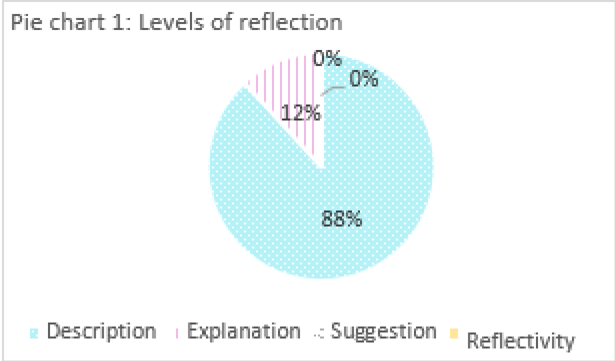



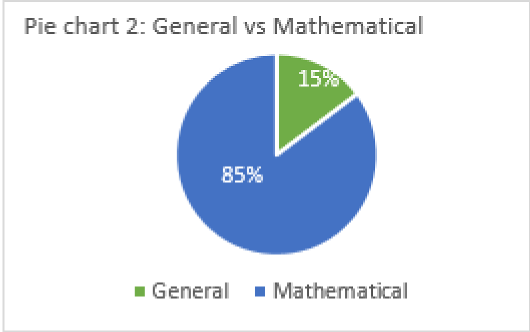

Tiny wrote 36 coded reflections using all six lenses of the SLF of which 28 were descriptions, eight were explanations. There were no suggestions or ideas displaying reflectivity. Six out of the 28 descriptions were GDs and only two of the six GDs were followed by explanations. One explanation comprised two ideas: *The lesson was learner centred* ***because*** *they kept answering questions and interacting with the teacher* (Tiny S3. C35 & 36). Most (22 out of 28) descriptions were MDs, and five of these were followed by explanations. Two of the five were expanded explanations with 2 ideas each, for example: *She used the number line to find to the nearest 10. By using a number line it is easy to find the nearest 10 and then seeing how much is left over to complete the addition sum* (Tiny S3. C4 & C5). Tiny’s reflections were therefore at the lower levels of the FLRM, with 78% of them at level 1, 22% at level 2, and none at levels 3 and 4 (see pie chart 1). Three-quarters (75%) of Tiny’s reflections were mathematical and 25% were general (see pie chart 2).

**Summary and analysis of Vee's S3 reflections**

Summaries of Vee's S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{\bullet}$ | ME | ME$^{\bullet}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 3 | 1 | 23 | 3 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| 4 | | 26 | | 1 | | 3 | | 0 | | 0 | | 0 | 0 | 34 |
| 30 | | | | 4 | | | | 0 | | | | 0 | | 34 |



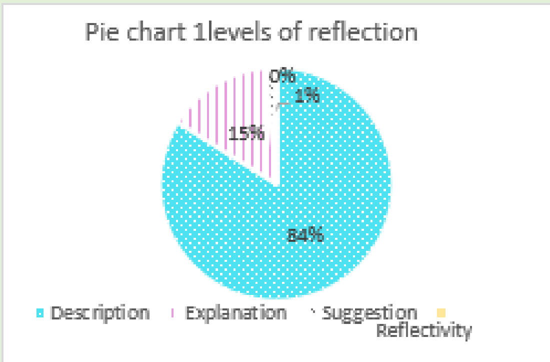

Vee wrote 34 coded reflections using all six lenses of the SLF. Thirty out of 34 ideas were descriptions, and four were explanations. There were no suggestions and no ideas displaying reflectivity. Four of the 30 descriptions were GDs and one of the four GDs was attended by a simple explanation: *Most of the time it is not that learners are unable to solve a problem, it is just that the instruction is not clear enough* (Vee S3. C33 & C34). As many as 26 of the 30 descriptions were mathematical, three of them followed by simple explanations such as *[the teacher was] using a number line as an aid to help [learners] add numbers* (Vee S3. C2 & C3). This places Vee's reflections at the lower levels of the FLRM, with 88% of the reflections at level 1, 12% at level 2 and 0% at levels 3 and 4 (see pie chart 1). A preponderance (85%) of Vee's reflections were mathematical and 15% were general (see pie chart 2).

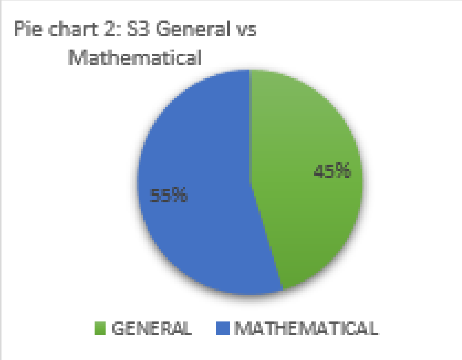
### *5.1.3.1 Summary of S3 reflections*

In this section I provide an overview of S3 to reach some general conclusions about the PSTs' reflections during the session. Table 5.6, below, presents summaries of all 19 PSTs' S3 reflections, followed by a brief analysis.

*Table 5. 6: Overview of summaries of S3 PSTs' reflections*

| Name of PST | Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | GD-+ | MD | MD-+ | GE | GE* | ME | ME* | GS | GS-+ | MS | MS-+ | GR | MR | Total |
| Alice | 7 | 0 | 26 | 5 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| Bonga | 20 | 2 | 19 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| Charity | 19 | 4 | 28 | 5 | 4 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| Dee | 10 | 3 | 15 | 8 | 3 | 0 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 47 |
| Joy | 16 | 2 | 7 | 7 | 2 | 0 | 6 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 42 |
| Langa | 5 | 2 | 20 | 4 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| Lee | 11 | 3 | 11 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| Lethu | 25 | 4 | 25 | 1 | 4 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 63 |
| Liz | 19 | 1 | 10 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| Lutho | 23 | 3 | 9 | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 42 |
| Mandy | 26 | 1 | 16 | 4 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 53 |
| Marylyn | 9 | 4 | 13 | 1 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| Micky | 13 | 4 | 9 | 4 | 3 | 1 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 39 |
| Ronny | 13 | 1 | 12 | 3 | 1 | 1 | 4 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 37 |
| Smith | 8 | 4 | 22 | 5 | 4 | 1 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 50 |
| Thula | 21 | 3 | 9 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 57 |
| Tiny | 4 | 2 | 17 | 5 | 2 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| Dumie | 9 | 6 | 22 | 5 | 5 | 1 | 4 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 55 |
| Vee | 3 | 1 | 23 | 3 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| Total | 261 | 50 | 313 | 64 | 46 | 7 | 53 | 13 | 5 | 3 | 2 | 2 | 0 | 0 | 819 |
| | 311 | | 377 | | 53 | | 66 | | 8 | | 4 | | 0 | 0 | 819 |
| | 688 | | | | 119 | | | | 12 | | | | 0 | | 819 |




The 19 PSTs recorded a total of 819 coded ideas in S3 using the six lenses of the SLF. Some 84% of these were descriptions and therefore level 1 reflections, 15% were explanations and therefore level 2 reflections, and only 1% were suggestions and level 3 reflections. There were no

reflections at level 4. There was no wide margin between the numbers of general and mathematical reflections. As seen in pie chart 2, 45% of reflections were general and 55% mathematical. The group pie charts below give a general visual overview on how each of the 19 PSTs contributed to the group overview pie charts above. Figure 5.11, below, presents the pie charts showing the PSTs' levels of reflection in S3.

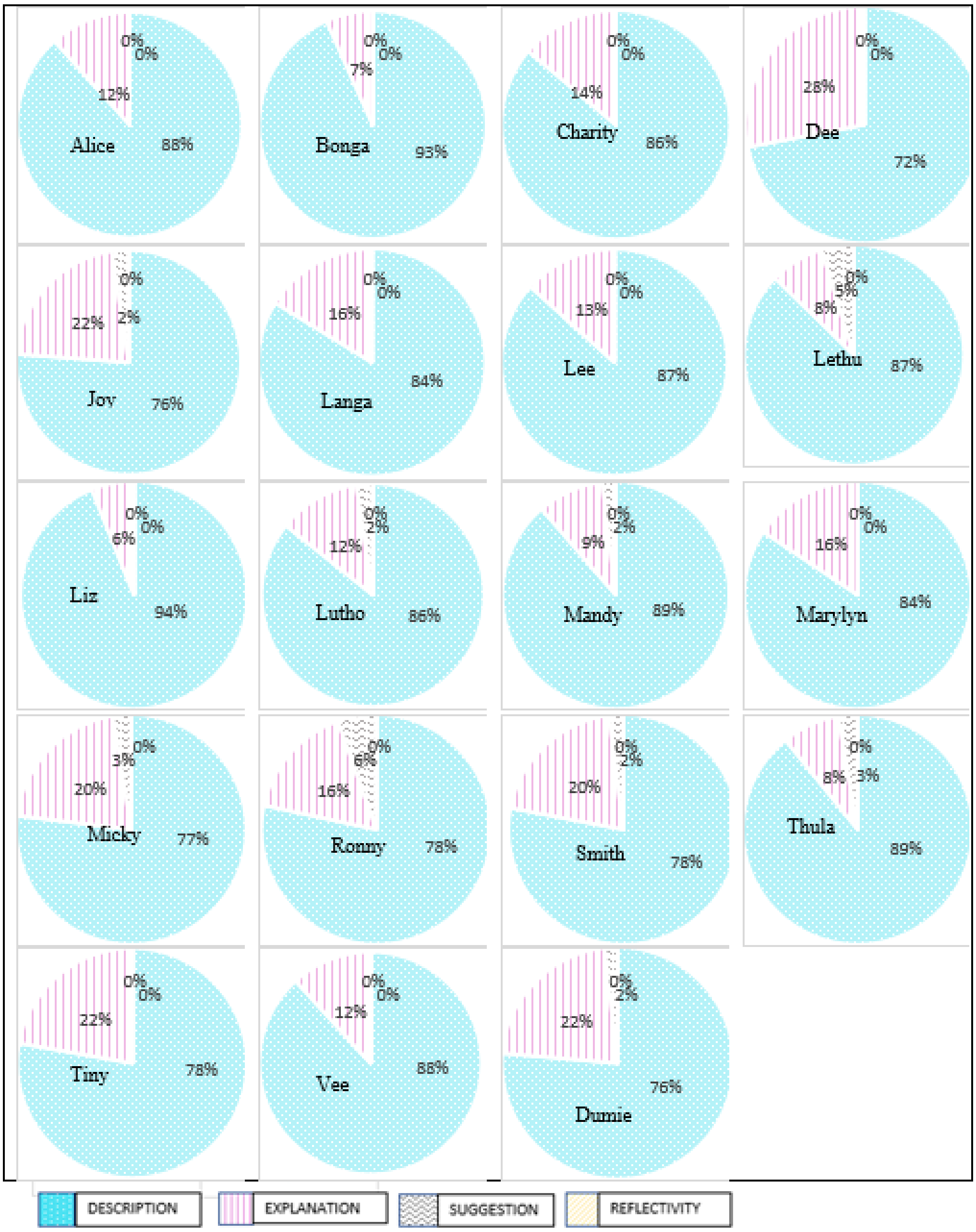



*Figure 5. 11: Overview summaries of PSTs' S3 levels of reflection*

The dominant baby blue colour in the grouped individual PSTs' pie charts reflects the dominance of descriptions in the PSTs' S3 reflections. However unlike in S1 and S2, no PST wrote reflections that were 100% descriptive. In S1 six PSTs had 100% descriptions. The number went down to two in S2 and zero in S3.

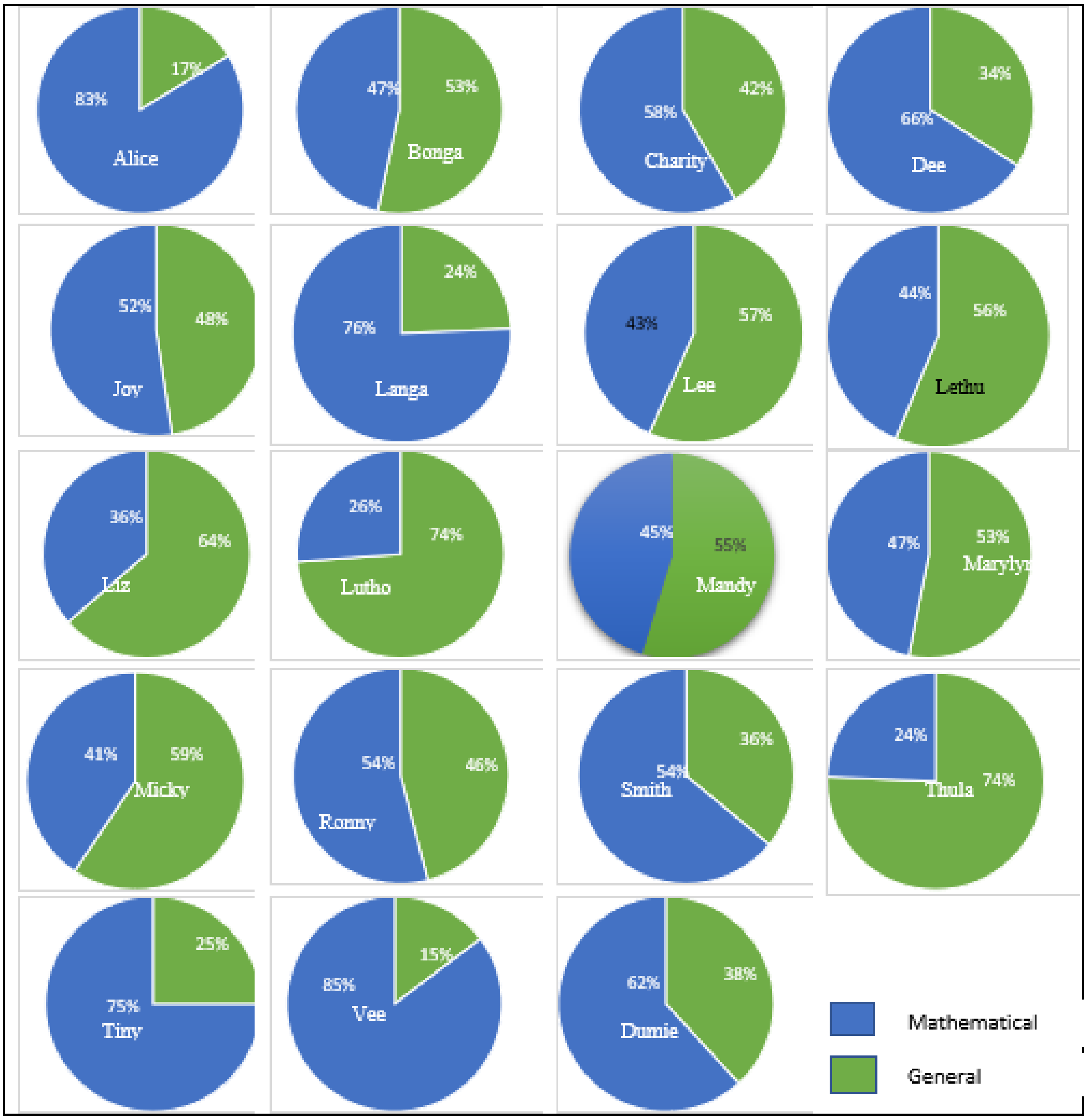



*Figure 5. 12: Mathematical versus general reflections in S3*

While the group's pie charts for general versus mathematical reflections in Figure show that the mathematical reflections were more numerous than the general ones, the difference is not abundantly obvious at a glance at the grouped individual pie charts in Figure 5.12, above. No colour is obviously dominant, as was the case with the S2 pie charts. While there were more mathematical reflections than general reflections in S3, the margin between them was not large. In S3 no PST wrote reflections that were either completely mathematical or 100% general, happened in S1 when six PSTs wrote reflections that were 100% general and one PST wrote reflections that were 100% mathematical. In S2 one PST wrote reflections that were 100% mathematical. In S3 ten PSTs wrote reflections that had more mathematical reflections than general and nine PSTs wrote reflections that were more general than mathematical.

### 5.1.4 Concluding Chapter 5 Part 1

Chapter 5 Part 1 sought to establish the nature of the reflections in which PSTs engaged when they analysed video-recorded lessons. The part was divided into three sections corresponding to the three sessions of analysis, with each section presenting the reflections or summaries of reflections that were recorded during that session.

*Table 5. 7: Overview of PSTs' levels of reflection and general versus mathematical reflections in the three session of reflective practice.*

| Session | LEVELS OF REFLECTION | | | | GENERAL VS MATHEMATICAL | |
|---|---|---|---|---|---|---|
| | Level 1 DESCRIPTION | Level 2 EXPLANATION | Level 3 SUGGESTION | Level 4 REFLECTIVITY | GENERAL | MATHEMATICAL |
| S1 | 88% | 11% | 1% | 0% | 71% | 29% |
| S2 | 84% | 14% | 2% | 0% | 37% | 63% |
| S3 | 84% | 15% | 1% | 0% | 45% | 55% |

In this part of the chapter I established that the PSTs' reflections were predominantly at the lowest level of the FLRM, with PSTs describing classroom events. Few of these descriptions were followed by explanations, very few suggestions were made, and no PST displayed any reflectivity. This aligns with Ward and McCotter's (2004) contention that PSTs do not know how to reflect, and rather assume that to reflect is to describe what transpired in a lesson. As seen in Table 5.7, level 1 reflections were above 80% in all cases, level 2 reflections increased steadily in small increments from S1 to S3. There was alternation between 1% and 2% at level 3 over the three sessions. PSTs were generally content to describe classroom events rather than provide a rationale for them and were less likely still to suggest alternative events. The steady increase in level 2 reflections from 11% in S1 to 14% in S2 and 15% in S3 suggests that PSTs were shifting marginally to higher levels of reflection over the three sessions. The exception is level 4, which no PST reached during the three sessions. This concurs with what Poom-Valickis and Mathews (2013) found in their study that PSTs' reflections on other teachers' practice graduated to higher levels as they reflected over time. In this study, while the percentage of suggestions went up from 1% to 2% in S2 and down again to 1% in S3, the number of individual PSTs going beyond providing explanations to making suggestions grew from 1 in S1 to four in S2 and again to 7 in S3. The implication is that a small number of PSTs were now starting to spread their reflections to higher levels of reflection (level three), although the reflections on this level admittedly remained very few. However, there was a notable shift of focus from general classroom occurrences to mathematical ones, witnessed by an increase in mathematical reflections from 29% in S1 to 63% in S2. This percentage declined to 55% in S3. These shifts and possible reasons for them are discussed in the second part of this chapter.

# CHAPTER 5 PART 2

# HOW DOES THE NATURE OF THE PSTS' REFLECTIONS CHANGE OVER TIME, IF AT ALL?

## 5.2 INTRODUCTION

As indicated in Table 5.1, above, in this part of the chapter I respond to my second research question, which asks: 'How does the nature of the PSTs' reflections change over time, if at all?' In order to respond to this question, I compared the PSTs' reflections across the three sessions. First, I compared the overviews of the reflections of all the participants in S1, S2 and S3 to look for possible changes in the coding summaries of PSTs' reflections. But because of changes in the types and number of lenses that PSTs used during these three sessions, I realised that such a comparison could be more complex. I therefore also compared the PST reflections recorded when the lenses remained constant across sessions, to counter the possibility of reflections changing as a result of the types of lenses being used. In this respect I compared the reflections of the ten PSTs who were in groups 2 and 4 during S1 and who used the lenses MMI and Tasks in all three sessions (S1, S2 and S3), to ascertain whether any shifts took place over time in relation to these lenses. (These were the only learners for whom the same two lenses were used in all three sessions). I therefore made a second comparison involving these ten PSTs' reflections and the two lenses concerned. The next section compares the summaries of all the PSTs' levels and foci of reflections across the three sessions.

### 5.2.1 Comparing PSTs' reflections over the three sessions

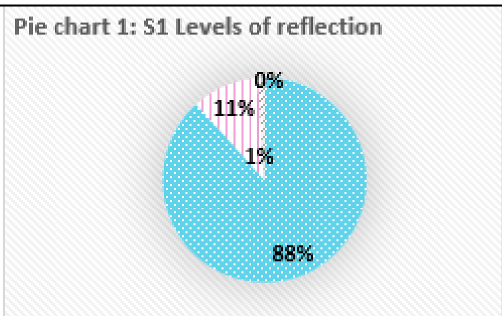
This section compares all the participants' reflections among S1, S2 and S3 to establish a general perspective on whether there were any changes in the way PSTs reflected as they moved from one session to the next. I sought to ascertain if there were any shifts in levels of reflection or in the focus of general versus mathematical reflections over the three sessions. In Figure 5.12 I present summaries of all the participants' reflections from S1 to S3.

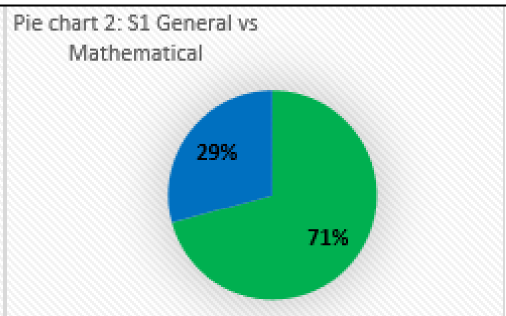
| SESSION | SUMMARIES OF PSTs' REFLECTIONS |
|---|---|

**S1**

2 lenses (different 2 lenses per group)

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 98 | 16 | 49 | 3 | 12 | 5 | 3 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 188 |
| 114 | | 52 | | 17 | | 3 | | 4 | | 0 | | 0 | 0 | 188 |
| 166 | | | | 20 | | | | 4 | | | | 0 | | 188 |



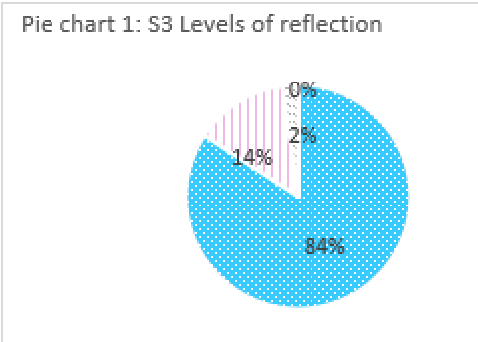



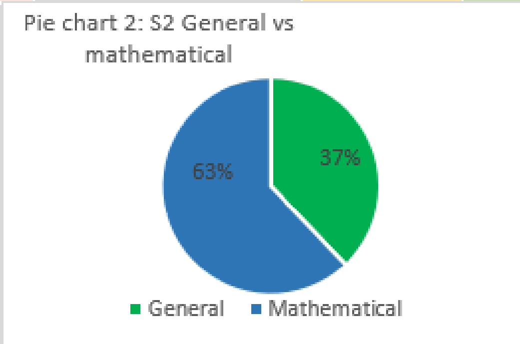

**S2**

3 lenses All PSTs same 3 lenses

Summaries of S2 Reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 85 | 14 | 130 | 22 | 9 | 5 | 20 | 6 | 0 | 0 | 3 | 4 | 0 | 0 | 298 |
| 99 | | 152 | | 14 | | 26 | | 0 | | 7 | | 0 | 0 | 298 |
| 251 | | | | 40 | | | | 7 | | | | 0 | | 298 |



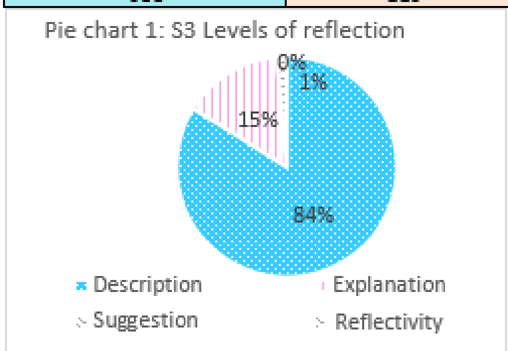




**S3**

6 lenses All PSTs given all 6 lenses

Summaries of S3 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 262 | 49 | 313 | 64 | 46 | 7 | 52 | 14 | 5 | 3 | 2 | 2 | 0 | 0 | 819 |
| 311 | | 377 | | 53 | | 66 | | 8 | | 4 | | 0 | 0 | 819 |
| 688 | | | | 119 | | | | 12 | | | | 0 | | 819 |



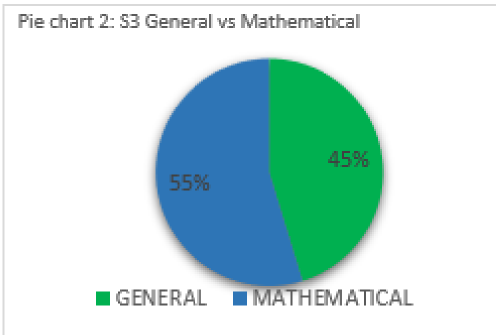




*Figure 5. 13: Summaries of all the three sessions' reflections*

As can be seen in Figure 5.12, there has been an increase in the quantity of reflections between the sessions mainly as a result of the increasing number of lenses the PSTs had to reflect with from session to session. In S1 each PST was assigned to reflect with only two lenses. As discussed earlier, these two lenses differed from group to group. In S2 they were all assigned to reflect on the same three lenses (MMI, Tasks and Goals), and in S3, they were all assigned to reflect with all six lenses, hence the large number of reflections. As revealed in Figure 5.13, the PSTs' reflections for all the three sessions were generally at the lower levels of the FLRM, with above 80% of reflections at level 1 for all the sessions. The percentage of descriptions shifted downwards from 88% in S1 to 84% in S2 and remained at 84% in S3. The proportion of explanations, on the other hand, rose slightly from session 1 to session 3. In S1 there were 11% explanations, which increased to 14% in S2 and increased again to 15% in S3, suggesting that more PSTs were starting to provide a rationale for the classroom occurrences that they had described. Suggestions were low across all three sessions. The suggestions increased from 1% in S1 to 2% during S2, then declined to 1% in S3. There was therefore a discernible shift to higher levels of reflection, particularly for level 2 reflections. There was also a notable shift of focus from general to mathematical between S1 and S2. As seen in Figure 5.10, mathematical reflections increased from 29% to 63% in S2. However, this figure reduced to 55% in S3.

For further analysis I provide Figure 5.14 with the pie charts of individual PSTs levels of reflection for all the three sessions. As can be seen in Figure 5.14. below, during S1 only one PST reflected up to level 3. In S2, the number of PSTs who wrote suggestions increased to four. However, Langa, the PST who had made a suggestion in S1, is not one of the four who wrote suggestions in S2, and he did not make any suggestions in S3 either. There was another increase in the number of PSTs who wrote suggestions in S3, from four in S2 to seven in S3. However only two of the PSTs, Lethu and Thula, who had written suggestions in S2 also wrote suggestions in S3. The other two did not make any further suggestions in S3. While there is only a small change in the levels of most of the PSTs' reflections, some PSTs' (such as Ronny and Smith) reflections shifted from being 100% at level 1 in S1 to having some level 2 reflections and then some level 3 reflections in S3. However, these shifts could be related to the changes in lenses used by these learners across the sessions. I will make further investigations in the next section, where I compared the reflections of the ten PSTs who reflected using MMI and Tasks in S1 with their reflections on the same lenses in S2 1nd S3.

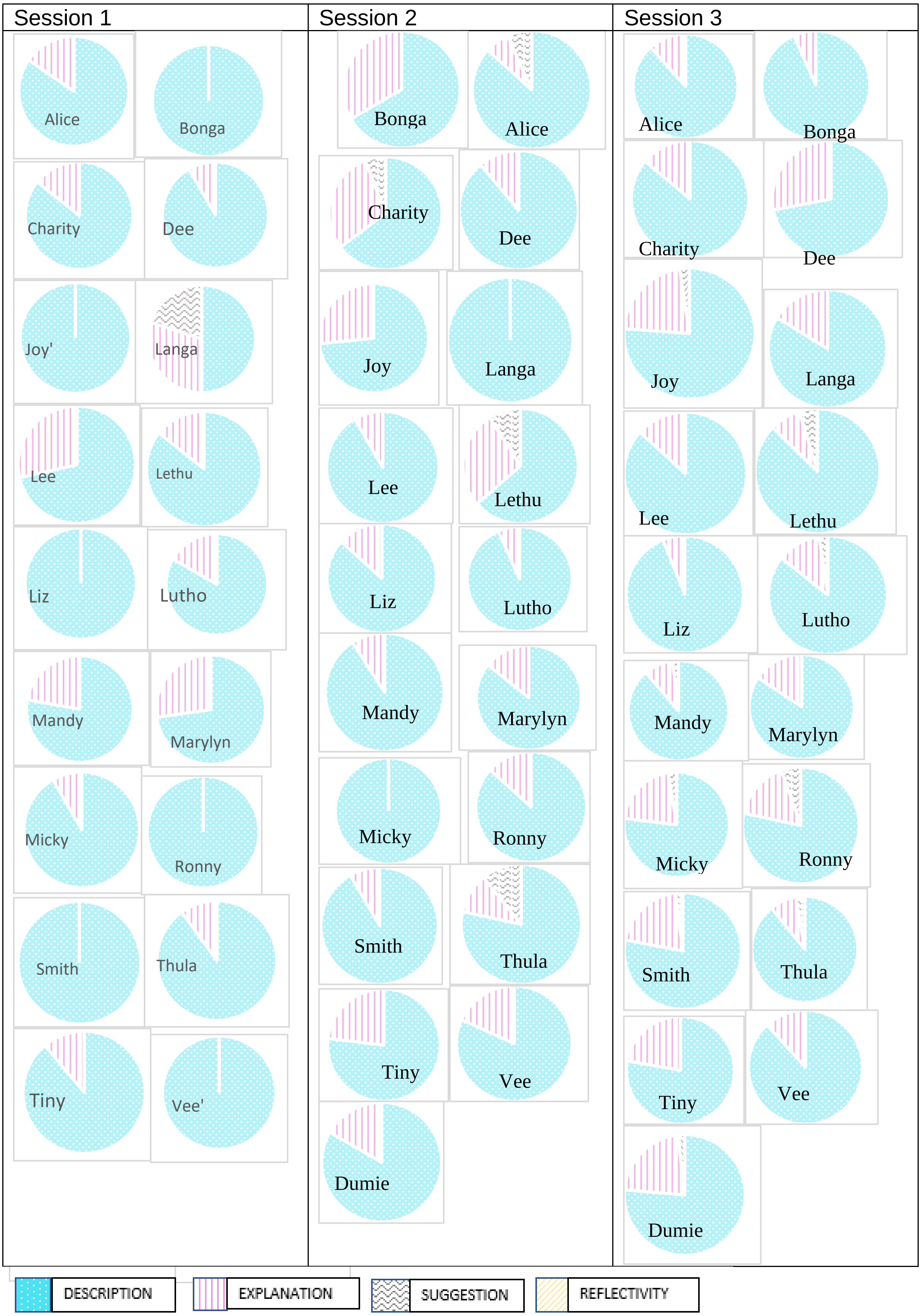



*Figure 5. 14: Summaries of PSTs' levels of reflection for all three sessions*

In Figure 5.15, I grouped all the PSTs' pie charts comparing general versus mathematical reflections. As mentioned earlier, the mathematical reflections increased from 29% in S1 to 63% in S2 but went down to 55% in S3. The general reflections deceased proportionately from 71% in S1 to 37% in S2 but increased to 45% in S3. This focus on individual PSTs shows how green dominated in S1, with 16 PSTs writing more than 50% general reflections. Only one PST, Dee, wrote down 100% mathematical reflections in S1. Thus, the majority of PSTs focused on general classroom events during S1. In S2 12 PSTs reached 50% and above for mathematical reflections. This is evidenced by the dominant blue colour in individual PSTs' S2 pie charts in Figure 5.15. Another shift occurs from S2 to S3, when there is a general decline in the percentage of mathematical reflections and an increase in general reflections. Many factors may have contributed to this change, including the possible effects of the increase in the number of the lenses used, and the fact that some lenses may invite both mathematical and general reflections. I will investigate the effects of each type of lens on PSTs' reflections in Section 5.4. In the next section I compare PSTs' reflections over the sessions when using the same lenses.

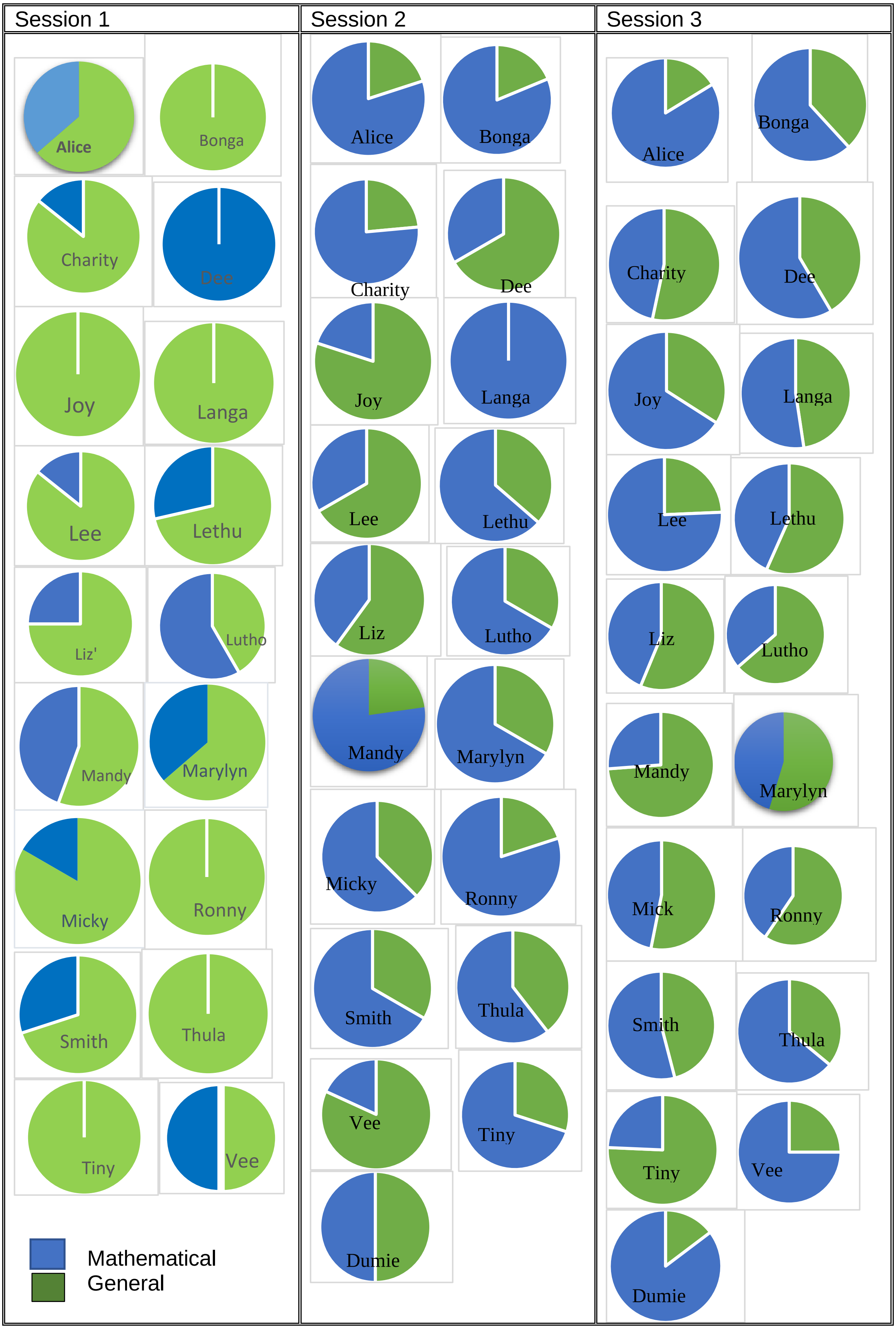



*Figure 5. 15: Summaries of PSTs general versus mathematical reflections over the sessions*

### 5.2.2 Are there any shifts in PSTs' reflections when the same lenses are used?

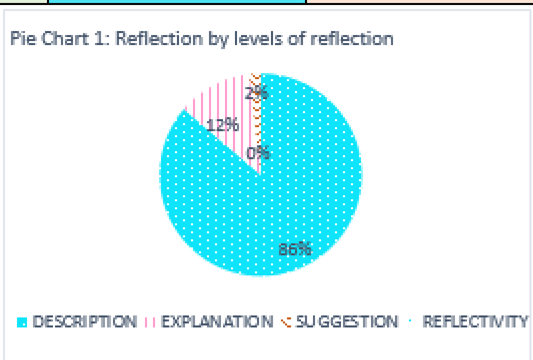
This section seeks to ascertain if there were any shifts in the nature of PSTs' reflections when their reflections were performed using the same lenses. To achieve this, I focus on the lenses used in all three sessions by two groups of PSTs. Only PSTs who were in Groups 2 and 4 during Session 1 used the same two lenses in all three sessions, namely, MMI and Tasks. I therefore grouped together the reflections on MMI, and Tasks made in each session by the ten PSTs concerned, I made group summaries for each session and compared them. In the next section I present these summaries and the results of the comparison.

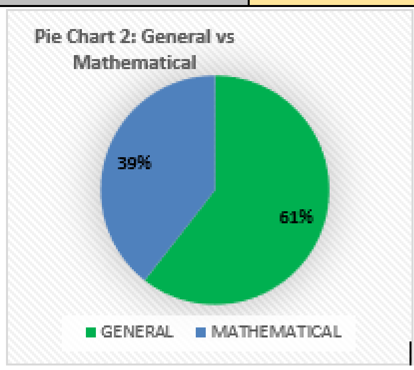
#### *5.2.2.1 Summaries of the ten PSTs' S1 reflections on MMI and Tasks*

The following is a summary of the ten PSTs' reflections on MMI and Tasks for S1

*Table 5. 8: S1 coding matrix on Mathematical Ideas and Tasks and Activities for the Groups 2 and 4, pre-service teachers*

| | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | $GD^{-E}$ | MD | $MD^{-E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{-E}$ | MS | $MS^{-E}$ | GR | MR | Total |
| Alice | 5 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Lutho | 3 | 1 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Mandy | 1 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Vee | 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Smith | 7 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Thula | 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Marylyn | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Liz | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Langa | 3 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 10 |
| Dee | 0 | 0 | 10 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| TOTAL | 43 | 10 | 39 | 2 | 9 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 109 |
| | 53 | | 41 | | 11 | | 2 | | 2 | | 0 | | 0 | 0 | 109 |
| | 94 | | | | 13 | | | | 2 | | | | 0 | | 109 |

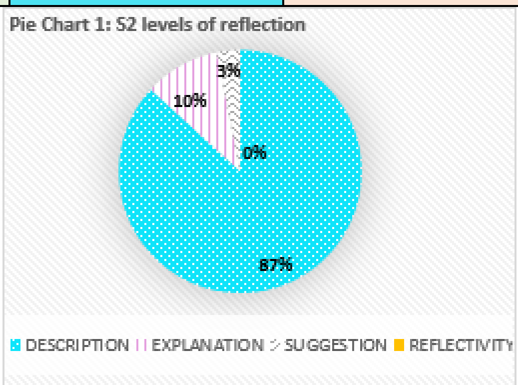


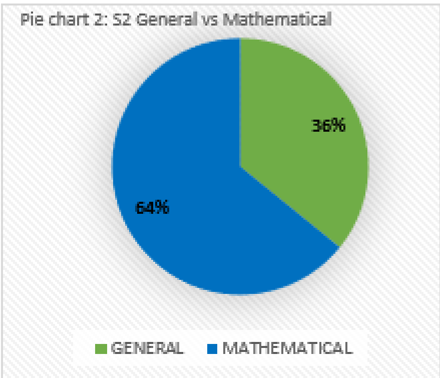




During S1, the ten PSTs in groups 2 and 4 wrote a total of 109 ideas using the MMI and Tasks. Lenses. Ninety-four of the 109 ideas were descriptions, 13 were explanations, only two were suggestions and there were no ideas displaying reflectivity. Fifty-three out of 92 descriptions were GDs, ten of which were followed by explanations, two of them expanded. Forty-one out of 92 descriptions were MDs and two of these were followed by explanations. While the ten PSTs' reflections spread across three levels of the FLRM, the majority of them were at the lowest level. As shown in pie chart 1, 86% of the PSTs' reflections were at level 1, 12% at level 2 and 2% at level 3. There were no reflections at level 4. The PSTs' reflections were mostly general (61%), with the remaining 39% mathematical. Table 5.9 displays summaries of the 10 PSTs' reflections on MMI and Tasks for S2.

*Table 5. 9: S2 coding matrix on Mathematical Ideas and Tasks and Activities for PSTs' Groups 2 and 4*

| | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE' | ME | ME' | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | Total |
| Alice | 3 | 0 | 9 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 15 |
| Lutho | 3 | 0 | 7 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Mandy | 3 | 0 | 13 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Vee | 5 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Smith | 7 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| Thula | 13 | 1 | 14 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 37 |
| Marylyn | 3 | 1 | 10 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| Liz | 6 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Langa | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Dee | 4 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| TOTAL | 47 | 5 | 77 | 9 | 2 | 3 | 11 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 159 |
| | 52 | | 86 | | 5 | | 11 | | 0 | | 5 | | 0 | 0 | 159 |
| | 138 | | | | 16 | | | | 5 | | | | 0 | | 159 |



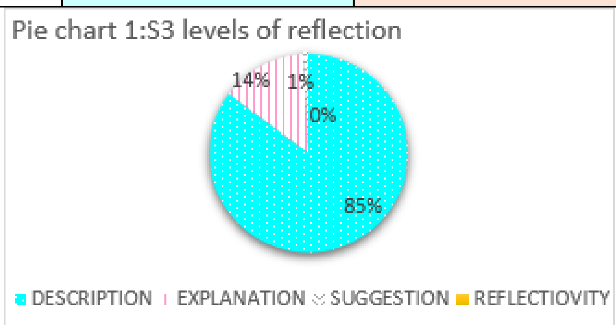



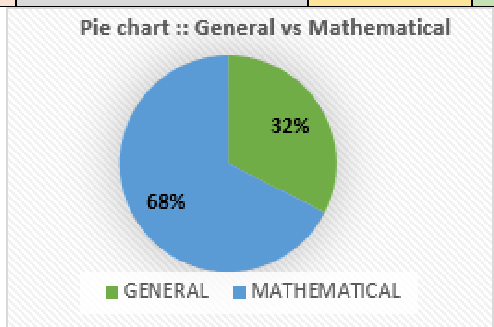

During S2, the ten PSTs wrote 159 coded ideas using the two lenses. Of these 159, 138 were descriptions, 16 were explanations, 5 were suggestions and there were no ideas that showed reflectivity. Of the 138 descriptions, 52 were GDs, five of them followed by explanations. But 86 of the descriptions were MDs, nine followed by explanations. All five suggestions were mathematical, two of them followed by explanations. The explanations totalled 16. The ten PSTs' S2 reflections were therefore at the lower levels of the FLRM, as they were in S1. As shown in pie chart 1, 87% of the reflections on MMI and Tasks were at level 1, 10% were at level 2, only 3% were at level 3 and no reflections were at level 4. Overall, 64% of the reflections were mathematical and 36% general.

Below are summaries of the ten PSTs' S3 reflections on MMI and Tasks.

*Table 5. 10: Summaries of the ten PSTs' coded S3 reflections on MMI and Tasks*

| | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | Total |
| Alice | 3 | 0 | 16 | 3 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| Lutho | 14 | 2 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 22 |
| Mandy | 13 | 0 | 10 | 3 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| Vee | 0 | 0 | 13 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| Smith | 4 | 0 | 19 | 4 | 1 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 33 |
| Thula | 7 | 1 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| Marylyn | 2 | 1 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Liz | 7 | 1 | 5 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| Langa | 3 | 1 | 14 | 4 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Dee | 0 | 0 | 9 | 4 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| TOTAL | 53 | 6 | 104 | 21 | 8 | 0 | 17 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 215 |
| | 59 | | 125 | | 8 | | 21 | | 2 | | 0 | | 0 | 0 | 215 |
| | 184 | | | | 29 | | | | 2 | | | | 0 | | 215 |



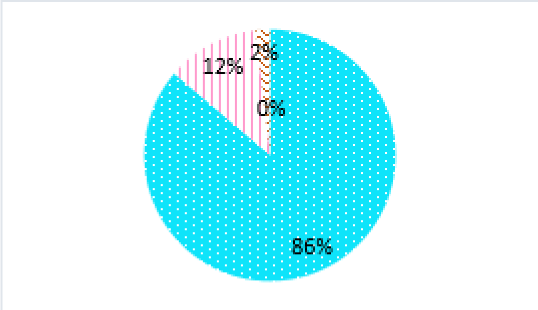

During S3, the ten PSTs wrote 215 coded ideas using MMI and Tasks. As shown in the summaries above, 184 of the 215 ideas were descriptions, 29 were explanations, two were suggestions and there were no ideas displaying reflectivity. Of the 184 descriptions, 59 were GDs and six of these were followed by explanations. On the other hand, 125 of the descriptions were MDs and 21 of them were followed by explanations. The PSTs' reflections were again mostly on the lower levels of the FLRM. As pie chart 1 depicts, 85% were at level 1, 14% at level 2 and 1% at level 3. There were no reflections at level 4. Of the group's S3 reflections using MMI and Tasks, 68% were mathematical compared to 32% general. In the next section I provide a conclusion to this analysis of whether there were any shifts in PSTs' reflections, session-to-session.

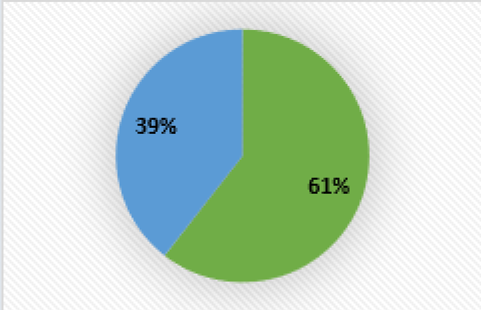
### 5.2.3 Conclusion to Part 2

This part of the chapter sought to establish if there were any shifts in the nature of the reflections in which PSTs engaged during different sessions of Phase 1 data collection. Comparisons were made between levels of reflection from session to session, and between general versus mathematical reflections over the three sessions. For ease of comparison, I place together the summaries of the three sessions in Figure 5.16, below.

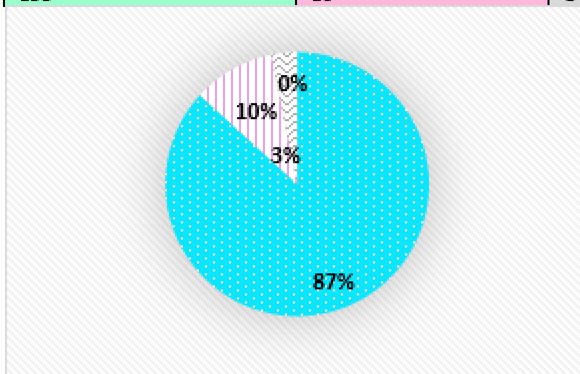
As can be seen in Figure 5.16, there was a consistent increase in the number of reflections from S1 to S3 when the ten PSTs reflected using the same lenses. In S1, the PSTs wrote 109 reflections using the two lenses. In S2 the number increased to 159, and further increased to 215 in S3. While these changes in the number of reflections were notable, the level of reflection tended to remain the same. Reflections at level 1 remained at above 80% in all sessions. Level 2 was just above 10% in all cases, while there was an increase in suggestions from 2% in S1 to 3% in S2 and a decline to 1% in S3. Thus, the PSTs' reflections remained firmly at the lower levels of the FLRM. However, there was a noteworthy shift from a general to a mathematical focus between S1 and S2, with mathematical reflections increasing from 39% to 64% of the total. The same trend can be discerned in the whole group's reflections, as discussed in the previous section. But unlike the comparison of all the PSTs' reflections, which revealed a decline in the percentage of mathematical reflections from 63% in S2 to 55% in S3, when focusing on the MMI and Tasks lenses alone, there was a further increase from 64% to 68%. In the next section I compare the PSTs' S3 reflections lens by lens to establish the influence of each lens on their reflections.

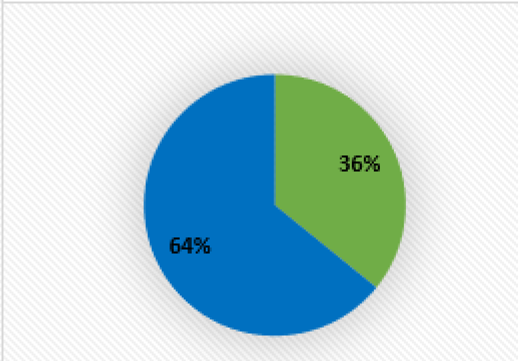
| | SUMMARIES OF THE TEN PSTs' REFLECTIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S1** | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | TOTAL |
| | GD | $GD^{\neg E}$ | MD | $MD^{\neg E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\neg E}$ | MS | $MS^{\neg E}$ | GR | MR | Total |
| | 43 | 10 | 39 | 2 | 9 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 109 |
| | 53 | | 41 | | 11 | | 2 | | 2 | | 0 | | 0 | 0 | 109 |
| | 94 | | | | 13 | | | | 2 | | | | 0 | | 109 |



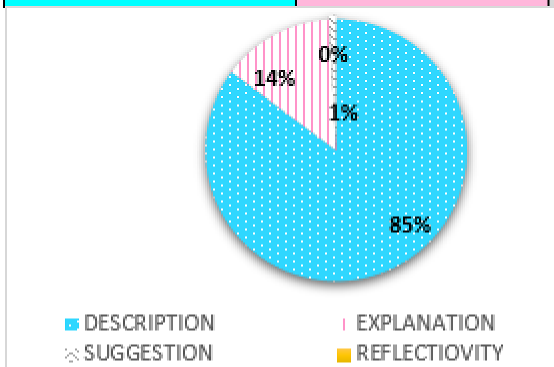




| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S2** | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | TOTAL |
| | GD | $GD^{\neg E}$ | MD | $MD^{\neg E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\neg E}$ | MS | $MS^{\neg E}$ | GR | MR | Total |
| | 47 | 5 | 77 | 9 | 2 | 3 | 11 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 159 |
| | 52 | | 86 | | 5 | | 11 | | 0 | | 5 | | 0 | 0 | 159 |
| | 138 | | | | 16 | | | | 5 | | | | 0 | | 159 |




| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S3** | Level 1 DESCRIPTION | | | | Level 1 EXPLANATION | | | | Level 1 SUGGESTION | | | | Level 1 REFLECTIVITY | | TOTAL |
| | GD | $GD^{\neg E}$ | MD | $MD^{\neg E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\neg E}$ | MS | $MS^{\neg E}$ | GR | MR | Total |
| | 53 | 6 | 104 | 21 | 9 | 0 | 17 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 216 |
| | 59 | | 125 | | 9 | | 21 | | 2 | | 0 | | 0 | 0 | |
| | 184 | | | | 30 | | | | 2 | | | | 0 | | 216 |



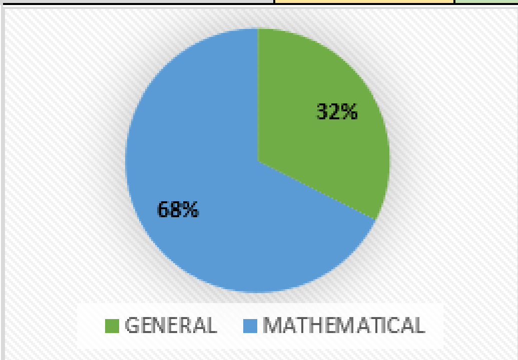




*Figure 5. 16: Summaries of the ten PSTs' reflections on MMI and Tasks for S1, S2 and S3*

In summary, there were few changes in the levels of reflection of the ten PSTs across the three sessions, though in Session 3 all the PSTs had some reflections that went beyond level 1. In terms of focus, however, as was the case with the general group there were a major shift from Session 1 to Sessions 2 and 3 away from general reflections towards mathematical reflections. Also, more PSTs were beginning to make suggestions in the latter two sessions. This may suggest that if they were to be exposed to more sessions of reflective practice, more suggestions might emerge. Of interest however is the way in which the number of reflective ideas increased for each of the two lenses that were constant for these ten PSTs across the three sessions. This seems to indicate that PSTs began to notice more aspects of the lessons they watched, or were more willing to invest time and effort in writing down ideas as the sessions unfolded

However, even though there were minor shifts in terms of levels of reflection, there was a significant shift in the quality of reflections. In S1 the majority of PSTs' reflections were in level 1 where PSTs generally described the environment or behaviour. For example, Alice wrote "*Learners were either under the umbrella, holding number cards (more/less) or answering questions* (Alice S1, C9). In S2 PSTs started displaying putting thoughts into the classroom events. For example, in S2 Alice wrote such reflections as: *Teacher asked what they saw on the cards, learners would explain how they got/ guessed the answer. Learners could have been repeating what their friends said without actually knowing the answer*" (C13-C15). While these are all descriptions and in Level 1, in S2 Alice displays thoughts beyond what she was seeing. Thus, her S2 reflection is deeper than mere reporting what was transpiring in class but reasons the possibility that learners could have been guessing the answers or mimicking their friends. In S3 her reasoning goes even deeper than in S2 and she gets to provide a possible rationale for the classroom event. For example, she wrote: *The class had to use a number line to help them think of how many to the nearest ten and then adding the rest of the number* (C2-C3). This finding concurs with what Arslan (2019) also found in her research, that the quality of the PSTs' reflections improves over time. Maaranen and Stenberg (2017) claim that PSTs' reflection can either be practical as well as idealistic. Maaranen and Stenberg (2017) propose that reflections on such factors as environment and behaviour should be regarded as substantial since it involves the reality of teaching practice. Arslan (2019) allege such reflections can also enable PSTs construct tacit knowledge which might grow and influence action (Schön, 1983). In the next part of this chapter I present summaries and analysis of S3 reflections, lens by lens, in an attempt to ascertain how the SLF influenced the PSTs' reflections.

# CHAPTER 5 PART 3

# WHAT ROLE IS PLAYED BY THE SIX LENS FRAMEWORK IN GUIDING PRE-SERVICE TEACHERS' REFLECTIVE PRACTICE?

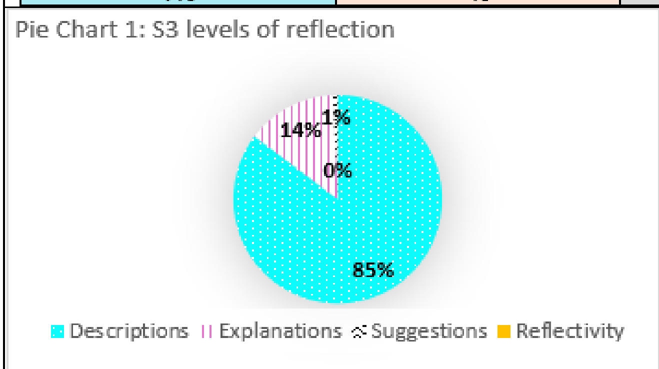
## 5.3 INTRODUCTION

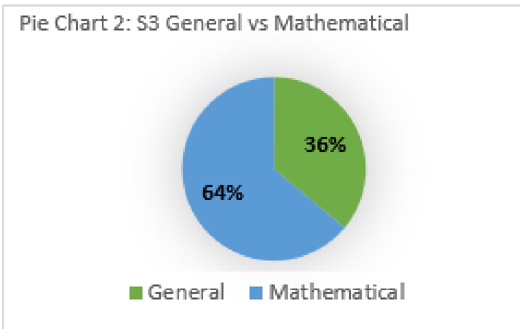
In this section I seek to answer my third research question: What role is played by the six lens framework as the reflective tool used to guide pre-service teachers' reflective practice? I do this by observing how the PSTs reflected using each of the six lenses. I focus here on S3 data because this is the only session in which the PSTs were asked to use all six lenses of the SLF. From the S3 data, I chose only the reflections of the PSTs who in fact used all six lenses to reflect, and who explicitly or implicitly indicated on each occasion the lens with which they were reflecting. Five of the 19 PSTs did not follow the instruction to use all 6 lenses and omitted one or two lenses. The remaining 14 PSTs met this criterion and their reflections were therefore selected for analysis of how different lenses might shape reflections. I made summaries of coded reflections with each lens for all 14 PSTs, indicating in the summaries how many ideas were recorded by each PST using each lens. I added together all the individual reflections per lens to come up with group summaries of reflections for all six lenses. Below I present the group summaries of coding for the 14 PSTs' S3 reflections, using each of the six lenses of the SLF, together with my analysis of them.

### 5.3.1 Summaries and analysis of the 14 PSTs' reflections on MMI

Summaries of 14 PSTs reflections on MMI

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | GE | ME | GS | MS | GR | MR | |
| 41 | 75 | 7 | 12 | 1 | 0 | 0 | 0 | |
| 116 | | 19 | | 1 | | 0 | | 136 |



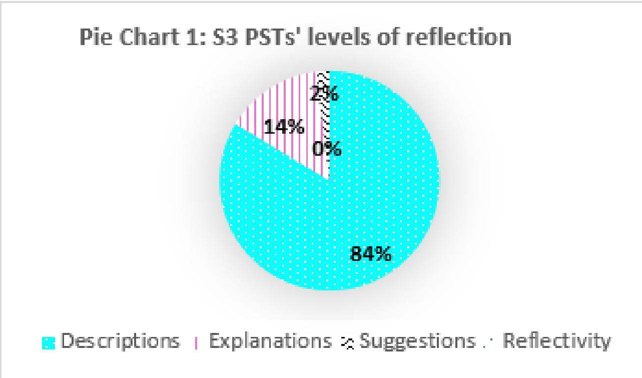



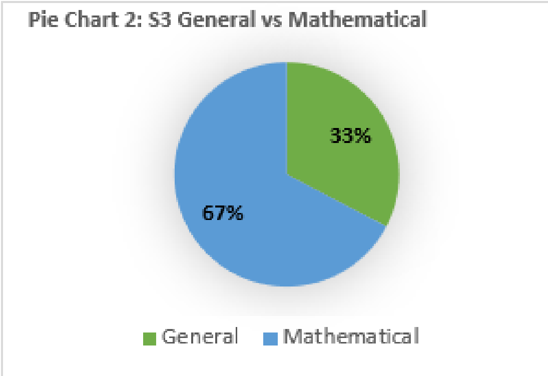
The 14 PSTs wrote 136 coded reflections using the MMI lens. Of these, 85% were descriptions, 14% were explanations and 1% were suggestions. There were no ideas that displayed reflectivity. Sixty-four per cent of their MMI reflections were mathematical while 36% were general.  As seen in Figure 5.17 towards the end of this section, this lens facilitated the second highest number of reflections after Tasks, and the third highest percentage of mathematical reflections, after Goals with 78% and Tasks with 67%.

### 5.3.2 Summaries and analysis of the 14 PSTs' reflections on Tasks and Activities

Summaries of the PSTs' reflections on Tasks

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | GE | ME | GS | MS | GR | MR | |
| 41 | 87 | 6 | 16 | 3 | 0 | 0 | 0 | |
| 128 | | 22 | | 3 | | 0 | | 153 |



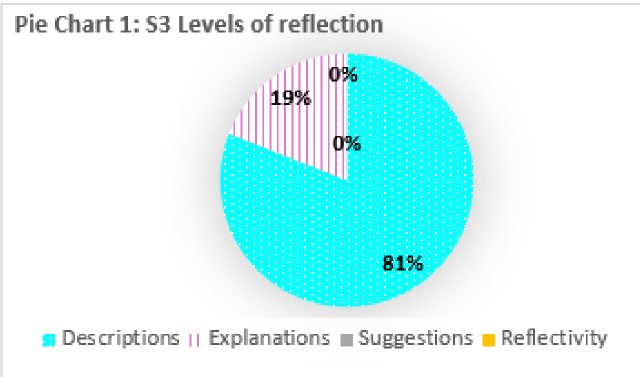



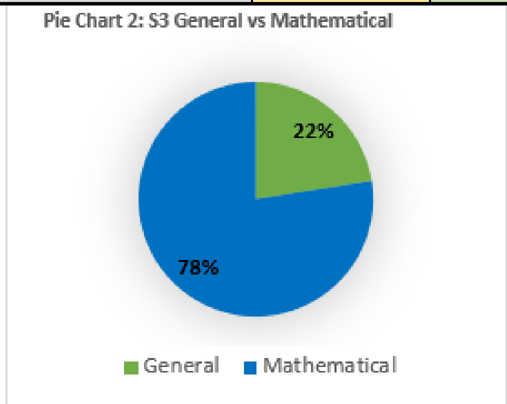

The 14 PSTs wrote 153 coded ideas while reflecting on Tasks, 84% of them descriptions, 14% were explanations and 2% were suggestions. There were no ideas showing reflectivity. Of the reflections, 67% were mathematical and 33% were general. This lens facilitated the highest number of reflections of all the lenses, which suggests that it gave PSTs more room to describe, explain and suggest in respect of classroom events observed.  The lens had the second highest percentage of mathematical reflections after Goals. This suggests the lens's potential to enhance attention to the mathematical events in a lesson.

### 5.3.3 Summaries and analysis of 14 PSTs' reflections on Goals

Summaries of the 14 PSTs' reflections on Goals.

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | GE | ME | GS | MS | GR | MR | |
| 14 | 50 | 3 | 12 | 0 | 0 | 0 | 0 | 79 |
| 64 | | 15 | | 0 | | 0 | | 79 |



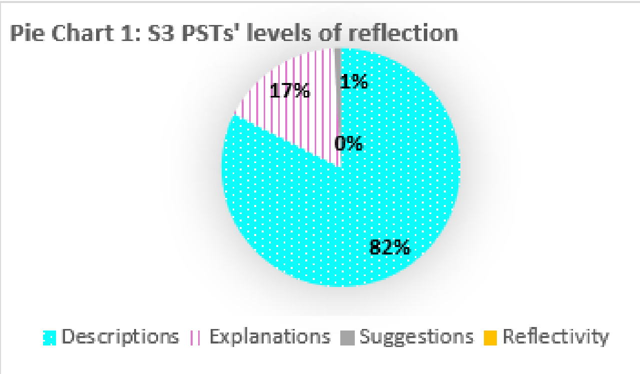



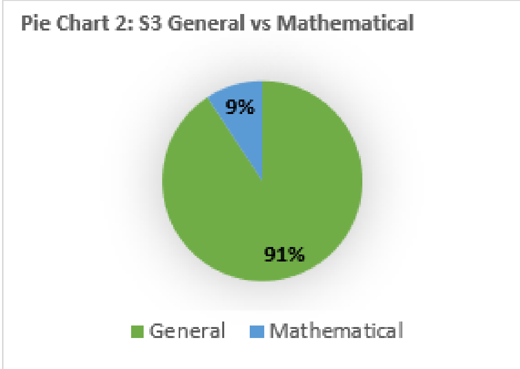

The 14 PSTs wrote 79 coded ideas using the Goals lens, 81% of them descriptions and 19% explanations. There were no suggestions and no ideas displaying reflectivity. However, 78% of the reflections were mathematical while only 22% were general, suggesting that the lens promoted mathematical reflections rather than general ones. As shown in Figure 5.17, Goals had the fourth highest number of reflections after Tasks, MMI and Interactions. But Goals had the highest percentage of mathematical reflections among the six lenses, suggesting the lens's potential for prompting a mathematical focus on classroom events. Goals also had the highest percentage of explanations, implying a potential to elicit explanations. Unlike the other lenses, though, no suggestions were made using this lens.

### 5.3.4 Summaries and analysis of 14 PSTs' reflections on Interactions

Summaries of 14 PSTs' reflections on Interactions

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | GE | ME | GS | MS | GR | MR | |
| 82 | 7 | 16 | 2 | 0 | 1 | 0 | 0 | |
| 89 | | 18 | | 1 | | 0 | | 108 |



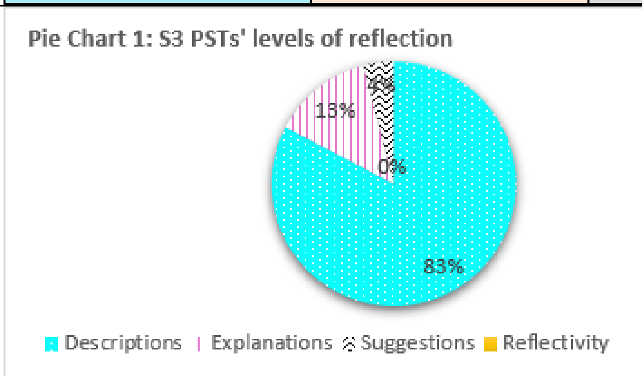



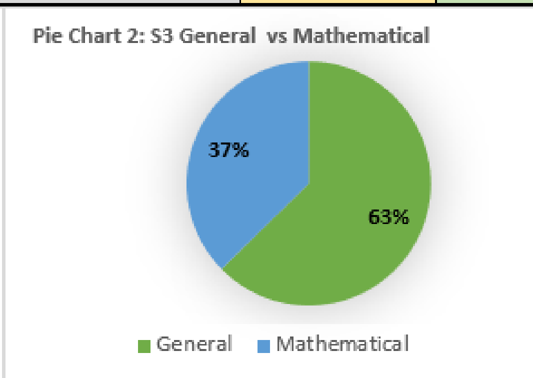

The 14 PSTs wrote 108 coded ideas using the Interactions lens, 82% of them being descriptions and 17% explanations. There was only 1% suggestions and no ideas displaying reflectivity. As much as 91% of these reflections were general, while only 9% were mathematical. This lens had the third highest number of reflections after Tasks and MMI and the lowest percentage of mathematical reflections. This suggests that, compared to the others, this lens has a greater tendency to promote general reflections than mathematical ones.

### 5.3.4 Summaries and analysis of 14 PSTs' reflections on DDM

Summaries of 14 PSTs' reflections on DDM

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | GE | ME | GS | MS | GR | MR | |
| 37 | 25 | 7 | 3 | 3 | 0 | 0 | 0 | 75 |
| 62 | | 10 | | 3 | | 0 | | 75 |



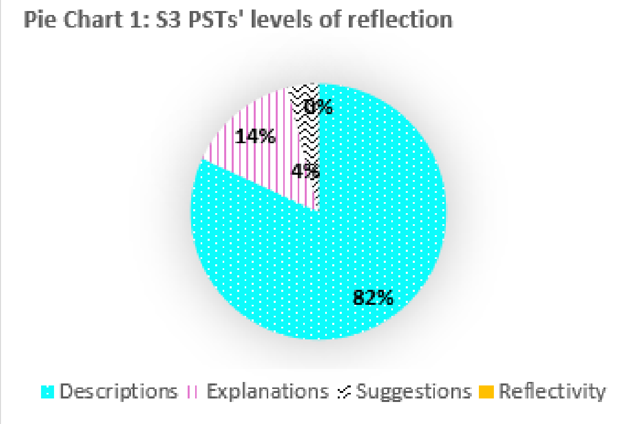



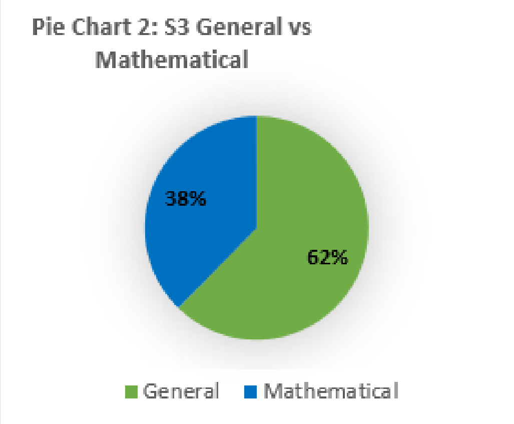
The 14 PSTs wrote 75 coded ideas on DDM, 85% being descriptions, 13% explanations and only 4% suggestions. Sixty-three per cent of the reflections were general and only 37% were mathematical. This lens elicited the lowest number of reflections among the six lenses and the second smallest percentage of mathematical reflections after Interactions. This suggests the lens's tendency to promote general reflections rather than mathematical subject-specific reflections.

### 5.3.6 Summaries and analysis of 14 PSTs' reflections on Beliefs

Summaries of 14 PSTs' reflections on beliefs

| Level 1 DESCRIPTION | | Level 2 EXPLANATION | | Level 3 SUGGESTION | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GD | MD | G E | ME | GS | MS | GR | MR | |
| 41 | 22 | 6 | 5 | 1 | 2 | 0 | 0 | 77 |
| 63 | | 11 | | 3 | | 0 | | 77 |




The 14 PSTs wrote 77 coded ideas on Beliefs. Of these ideas, 82% were descriptions, 14% were explanations, and only 4% were suggestions. There were no ideas exhibiting reflectivity. Sixty-two per cent of the reflections were general while only 38% were mathematical. This lens had the second smallest number of coded reflections after the DDM and the third smallest percentage of mathematical reflections. This suggests that the lens also has a greater potential for prompting general reflections than mathematical. Figure 5.17, below, compares the number of reflections per lens by reducing them to percentages.

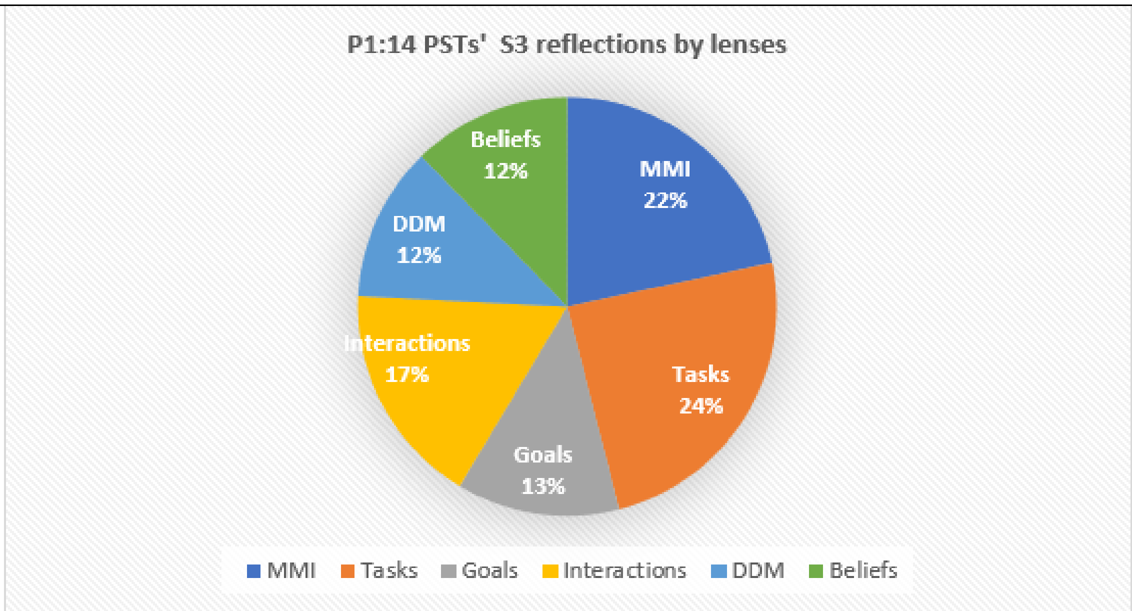



*Figure 5. 17: Showing the percentage contribution of each lens to the 628 reflections written by the 14 PSTs who reflected using all the six lenses of the SLF during S3*

As noted above, the 14 PSTs wrote a total of 628 coded reflections. Figure 5.17, above, reveals that Tasks had the highest number of S3 reflections (153 or 24%); MMI had 22% of the coded ideas, Interactions 17%, Goals 13%, while DDM and Beliefs tied at the bottom with 12% each. Figure 5.18 indicates the ratios of general to mathematical reflections as recorded by the 14 PSTs using each of the six lenses. Tasks, MMI and Goals prompted more mathematical reflections than general, while Interactions, DDM and Beliefs stimulated more general reflections than mathematical. The latter could be the reason why there was a decline in the percentage of mathematical reflections in S3, when the PSTs were reflecting with all the lenses, including these three. As is evident from this Figure, the MMI, Tasks and Goals lenses attracted more mathematical reflections. This perhaps explains why there were more mathematical reflections in S2, when PSTs had familiarised themselves with both analysing video-recorded lessons and using the SLF.

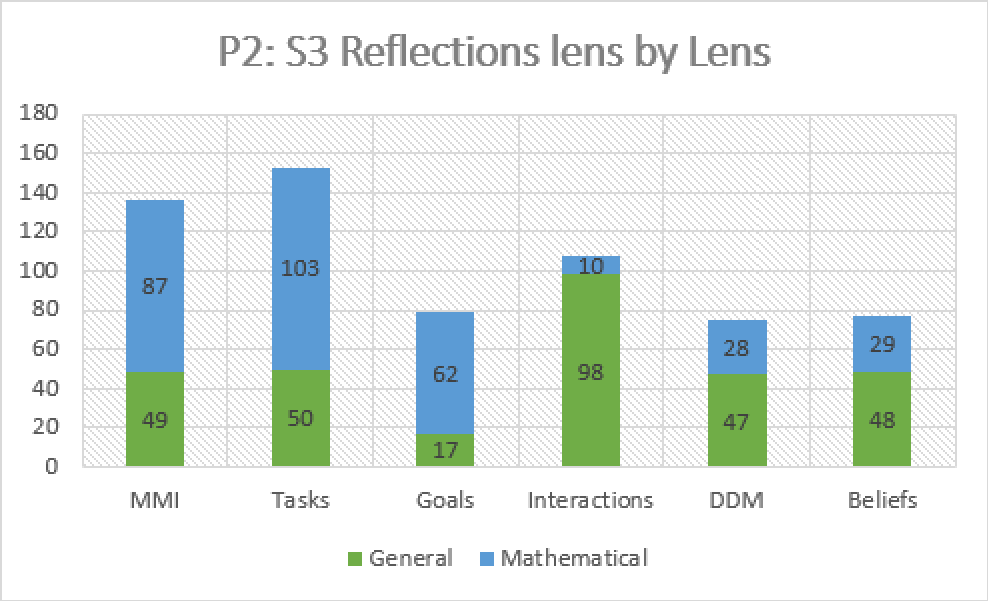



*Figure 5. 18: Showing the total number of reflections per lens in terms of general versus mathematical*

Noted from all the lenses is that the reflections were generally at the bottom levels of the FLRM, with level 1 reflections ranging between 81% and 85% for all the lenses, explanations ranging between 13% and 19%, while suggestions ranged between 0% and 4%. None of the PSTs reached reflectivity level. Some of the lenses like DDM and beliefs had the highest percentage of suggestions (at 4% each) while others like goals had no suggestions at all while MMI and Interactions had 1% each. The Tasks had 2%. This suggests that while some lenses like DDM and Beliefs encouraged the reflections on higher levels of the FLRM.

## 5.4 CONCLUDING PHASE 1 DATA PRESENTATION

In this chapter I presented and analysed Phase 1 data that focused on the 18/19 PSTs' written reflections in pursuit of answers to my three research questions. The chapter was divided into three major parts, with each part responding to one research question. In the first section I presented and analysed the PSTs' written reflections to establish the nature of reflections they engaged in when they analysed video-recorded lessons. In line with the findings of Ward and McCotter (2004), in this part of the chapter I found that the PSTs' reflections were generally descriptive, with few of them being followed by explanations and only two suggestions from one PST. However, the PSTs' reflections were shifting by fine gradations to higher levels. As noted, more PSTs reached level 3 of reflection in S3 than in S1. No PST displayed reflectivity in any of the three sessions of Phase 1 data collection. I also noted that the reflections started off more general than mathematical in S1 but shifted to more mathematical than general in S2 and S3.

Notwithstanding, PSTs' reflections remained towards the bottom of the FLRM and no reflections were found at the highest level of the model (reflectivity).

In the second part of the chapter, I sought to establish if there were any shifts in the way PSTs reflected over time and found a slight increase in the number of explanations and suggestions from S1 to S3. The increase was not altogether stable, as the number of suggestions went up in S2 and came down again in S3. However, the number of PSTs who wrote suggestions increased consistently from session to session. There was also a shift from a preponderance of general reflections in S1 to a majority of mathematical reflections in S2, followed by a slight fall in S3. However, I noted that the quality of PSTs reflections kept improving from one session to another, concurring with the findings of such scholars as Arslan (2019).

In the third part of the Chapter I explored the role played by each of the six lenses of the SLF in influencing the PSTs' reflections and found that some lenses – such as Tasks, MMI and Interactions – attracted more discussion than others and produced a larger number of reflections than the other three lenses. I also found that Tasks, MMI and Goals attracted more mathematical reflections than general reflections, while DDM, Interactions and Beliefs prompted more general reflections than mathematical ones. In conclusion, this chapter found that the PSTs' reflections were mostly descriptive, with very few descriptions being followed by a rationale for the event described. In all three sessions, above 80% of the PSTs' reflections were at level 1 of the FLRM. Level 2 reflections ranged between 11% and 15%, while level 3 reflections ranged between 1% and 2%. In all three sessions no PST wrote reflections that displayed reflectivity. While the reflections were more general than mathematical in S1, with general reflections comprising 71% of all reflections while only 29% were mathematical, there was a shift to mathematical reflections in S2 and S3, where PSTs recorded 63% mathematical descriptions and only 37% general in S2, and 45% general versus 55% mathematical in S3. In order to respond to RQs 4, 5 and 6, the next chapter focuses on the reflections of the four PSTs who were in my smaller sample and reflected on their own practice (as discussed in Chapter 4).

# CHAPTER 6

# THE REFLECTIONS OF FOUR PRE-SERVICE TEACHERS AFTER ADDITIONAL SESSIONS WITH FACILITATOR INPUT

## 6.1 INTRODUCTION

In Chapter 5, 1 presented and discussed the reflections of the 18/19 PSTs who formed the larger sample in this research, in order to gain a broad understanding of the nature of these reflections when the PSTs responded to video-recorded lessons of other teachers. I focused on the shifts taking place in these reflections over the three sessions of observation and analysis, and on the influential role played by the SLF in shaping them. This chapter addresses the reflections of the four PSTs in the smaller sample (as discussed in Chapter 4), in pursuit of a deeper understanding of the phenomenon under study. The four PSTs in focus in this chapter are Bonga, Dumie, Joy and Lutho (pseudonyms presented in alphabetic order). While these four PSTs also took part in the sessions presented in Chapter 5 that were based on video-recorded lessons taught by other teachers, these four PSTs additionally reflected on video-recorded lessons of themselves teaching mathematics. The recordings were made during their first practicum, as explained in Chapter 4. In this phase of the research I brought to bear the same three overarching research questions:

1. What is the nature of reflections that PSTs develop as they engage in video-recorded lesson analysis?
2. How does the nature of these reflections change over time, if at all?
3. What role is played by the six-lens framework as the reflective tool used to guide pre-service teachers' reflective practice?

Three additional questions that this chapter addresses are:

4. (a) How do PSTs reflect on a video-recording of their own teaching? (b) Are these reflections any different from their reflections on video of other teachers' lessons?
5. What is the nature of their reflections after receiving guidance from a skilled facilitator in small group sessions?
6. How did their reflections on their own practice change following skilled facilitation, if at all?

As discussed in Chapter 4, the four PSTs wrote two sets of reflections on the same lesson taught by themselves, which they had video-recorded during their TP. The first set was written in August 2018 at the beginning of Phase Two, before they engaged in reflection sessions guided by the facilitators in small group sessions. The second set was written in October 2019 after they had participated as a group of four students in three sessions of facilitator-guided reflections. These additional facilitator-guided sessions were not part of their normal studies but were arranged for the purposes of this research and were entirely voluntary. This data was gathered to investigate the reflections in which the PSTs engaged as they reflected on video-recorded lessons of their own teaching. There were two other aims: to establish if there were any differences between the way in which they reflected on other people's teaching and the way in which they reflected on their own teaching (RQ 4, above); and to ascertain whether smaller group facilitator-led discussions strengthened these reflections.

For the purposes of clarity, I have divided this chapter into five sections, as shown in Table 6.1, below. Each section responds to an identified RQ.

*Table 6. 1: Overview of Chapter 6 and the research questions targeted by each section of the chapter*

| Section | What each section does | Targeted Research Question | |
|---|---|---|---|
| 6.1 | Introduction | | |
| 6.2 | Presenting the four PSTs' 2018 reflections on own practice | 4a | How do PSTs reflect on video of their own teaching? |
| 6.3 | Comparing the four PSTs' 2018 reflections on own practice to S3 reflections on another teacher's practice | 4b | Are these reflections any different from their reflections on video of other teachers' lessons? |
| 6.4 | Presenting the four PSTs' 2019 reflections on own practice following facilitator-led sessions | 5 | What is the nature of PSTs' reflections following guidance by a skilled facilitator in small group sessions? |
| 6.5 | Comparing the four PSTs 2018 reflections on own practice and 2019 reflections on own practice | 6 | How did the nature of their reflections on their own practice change following skilled facilitation, if at all? |

The chapter follows the order shown in Table 6.1 above. I begin the chapter by presenting the four PSTs' 2018 reflections on own practice in the next section.

## 6.2 HOW DO PSTS REFLECT ON VIDEO OF THEIR OWN TEACHING?

As mentioned above, this section sought to understand the nature of PSTs' reflections based on their own teaching (RQ 4a). Below I present each of the four PSTs' reflections prefaced by a brief summary of the video-recorded lesson of their own teaching taken during their 2018 practicum. Their first written reflections on these lessons were all done in August 2018 while the second set of written reflections were done in 2019 after the small group facilitator-led reflection sessions.

For all four teachers I refer to the first 2018 reflections as Reflections on own practice (ROP), and the second set as 2019 ROP.

### 6.2.1 Bonga's 2018 reflections on his own teaching

Bonga is a male participant in his early twenties. This section presents and analyses his first set of reflections (ROP) written in 2018. In this lesson Bonga was teaching a Grade 1 class at a local primary school. His lesson started with counting forward and backwards between one and 20, then developed into doing the bonds of 15 where he would give a number and the learners would give the number that should be added to the teacher's number to make 15. He further developed the lesson by getting learners to add and subtract two-digit numbers. Different resources such as number grids and counters were used during this lesson. Bonga's ROP and my analysis thereof are given below:

***Meta and mathematical idea***

*1 In this lesson I planned to teach learners bonds of 15 MD. 2 I wanted learners to come up with two numbers that can be added to make up the number 15 MD. 3 Each learner would raise a hand GD 4 and give the two numbers MD, 5 explain to the class how they calculated it MD. 6 Learners had to justify their answers by explaining to the class MD$^{\rightarrow E}$. 7* ***This was*** *for helping them to have number sense, 7b to help them with addition ME$^{e}$. 8 Aims of this lesson was to equip my learners with 'adding on' instead of starting from 1 when adding MD. 9 As learners were explaining to how they arrived at making 15 with two digits MD, 10 I helped them to start with the larger number instead of small number to do so MD.*

***Explicit and implicit***

*11 The goals of this lesson was to equip learners with different strategies of adding without using counters MD 12 but use the mind and hands MD$^{\rightarrow E}$. 13* ***This was to help*** *learners to be able to use easy ways to calculate instead of long processes ME. 14 The 1st activity I asked learners to give me two digit numbers that will make up number 15 MD. 15 Learners gave me these numbers MD 16 and explained how they got it MD$^{\rightarrow E}$. 17 Through this I was able to introduce 'counting on' ME 18 Some learners however, already knew the strategy MD, 19 I had to explain it further more MD 20 and try to make it as simple as I can for other learners MD.*

***Task***

*21 In this lesson plan, my introduction was a song learners sang GD. 22 This song had action with it GD. 23 Learners had to stamp their feet GD 24 when they call a number MD 25 and move forward GD. 26 Learners were counting from 1 to 20 MD. 27 Then counted backwards from 20 to 1 while moving backwards MD$^{\rightarrow E5}$. 28* ***because*** *I wanted this to be fun 28b and active 28c rather than just doing mental maths the old fashion way of just asking questions, 28d I wanted learners to engage 28e and play ME$^{e5}$. 29 I believe learners learn through play GD, 30 and in a good atmosphere GD. 31 The 1st activity in my lesson development, dealt more with what I needed to help the learners know GD. 32 I was able to make them do the maths on their own MD 33 and I had to help explain further MD. 34 I developed my lesson plan from what they know GD$^{\rightarrow E}$. 35* ***Through this*** *activity I was able to explain the counting on* *strategy, 35b and help them use it $ME^{e}$. 36 The second activity during my lesson development was the number grid MD. 37 In this grid, learners first add two number that are given MD 38 and they have to find out what is the number left to make the total number 15 $MD^{\to E}$. 39 **This develops** problem solving skills ME. 38 Learners have to count MD 40 and think MD 41 and workout the number needed to make the total MD. 42 I used this game $MD^{\to E}$ 43 **to** help learners gain the skill of adding on ME. 44 The third activity was number line $MD^{\to E}$, 45 **this also helped** me in emphasizing the above skills ME. 46 In this activity learners had to come to the board GD 47 and write on their own GD. 48 The tasks I did with these learners were good for their level GD. 49 They were not difficult GD 50 but a bit challenging GD, 51 they needed learners to think GD. 52 I focused on number bonds MD, 53 learners adding MD, 54 I wanted to expose learners to different [ways of adding] MD 55 and easy ways of adding MD. 56 My goals did not shift GE 57 because I had to be more explicit with other learners 57b and explain more GD. 58 I came up with three different activities $GD^{\to E}$ 59 **in order to** try and help them GE. 60 Some learners do not grasp new information or skills quickly therefore GD 61 I wanted them to practice these skills in different activities $GD^{\to E}$ 62 **so that** they can know they can take one skill they learnt from other activities and apply it to another in order to solve a problem GE.*

***Interaction with learners***

*63 My teaching approach was questioning using constructive theory GD. 64 Learners doing things by themselves GD 65 and teacher guiding them GD 66 At the same time it [the teaching approach] was learner centered $MD^{\to E}$ 67 **because** I asked learners to solve a sums 67b and they solved it $ME^{e}$. 68 Learners had to explain how they got to their answer $MD^{\to E}$, 69 this allowed learners to think about the calculations 69b and they had chance to correct themselves if they were wrong $ME^{e}$. 70 Learners who behaved were selected to talk GD. 71 When I ask a question GD 72 learners jumped calling 'teacher teacher!' I would look for the quiet learner and say "I'm picking her because she is behaved, s/he not talking or shouting". GD 73 I also selected learners who were quiet for too long, I would just say "Lisa you been quiet, what do you think?" $GD^{\to E}$ 74 because I was trying to get them to participate GE.*

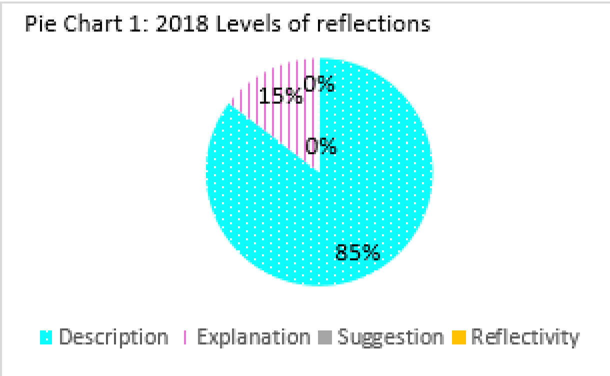
***Dilemmas***

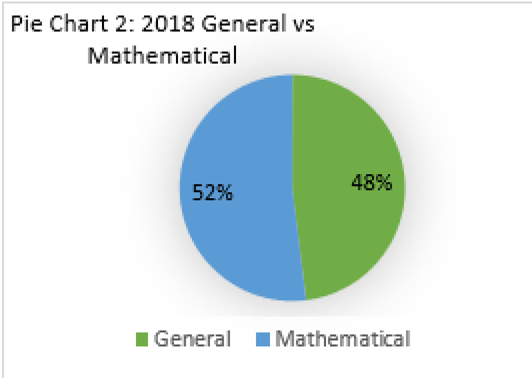
*75 Thinking on our feet is our daily bread as teachers GD, 76 learners do not always do what you ask GD, 77 or give right answers GD, 78 they often make mistakes GD 79 and as teachers we must use those opportunities for learning GD. 80 During my lesson some learners gave me numbers that were more than what we needed to make 15 MD. 81 When they were explaining it to the class, MD 82 they notice that their number was wrong MD 83 and they think of another number MD. 84 Another mathematical dilemma was when I asked learners to give me two numbers to make 15 MD. 85 One of the learners gave me 3 numbers, MD 86 I allowed it $MD^{\to E}$ 87 because she wasn't wrong 87b and it linked to the next activity $ME^{e}$, 88 Some learners are more intellectual than others GD.*

***Beliefs***

*89 Any discipline can be made fun by a teacher GD, 90 it's all just a time needed to be taken by the teacher GD 91 and willingness to allow the children play as they learn GD. 92 I believe young children learn best when they are doing things by themselves GD, 93 playing GD, 94 manipulating the numbers MD 95 or whatever the teacher is teaching GD. 96 Involving the learners in the lesson GD 97 than just explaining to them can be a waste of time GD. 98 I think the atmosphere of the classroom matters GD, 99 and it's all up to how one starts their day GD 100 or introduce the lesson GD. 101 I think how one introduces a lesson, sets the how the lesson will be carried out GD. 102 Therefore for me, the introduction is important GD.*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | GE* | ME | ME* | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 40 | 4 | 34 | 9 | 4 | 0 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 102 |
| 44 | | 43 | | 4 | | 11 | | 0 | | 0 | | 0 | 0 | 102 |
| 87 | | | | 15 | | | | 0 | | | | 0 | | 102 |




Bonga wrote 102 coded reflections using the six lenses of the SLF. Of these, 87 were descriptions, 15 were explanations and there were no suggestions or ideas displaying reflectivity. Forty-four of the 87 descriptions were GDs and 43 were MDs. Four of the 44 GDs were followed by explanations while 11 of the 43 MDs were followed by explanations. Six of the 11 MEs were simple, and five of the 11 MEs were expanded, four with two ideas and one with five ideas. Thus, Bonga's 2018 reflections were at the lower levels of the FLRM: as seen in pie chart 1, 85% were at level 1 and only 15% at level 2. There were no reflections at levels 3 and 4. On the other hand, his overall focus was slightly more mathematical than general: as evidenced in pie chart 2, there were 52% mathematical reflections compared to 48% general.

### 6.2.2 Dumie's 2018 reflections on own teaching

Dumie is also a male participant in his early twenties. He taught a Grade 2 class at a local primary school. Dumie's lesson was also on adding and subtracting two-digit numbers using different strategies such as unit counting, the count-on strategy, and the breaking and building up numbers' strategy. Dumie's 2018 ROP and my analysis thereof are given below:

***<u>Mathematical and Meta-mathematical idea</u>***
*1 The idea of the lesson was to teach the learners about addition MD 2 and different ways or strategies of adding MD 3 or subtracting numbers through solving different sums with two digit number. For example, 34-20= or 12+11=. MD 3 I also used resources $MD^{\to E}$ 4 in order to help the learners count ME. 5 Learners need to understand that adding is putting together MD 6 and subtracting is taking away from MD. 7 They must also relate the whole concept with their real life situation MD. 8 However, learners were expected to invent or create different strategies of addition MD 9 and subtraction MD. 10 They found some of the ways during mental maths MD. 11 But now they were given an opportunity to use counters to calculate MD. 12 The language use could have been more developed during the lesson $MS^{\to E}$. 13 because in grade one they use isiXhosa to learn math ME. 14 I could have put more emphasis on making them to master the basics of how to count rather than mixing the language with English*

using such as: one instead of ‘Inye’ MS. 15 However, I did saw the development during the lesson development GD[→E]. 16 Learner getting the answers correct MD 17 and understanding the addition MD, 18 subtraction MD 19 and the different strategies.

**Explicitly goal and implicitly goals**

20 The explicit goal of the lesson was to teach addition MD 21 and subtraction, using different sums MD. 22 The evidence is that, I used flash cards that had the sums MD. 23 It was variety of sum with addition MD 24 and subtraction MD. 25 Along the way I discovered that they also found different strategies of calculating the same sum MD. 26 They also found ways of understanding the sum differently MD. 27 I also discovered this through asking questions such as: tell me how did you calculate the sum? Which other ways would you have done it? Would you like to explain it to the next person or learner sitting next to you? Why did you add 13 instead of 10? MD 28 Some of these questions were mainly based on the students who more advanced MD. 29 Some of the interesting implicit goals were that they used number lines MD 30 and counting on. For example, 13 +8=14, 15, 16, 17…21 MD, 31 but, I was expecting them to use strategies I gave them MD. 32 At the same time, I did not want to limit them GD. 33 In addition, I think this shifting of the goals occurred MD[→E] 34 because of the fact that, I did not limit them to use my strategies 34b but to find ways of counting by themselves ME[e].

**Task and activity**

35 The learners were grouped GD[→E] 36 **so that** the activity could be interesting 36b and inviting to learners GE[e]. 37 Each group was given an activity according to their groups GD. 38 These groups were also created according to their level of fluency in math MD. 39 They were divided into three groups GD. 40 These groups were made to challenge the learners in maths MD. 41 Each group was given an activity on the black board to calculate MD 42 and once they finish, they are getting another sum that is challenging them a little bit MD. 43 I introduced this lesson by explaining what is needed GD 44 and how it will work GD. 45 Learners were also given different resources or counters to work with MD[→E] 46 **So that** they can show different strategies of calculating their maths problem ME. 47 They were using different counters such as Dice, dominos and slate MD 48 Learners were able to exchange the counters MD[→E] 49 **so that** they can use the ones they are comfortable with ME. 50 The resources were also arranged according to their level of fluency in problem solving. For example, the slate, was meant for those who can write and solve the maths quick MD. 51 The purpose was for them to find different ways of calculating different problems MD, 52 using different strategies MD, 53 and be able to learn from others GD. 54 Furthermore, to understand that there are different ways of solving maths problems MD 55 and there is always a solution. For example some of the problem were 12+7= was on board in a flash card could be solved by learners differently 10+2+7 or 10 +9= MD.

**Interaction with the student**

56 First of all, I was walking around the classroom GD, 57 helping learners who had questions GD 58 and those who were stuck GD. 59 I was addressing them as a group since, I grouped them GD,60 but I noticed that some of them were confused GD, 61 I decided to sit with them one on one GD. 62 The time was a problem GD[→E] 63 because, I ended up spending lot of time with some students GE 64 while others were struggling GD 65 and I couldn’t finish all of them to see whether they were following the activity GD. 66 The questions that, I was asking to students, some of they were questions like: if you have 12 dominos and added 7 dominos, how many of them in total MD 67 I also told them that addition means putting together MD 68 and subtraction means taking away MD. 69 Some of the students had questions revolving around on how to use the counters MD. 70 Some they were not familiar on how to use them [counters] MD. 71 I also had a rule that, when I speak they should listen GD 72 and when someone wants to speak must raise their hands GD[→E], 73 so that I can give there is order in class GE. 74 Even though the class was a little bit chaotic GD 75 when I was busy with a group of students GD 76 some would make noise GD.

**Dilemmas and decision making.**

77 The use of counters did not go as, I expected for example in the situation of the dominos MD. 78 Instead of counting the dots they were counting the whole dominoes MD[→E]. 79 It is because they did not understood how they [the dominos] worked ME. 80 It was something that I have observe at that moment GD[→E], 81 **so that** next time, I can bring games that have dominos, 79b so they can learn how to use them formally ME[e]. 82 Learners were confused by the sums MD. 83 They were supposed to complete sums that were under their group name MD 84 but they were doing every sum that was on board MD 85 these sums were difficult for most of them GD. 86 However, next time, I will give each table rather than putting it on board GS

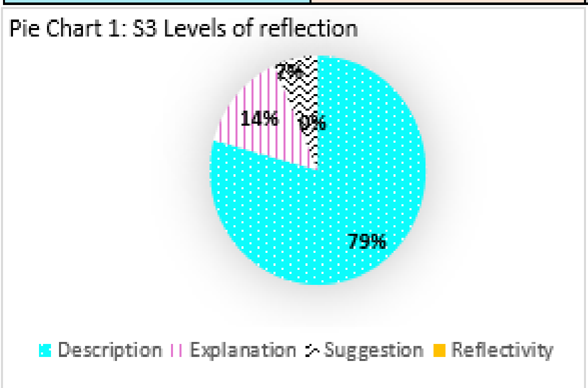
**Beliefs about mathematic teaching.**

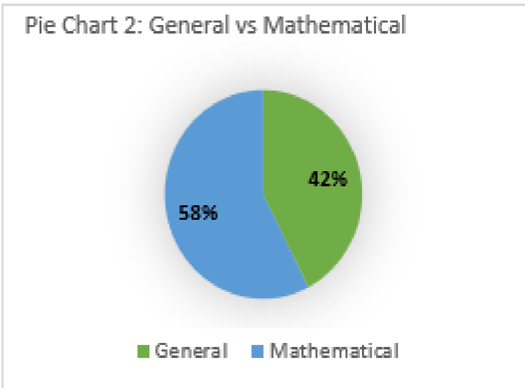
87 That mathematics is around us MD, 88 and learners can be able to do it. MD 89 Encouraging them all the time GD. 90 Positive reinforcement should be a priority GS[→E] 91 **so that** learners can be empowered all the time GE. 92 As teacher it is very important to integrate math with everyday life MS.

93 *I should have used things they know in my sums For example, if I have 5 bananas and I need ten in total, how many bananas should, I add to make ten?* MS→E *94 Because learner learn easy when we relate what they know to any subject* ME. *95 As a teacher, I should be reflecting on the lesson every time* GS→E *96* ***so that****, I can see my pitfalls 96b and achievements in the lesson* GE^e. *97 Lesson evaluation is very important to me* GD→E *98* ***because*** *it guides me* GE. *99 Lesson evaluation also helps know where to fix my lesson* GD→E *100* ***so that****, it can be improved* GE. *101 My role as teacher is to guide learners to develop in mathematics* GD. *102 To also apply constructivism theory that learners construct knowledge* GD *103 and meaning from their own experience* GD. *104 I should not to spoon feed them by knowledge* GD. *105 I understand that learners learn differently in class* GD *106 and [that] Mathematics needs different ways to explain it* MD. *107 In addition, student's role is to try more and practice more* GD. *108 They have to investigate* GD, *109 generate and give reasons for every problem that they solve* MD.

Summaries of Dumie's 2018 reflections on his own teaching.

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^e | ME | ME^e | GS | GS→E | MS | MS→E | GR | MR | |
| 27 | 7 | 48 | 5 | 5 | 2 | 6 | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 109 |
| 34 | | 53 | | 7 | | 8 | | 4 | | 3 | | 0 | 0 | 109 |
| 87 | | | | 15 | | | | 7 | | | | 0 | | 109 |




Dumie wrote 109 coded ideas using all six lenses of the SLF. Of these, 87 were descriptions, 15 were explanations and 7 were suggestions. There were no ideas displaying reflectivity. Thirty-four of the 87 descriptions were GDs and only seven of these were followed by explanations. Two of the explanations were expanded with two ideas each, while the rest were simple GEs. The remaining 53 of the 87 descriptions were MDs. Five of the MDs were followed by explanations, and two of these were expanded with two ideas each. Four of the seven suggestions were GSs, two of them followed by simple explanations. Three of the suggestions were MSs and two of these were also followed by simple explanations. Thus, Dumie's 2018 reflections were spread across the first three levels of the FLRM, with 87% at level 1, 15% at level 2 and only 7% at level 3 (as shown in pie chart 1). There were no reflections at level 4. Fifty-eight per cent of the reflections were mathematical while 42 were general.

### 6.2.3 Joy's 2018 reflections on her own teaching

Joy is a female participant in her late twenties. She taught a Grade 2 class at a local primary school, and her lesson was on measurement. The lesson started with mental mathematics that involved counting forwards and backwards. Joy then introduced the subject of measurement, asking learners what measurement was, what materials they used for measurement and why they needed to know how to measure. She then gave learners three pencils per pair and asked them to measure the length and breadth of their desks after she had demonstrated how to use pencils to measure the length of the section of a chalkboard. She then asked learners to do individual work in their books measuring different objects in their classroom using nonstandard measurements. Joy wrote the following reflections based on this lesson in 2018. Below are Joy's 2018 ROP followed by analysis.

***[Mathematical and meta- mathematical ideas]***

*1During this lesson I was trying to get the learners to think about using non-metric tools to measure bigger items using smaller items MD. 2 I started the lesson off with some rote counting MD 3 and a mental maths exercise MD. 4 The aim of the rote counting was to ignite their number sense MD 5 and connect their thinking to numbers MD. 6 Because the rote counting was done in a chorusing manner MD, 7 I was not able to pick up the learners who were miming MD 8 or not even attempting to count MD, 9 they were therefore left out of that exercise MD. 10 Also, the way they were counting sounded more like them reciting a memorized grid of numbers MD. 11 During the counting I would ask them to start at a random number MD$^{\rightarrow E}$,12* ***this was to*** *promote their awareness 12b and to engage them in the lesson ME$^{e}$. 13 They would need to have listened to me to be able to know where to start and stop GS. 14 The mathematical ideas that were brought forward in my lesson were measurement using a non-standard unit MD, 15 count in tens backwards and forward MD 16 and develop their understanding of the relationship between addition and subtraction MD. 17 The idea of having a set starting point when measuring MD 18 and keeping the measuring tools steady were left out MD.*

***[Goals]***

*19 I was trying to connect what I was about to teach them to what they already know GD$^{\rightarrow E}$ 20 because by doing so, they will be able to understand and remember it better GE. 21 I did this by asking them what they think we can use to measure things MD, 22 but I first found out whether they knew what concept of measuring is about MD. 23 I had initially planned to use blocks to carry out this exercise MD 24 but using pencils connected more with the idea of using known tools to measure bigger items MD. 25 I also changed to pencils GD$^{\rightarrow E}$ 26* ***to*** *maintain the control in the classroom GE, 27 the blocks would have been more distracting GS.*

***[TASKS AND ACTIVITIES]***

*The tasks were in the following order:*

*28.Rote counting in 10s MD. 29 Mental maths activity – number plus 2 MD, 30 Measuring desks using pencils MD, 31 Writing down their measurement observation in their workbooks MD 32 I asked the learners leading questions GD$^{\rightarrow E}$ 33 so as to scaffold them GE. 34 Sometimes the learners would not understand what answer I was looking for GD. 35 In rote counting, as mentioned before some of the learners were not counting correctly MD 36 or even counting at all MD. 37 But that was difficult for me to pick up MD. 38 By doing the mental maths activity MD$^{\rightarrow E}$, 39 they got to revise on their addition skills ME. 40 They did the measuring activity MD$^{\rightarrow E}$ 41 so that they got to see how many pencils can fit into the length of their desk ME. 42 They should have written their observation in their workbooks GS$^{\rightarrow E}$. 43 The benefits of this are they get to connect what they observe with writing it down, a form of report GE.*

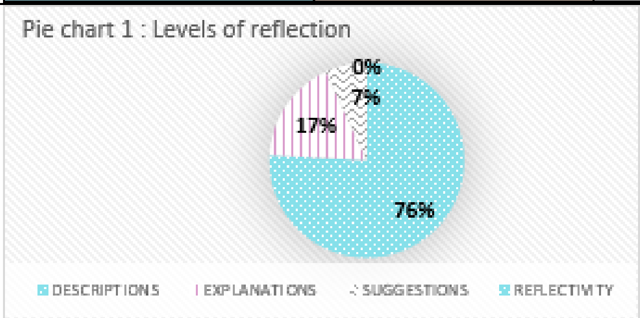
***[Interactions]***

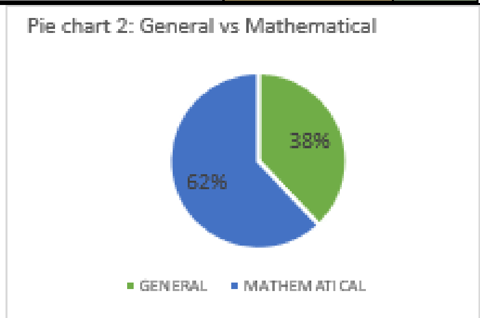
*44 When it comes to getting answers from the learners, it is usually the same learners that respond GD. 45 So, what I would do I would ask the learners who seldomly answer GD$^{\rightarrow E}$, 46 this is to help them gain confidence of giving answers even if what they think is right is not GE. 47 I always give them positive feedback GD 48 and their favourite "hi-five" GD$^{\rightarrow E}$ 49* ***to*** *try to encourage them GE*

***Dilemmas and decisions making***
*50 A dilemma I had was in the mental maths where they could not fully understand what I required from them MD. 51 I abstractly asked them GD, 52 and they could not make the connection GD. 53 I therefore had to use the count on strategy MD 54 or the addition strategy MD. 55 The constraint to that could be my scaffolding GS→E, 56 may cause them to be too dependent GE.*
***Beliefs***
*57 My mathematical beliefs that are displayed in this video are that maths is a fun learning area MD.*
*58 It can be easily integrated into our everyday life GD.*

Summaries of Joy's 2018 reflections on her own teaching

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 6 | 5 | 31 | 3 | 7 | 0 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 58 |
| 11 | | 33 | | 7 | | 3 | | 4 | | 0 | | 0 | 0 | 58 |
| 44 | | | | 10 | | | | 4 | | | | 0 | | 58 |




Joy did not explicitly indicate the lenses she was reflecting with, but it was easy to see where all the lenses were used from the way she paragraphed her work and the leading statements for each paragraph. She recorded 58 coded ideas using the six lenses of the SLF, of which 44 were descriptions, ten were explanations and only 4 were suggestions. No ideas displayed reflectivity. Of the 44 descriptions, 33 were MDs and 11 were GDs. Five of the GDs and three of the MDs were followed by explanation, one of the latter expanded with two ideas. All the suggestions were general and two of these were followed by explanations, resulting in a total of ten explanations at level 2. Thus, Joy's reflections were concentrated at the lower levels of the FLRM. As shown in pie chart 1, 75% of the reflections were at level 1, 17% at level 2, 7% at level 3 and 0% at level 4. On the other hand, Joy produced more mathematical reflections (62%) than general reflections (38%, see pie chart 2).

### 6.2.4 Lutho's 2018 reflections on her own teaching

Lutho is also a female participant in her early twenties. She gave a Grade 2 class at a local primary school a lesson on money. She taught her learners about the different denominations of South African money and their features. She gave the learners paper money and asked them to identify the features of each denomination. She asked them to practise addition to make up given amounts of money using combinations of different denominations. Below are Lutho's 2018 ROP and my analysis thereof.

***Mathematical and meta-mathematical ideas***

*1 The teacher bought forward the money concept MD, 2 the aim was to teach about the currency used in SA MD. 3 This is evident through her use of a chart GD 4 and the different pictures of monies GD 5 that she uses as manipulative materials for the children GD$^{\rightarrow E}$ 6 to acquire concrete understanding GE. 7 In her teaching she incorporated addition MD 8 when asking children how much money is needed to produce a certain amount MD.*

***Explicit and implicit goals***

*9 The teacher's goal was to expose children to the use of money MD 10 and the different currencies from coins to notes used in SA MD. 11 This is evident from materials that she used in carrying out her lesson GD. 12 An additional goal was the addition of money MD, 13 whereby the teacher instructed the children to add a certain amount of money MD 14 using the manipulates she gave them MD. 15 She added this goal MD$^{\rightarrow E}$ 16 **so as to** see the learners knowledge about adding money, 16b **so that** perhaps on the next lesson she emphasizes on it ME$^{e}$. 17 The children need more knowledge about it [adding money] MD.*

***Tasks and activities***

*18 Two main tasks were involved in this video GD. 19 Recognition of money MD 20 and addition of money MD. 21 In the first task – the teacher names a currency MD 22 and then instructs the children to show it MD 23 using their manipulatives MD$^{\rightarrow E}$ 24 **– this allows** the teacher to see if the children really comprehended the different currencies taught ME. 25 On the latter task – the teacher deviates to addition of money MD$^{\rightarrow E}$. 26 This allows the teacher to get a glimpse of the learners knowledge about money addition ME.*

***Interactions with the students***

*27 The teacher used collaborative learning GD$^{\rightarrow E}$. 28 This allows active interaction with the learners GE 29 The teacher is asking questions GD 30 and depend on the children to answer the questions GD. 31 If the learners give incorrect answers GD 32 she does not tell them that they are wrong GD 33 instead she says it's a more or less GD. 34 the children need to add MD or 35 subtract the amount MD 36 that they primarily gave to arrive at the right answer MD.*

*37 All children are allowed to answer questions to their best ability GD, 38 when the class gets chaotic GD 39 she uses strategies of directing the children back to learning such as "all eyes on me" GD.*

***Dilemmas and decision making***

*40 Some children had difficulties in adding the money MD. 41 If a child gave an incorrect amount MD 42 the teacher asked the class to help for the definite answer MD. 43 The teacher explained how was that answer arrived at MD 44 and wrote the addition steps on the board MD$^{\rightarrow E}$, 45 to help the child that did not understand ME. 46 Moreover, she also asked for other alternatives of solving the asked question MD.*

*47 Affordances – the aim was achieved GD. 48 This evident when the teacher asks the learners what they have learnt about at the end of the lesson GD.*

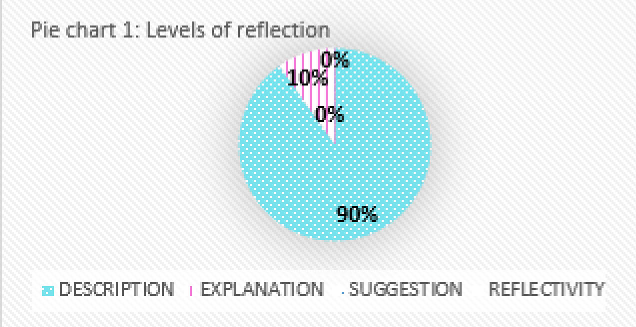
*49 Constraints – children maybe be unable to link the money concept MD 50 and addition MD. 51 Some might be confused by the different currencies of the same kind of money GD.*

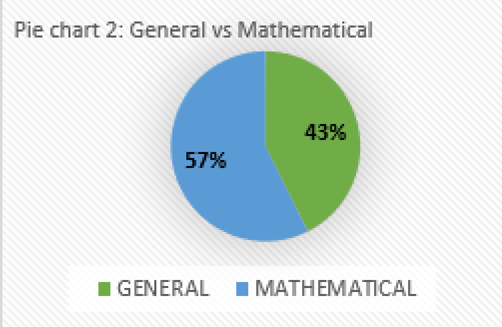
***Beliefs about mathematics teaching***

*52 The teacher believes in effective teaching GD. 53 She sees herself as the more knowledge other GD 54 but also as a mediator/facilitator between education and the learners GD. 55 She views mathematics as an important aspect MD 56 that teaches children about different channels of life MD. 57 Hence, it one of the vital subjects that one should be proficient in MD. 58 She perceives students as people who just need a little push to understand something GD 59 because of the knowledge they come to school with GD. 60 If a teacher builds on this knowledge GD 61 then it becomes easier for the children to relate their prior knowledge to what is learnt at hand GD.*

*Summaries of Lutho’s 2018 reflections on her own teaching*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 22 | 2 | 29 | 4 | 2 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 61 |
| 24 | | 31 | | 2 | | 4 | | 0 | | 0 | | | | 61 |
| 55 | | | | 6 | | | | 0 | | | | 0 | | 61 |




Lutho wrote 61 coded ideas using all six lenses of the SLF. Fifty-five of these were descriptions and only six were explanations. There were no suggestions, and neither were there any ideas that displayed reflectivity. Of the 55 descriptions, 24 were GDs and two of these were followed by simple explanations. The other 31 descriptions were MDs, four of them followed by explanations. One of the four explanations was expanded with two ideas. Thus, Lutho’s 2018 ROP were mostly at the lowest levels of the FLRM, with 90% at level 1 and 10 % at level 2. There were no reflections at levels 3 and 4. However, Lutho focused more on mathematical events than on general, 57% of her reflections being mathematical and 43% general.

### 6.2.5 Conclusion

The aim of this section was to establish the nature of the reflections in which the PSTs in the smaller sample engaged as they reflected on their own practice. In Figure 6.1, below, I provide summaries of the four PSTs’ 2018 ROP grouped together. As seen in Figure 6.1, the PSTs’ reflections on their own practice were generally at level 1 of the FLRM, descriptions of classroom events, with less than a fifth of these accompanied by a rationale. This finding echo those of a study conducted by Cohen-Sayag and Fischl (2012), who explored 24 PSTs’ reflections on own practice and found that their reflections were primarily descriptive in nature, with only a few participants reflecting at higher levels. The majority of the PSTs’ reflections in this study were indeed descriptions of what was taking place in the classroom, such as: *The teacher is asking questions and depend on the children to answer the questions. If the learners give incorrect answers, she does not tell them that they are wrong instead she says it’s a more or less*. (Lutho 2018, ROP, C29-33). There were, however, some cases where PSTs demonstrated a more analytic approach. For example, Dumie wrote: *The language use could have been more developed during* *the lesson because in grade one they use isiXhosa to learn math. I could have put more emphasis on making them to master the basics of how to count rather than mixing the language with English using such as: one instead of 'Inye*' (2018 ROP, C12-14). As seen in Figure 6.1, above three-quarters of the PSTs' reflections were at level 1 of the FLRM. Their level 2 reflections comprised less than a fifth of their total reflections. Only two PSTs, Dumie and Joy, reached level 3 of reflection, with 7% each. On the other hand, while all four PSTs wrote more mathematical reflections than general, Joy wrote the highest proportion of mathematical reflections (62%). As shown in Figure 6.1, the percentages for the other PSTs' mathematical reflections were in the fifties.

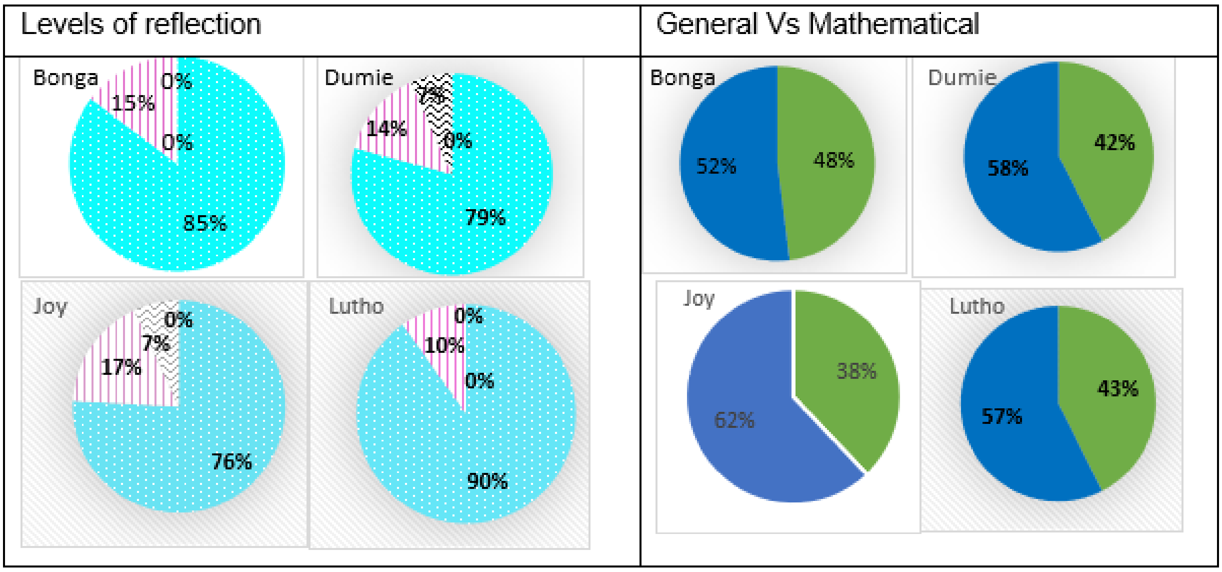



*Figure 6. 1: Summaries of the four PSTs' 2018 reflections on their own practice*

In the next section I compared these reflections on own teaching (ROP) with their reflections on other teachers' practice (included in Chapter 5) to investigate if there are any differences in the way PSTs reflected on own practice to when they reflected on other teachers' practice. I compared the 2018 ROP with the 2018 S3 reflections on the practice of other teachers.

## 6.3 ARE THERE ANY DIFFERENCES BETWEEN PSTS' REFLECTIONS ON THEIR OWN TEACHING AND ON OTHER TEACHERS' PRACTICE?

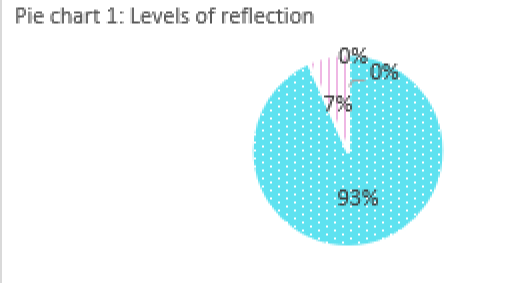
As indicated above, this section addresses the question RQ4b above, 'Are there any differences between PSTs' reflections on their own teaching and on other teachers' practice'? As mentioned above, I engage with this by comparing the PSTs' 2018 ROP with reflections made during Phase 1 S3 data collection, when PSTs reflected on another teacher's practice (referred to as S3). I aim to ascertain whether the PSTs reflected differently when reflecting on a video-recording of their own teaching. I juxtapose the summaries of 2018 ROP that I presented in Section 6.2, above, and those of S3 of Phase 1 (see Appendix 3.2). As indicated earlier, I chose the last session (S3) of Phase 1 for two reasons: the two sets of reflections were written one after another within a period of three months, and S3 was the only session in which PSTs were instructed to use all six lenses of the SLF. Below are summaries of the four PSTs' S3 and 2018 ROP, also presented in alphabetical order of the four participants' pseudonyms.

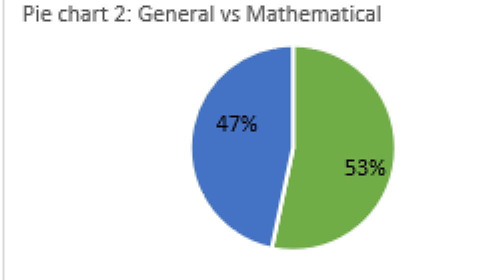
### 6.3.1 Summaries and analysis of Bonga's reflections

Below are summaries of Bonga's S3 reflections and his 2018 ROP, followed by a comparison between the two.

Summaries of Bonga's S3 reflections on another teacher's lesson video

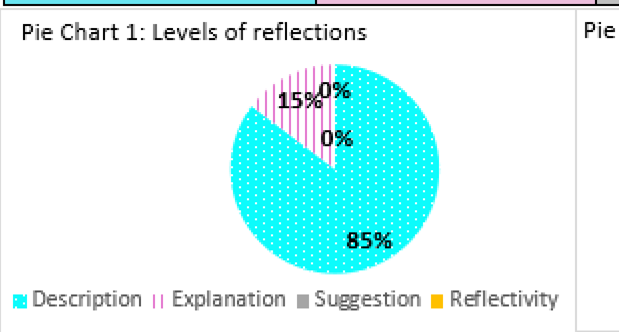
| LEVEL 1 DESCRIPTION | | | | LEVEL 2 EXPLANATION | | | | LEVEL 3 SUGGESTION | | | | LEVEL 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD* | MD | MD* | GE | GE* | ME | ME* | GS | GS* | MS | MS* | GR | MR | |
| 20 | 2 | 19 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| 22 | | 20 | | 2 | | 1 | | 0 | | 0 | | 0 | | 45 |
| 42 | | | | 3 | | | | 0 | | | | 0 | | 45 |

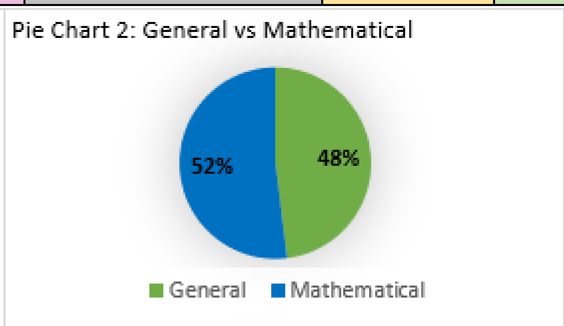



Summaries of Bonga's 2018 ROP

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD* | MD | MD* | GE | GE* | ME | ME* | GS | GS* | MS | MS* | GR | MR | |
| 40 | 4 | 34 | 9 | 4 | 0 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 102 |
| 44 | | 43 | | 4 | | 11 | | 0 | | 0 | | 0 | 0 | 102 |
| 87 | | | | 15 | | | | 0 | | | | 0 | | 102 |



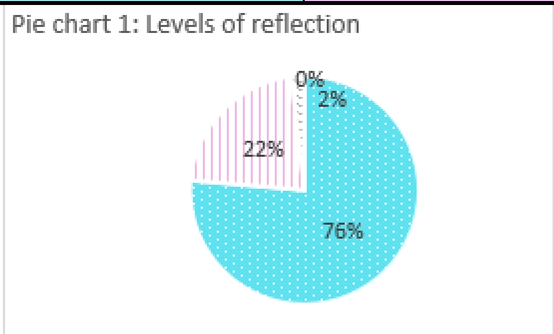

When comparing Bonga's S3 and 2018 ROP, I noted the following differences. As seen in the summaries above, there was an increase (of more than double) in the number of reflections Bonga wrote using the six lenses from 45 in S3 (on a video of another teacher's lesson) to 102 in his

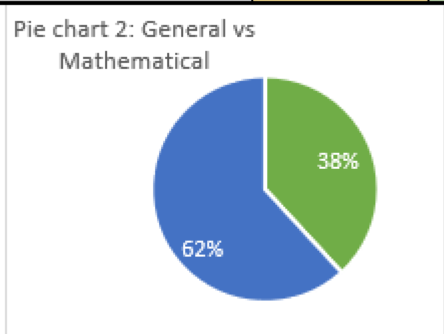
2018 ROP. This could suggest Bonga found it easier or more engaging to write about his own practice than about other teachers' practices. While his reflections remained clustered at the lower levels of the FLRM in both cases, there was an increase in level 2 reflections from 7% of the total reflections to 15% (when he was reflecting on his own teaching). This increase is matched by a decrease in the percentage of level 1 reflections from 93% to 85%. However, in both situations Bonga's reflections did not go beyond level 2 of reflection. That is, Bonga did not make any suggestions as to how to improve instruction nor did he display reflectivity about any event. It could be that he found it difficult, which Ward and McCotter (2004) claim is typical of PSTs. The second pair of pie charts reveals a slight shift in reflections from general (in S3 general reflections dominated at 53%) to mathematical reflections (52% when Bonga was reflecting on his own teaching in 2018).

### 6.3.2 Summaries and analysis of Dumie's reflections

Below are summaries of Dumie's S3 reflections and his 2018 ROP, followed by a comparison between the two.

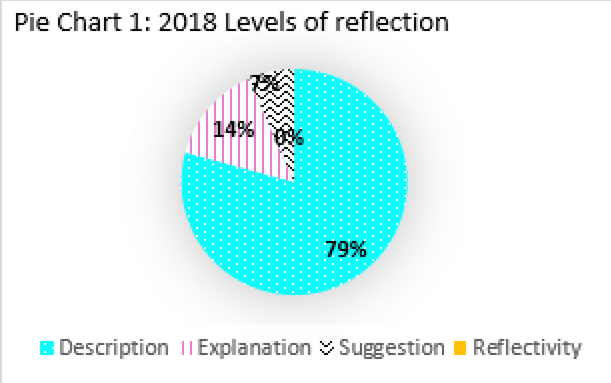
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GSS | GES | MSS | MES | GR | MR | |
| 9 | 6 (1E) | 22 | 5(1E3) | 5 | 1 | 4 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 55 |
| 15 | | 27 | | 6 | | 6 | | 0 | | 1 | | 0 | | 55 |
| 42 | | | | 12 | | | | 1 | | | | 0 | | 55 |

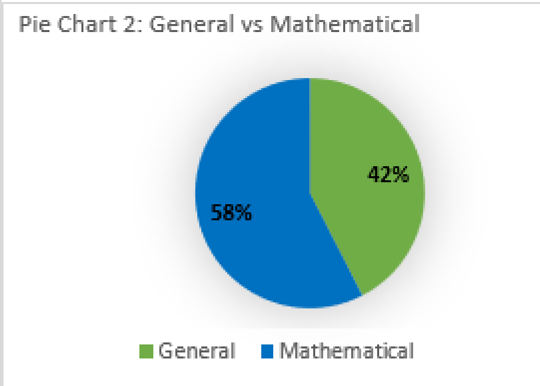



Summaries of Dumie's 2018 reflections on own teaching practice (ROP)

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 27 | 7 | 48 | 5 | 5 | 2 | 6 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 109 |
| 34 | | 53 | | 7 | | 8 | | 4 | | 3 | | 0 | 0 | 109 |
| 87 | | | | 15 | | | | 7 | | | | 0 | | 109 |



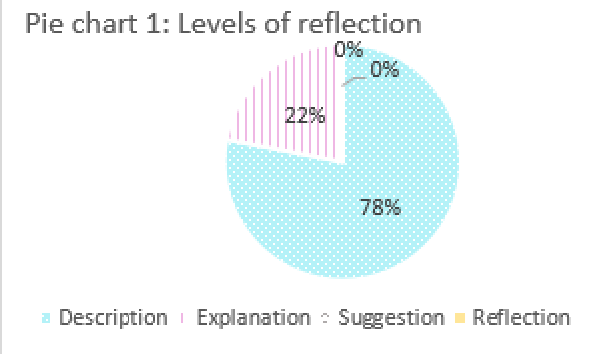

When Dumie's S3 reflections on another teacher's practice were compared with his reflections on the video of his own teaching, the following differences were noted. As was the case with Bonga, there was an almost 100% increase in the quantity of Dumie's reflections between the S3 reflections and his ROP reflections, from 55 coded ideas to 109. This suggests that Dumie noticed more classroom events in his own teaching than in the practice of others. While his reflections were similarly largely at the lower levels of the FLRM, there was a decrease in level 2 reflections from 22% to 14%, complemented by an increase in level 3 reflections (suggestions) from 2% in S3 to 7% in ROP. However, unlike Bonga, Dumie's reflections became slightly more general when he was reflecting on his own teaching video. In S3, his reflections were 62% mathematical and 38% general while in reflections on his own teaching they shifted to 58% mathematical and 42% general.

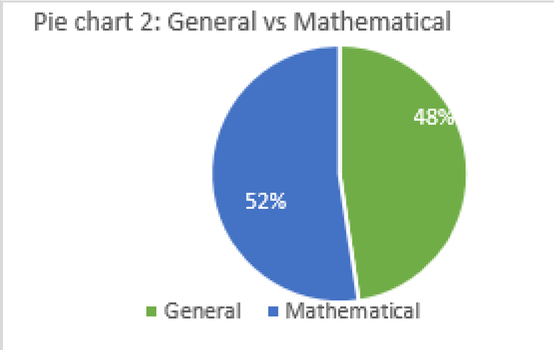
### 6.3.3 Summaries and analysis of Joy's reflections

Below are summaries of Joy's S3 and 2018 ROP, followed by a comparison of the two.

Summaries of Joy's S3 reflections

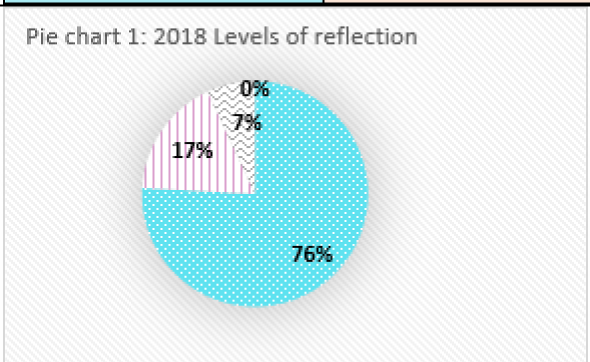
| Level 1 DESCRIPTION | | | | Level2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\to E}$ | MS | $MS^{\to E}$ | GR | MR | |
| 16 | 2 | 7 | 7 | 2 | 0 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 42 |
| 18 | | 14 | | 2 | | 7 | | 0 | | 1 | | 0 | | 42 |
| 32 | | | | 9 | | | | 1 | | | | 0 | | 42 |

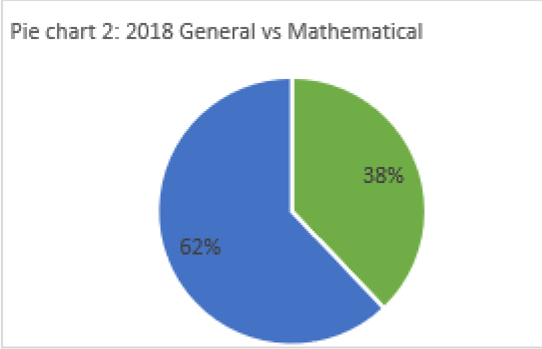



Summaries of Joy's 2018 ROP reflections

| *Level 1 DESCRIPTION* | | | | *Level 2 EXPLANATION* | | | | *Level 3 SUGGESTION* | | | | *Level 4 REFLECTIVITY* | | *TOTAL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *GD* | *$GD^{\to E}$* | *MD* | *$MD^{\to E}$* | *GE* | *$GE^{*}$* | *ME* | *$ME^{*}$* | *GS* | *$GS^{\to E}$* | *MS* | *$MS^{\to E}$* | *GR* | *MR* | |
| *6* | *5* | *31* | *3* | *7* | *0* | *2* | *1* | *2* | *2* | *0* | *0* | *0* | *0* | *58* |
| *11* | | *33* | | *7* | | *3* | | *4* | | *0* | | *0* | *0* | *58* |
| *44* | | | | *10* | | | | *4* | | | | *0* | | *58* |



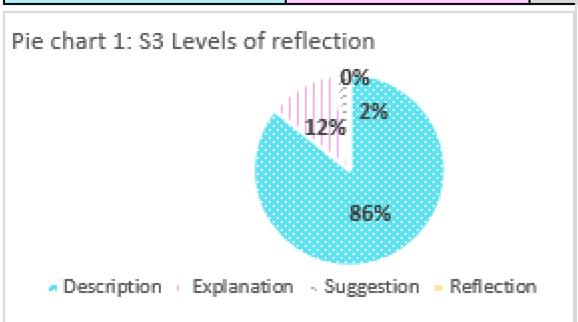

As seen in the summaries above, there was no huge increase in the number of Joy's coded reflections from S3 to ROP 2018, as noted in Bonga's and Dumie's cases. Her reflections increased from 42 to 58, suggesting she did not view her own teaching very differently from the way she viewed other teachers' practices. While her level 1 reflections remained at 76% in both S3 and the 2018 reflections, the level 2 reflections decreased from 22% in S3 to 17% in ROP 2018. On the other hand, Joy's level 3 reflections increased from 0% to 7%, perhaps indicating that she found it easier to suggest how she might improve her own instruction than to do so for others. Joy did not display reflectivity in either S3 or 2018. There was nevertheless a 10% increase in mathematical reflections between S3 and ROP 2018. In S3 she recorded 52% mathematical reflections and 48% general, while in 2018 these figures became 62% mathematical reflections and 38% general. She seemed to pay more attention to her own mathematical events than to those of others.

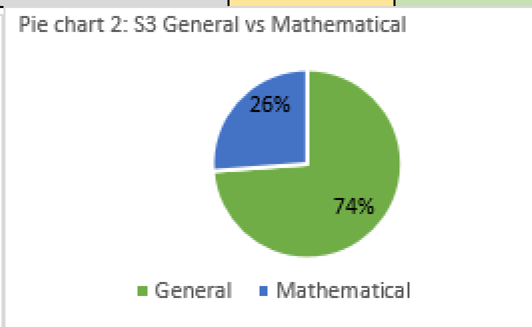
### 6.3.4 Summaries and analysis of Lutho's reflections

Below appear summaries of Lutho's S3 reflections and his 2018 ROP, followed by a comparison of the two.

Summaries of Lutho's S3 reflections

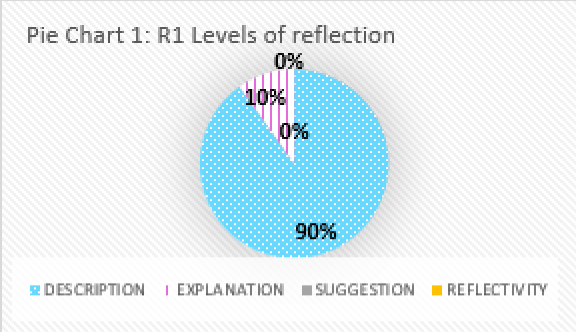
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE* | ME | ME* | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 23 | 3 | 9 | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 42 |
| 26 | | 10 | | 4 | | 1 | | 1 | | 0 | | 0 | | 42 |
| 36 | | | | 5 | | | | 1 | | | | 0 | | 42 |

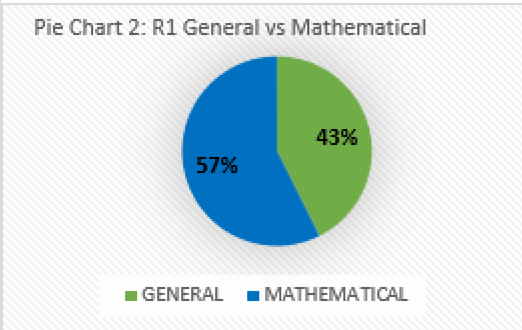



Summaries of Lutho's 2018 reflections

| *Level 1 DESCRIPTION* | | | | *Level 2 EXPLANATION* | | | | *Level 3 SUGGESTION* | | | | *Level 4 REFLECTIVITY* | | *TOTAL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *GD* | *GD$^{\to E}$* | *MD* | *MD$^{\to E}$* | *GE* | *GE** | *ME* | *ME** | *GS* | *GS$^{\to E}$* | *MS* | *MS$^{\to E}$* | *GR* | *MR* | |
| *22* | *2* | *29* | *4* | *2* | *0* | *4* | *1* | *0* | *0* | *0* | *0* | *0* | *0* | *61* |
| *24* | | *31* | | *2* | | *4* | | *0* | | *0* | | | | *61* |
| *55* | | | | *6* | | | | *0* | | | | *0* | | *61* |



As seen in the summaries above, as was the case with Joy, the number of Lutho's reflections did not increase as much as those of Bonga and Dumie. Her reflections increased from 42 to 61 between S3 and 2018. Level 1 reflections increased from 86% in S3 to 90% in 2018, while level 2 reflections decreased from 12% in S3 to 10% in 2018. This suggests that Lutho did not seriously attempt to provide rationales for her classroom events. The level 3 reflections started at 2% during S3 but decreased to 0% in 2018, suggesting she was satisfied with the way she handled her classroom events and did not think she needed to countenance alternative ways of providing instruction. Like the rest of the PSTs, Lutho displayed no reflectivity in either set of reflections. There was, however, a significant shift from general to mathematical reflections. In S3 Lutho wrote 26% mathematical reflections which increased by more than 100% to 57% in 2018, suggesting it was easier for Lutho to notice mathematical events in her practice than in the practice of others.

### 6.3.5 Conclusion

This section sought to respond to the second part of RQ 4, 'How do PSTs reflect on video-recorded lessons of their own teaching? (b) *Are these reflections any different from their reflections on video-recorded lessons of other teachers' practices?* To answer this, I compared each of the four PST's reflections in S3 with the reflections they wrote in 2018 based on their own practice (ROP 1). Table 6.2, below, summarises the four PSTs' reflections during these two sessions. I found that PSTs' ROP 1 were generally greater in number than those in S3, particularly for Bonga and Dumie, whose reflections on their own practice almost doubled the number they came up with in S3. It seems that PSTs found more to say about their own practice than they did about the practice of others. Arrastia, Rawls, Brinkerhoff and Roehrig (2017), however, suggest that an increased number of reflections on own practice can possibly result from PSTs' remembering what they had planned to teach in addition to noticing classroom events in the video of their own teaching. This possibility is evidenced by Bonga, who begins his reflections by saying: *In this lesson I planned to teach learners bonds of 15. I wanted learners to come up with two numbers that can be added to make up the number 15. Each learner would raise a hand and give the two numbers, explain to the class how they calculated it* (Bonga 2018 ROP, C1-4). This excerpt shows that Bonga's noticing was supplemented by his remembering what he had planned to do in the lesson concerned.

I also found that there was no general trend with regard to levels of reflection among the four PSTs. While Bonga evinces a decrease in level 1 reflections from 93% to 85%, accompanied by an increase in level 2 reflections, Dumie and Lutho increased level 1 reflections while decreasing level 2 reflections. Joy's level 1 reflections did not change but her level 2 reflections declined like those of Dumie and Lutho. This fall in level 2 reflections suggests that the PSTs did not provide as much reasoned explanation for their own classroom events as they did with the practice of others. This is in line with the finding of Leijen et al. (2012), that it was more difficult for PSTs to deepen the reasoning in reflection concerning their own actions as opposed those of others. According to Poom-Valickis and Mathews (2013), "[one reason why it is easier to analyse somebody else's case from a bystander's point of view is because there is no personal and emotional connection with the situation, which makes it potentially easier to see the problem and find possible solutions." While Poom-Valickis and Mathews' (2013) reasoning may apply to Dumie and Lutho's level 2 ideas, it does not work in the cases of Bonga and Joy, who managed to make more suggestions for improvement in respect of their own teaching than they did in S3.

*Table 6. 2: Summaries of each of the four PSTs' reflections during Phase 1 S3 and Phase 2 ROP 1*

| PST | Session | Level 1 DESCRIPTION | Level 2 EXPLANATION | Level 3 SUGGESTION | Level 4 REFLECTIVITY | TOTAL | G | M |
|---|---|---|---|---|---|---|---|---|
| Bonga | S3: Qty | 42 | 3 | 0 | 0 | 45 | 24 | 21 |
| | %age | 93% | 07% | 0% | 0% | 100% | 53% | 47% |
| | ROP 1: Qty | 87 | 15 | 0 | 0 | 102 | 48 | 54 |
| | %age | 85% | 15% | 0% | 0% | 100% | 48% | 52% |
| Dumie | S3: Qty | 42 | 12 | 1 | 0 | 55 | 21 | 34 |
| | %age | 76% | 22% | 2% | 0% | 100% | 38% | 62% |
| | ROP 1: Qty | 87 | 15 | 7 | 0 | 109 | 45 | 64 |
| | %age | 79% | 14% | 7% | 0% | 100% | 42% | 58% |
| Joy | S3: Qty | 32 | 9 | 0 | 0 | 42 | 20 | 22 |
| | %age | 76% | 22% | 0% | 0% | 100% | 48% | 52% |
| | ROP 1: Qty | 44 | 10 | 4 | 0 | 58 | 22 | 36 |
| | %age | 76% | 17% | 7% | 0% | 100% | 38% | 62% |
| Lutho | S3: Qty | 36 | 5 | 1 | 0 | 42 | 31 | 11 |
| | %age | 86% | 12% | 2% | 0% | 100% | 74% | 26% |
| | ROP 1: Qty | 55 | 6 | 0 | 0 | 61 | 26 | 35 |
| | %age | 90% | 10% | 0% | 0% | 100% | 43% | 57% |

Another finding pertains to the extent to which PSTs focused either on mathematical or on general classroom events. Three of the four PSTs wrote down more mathematical events regarding their own teaching than they did with S3 reflections where they were reflecting on another teacher's practice. Dumie, however, did the opposite of the other three: his general reflections went up from 38% in S3 to 42% in ROP1, while his mathematical reflections decreased from 62% in S3 to 58% in ROP 1.

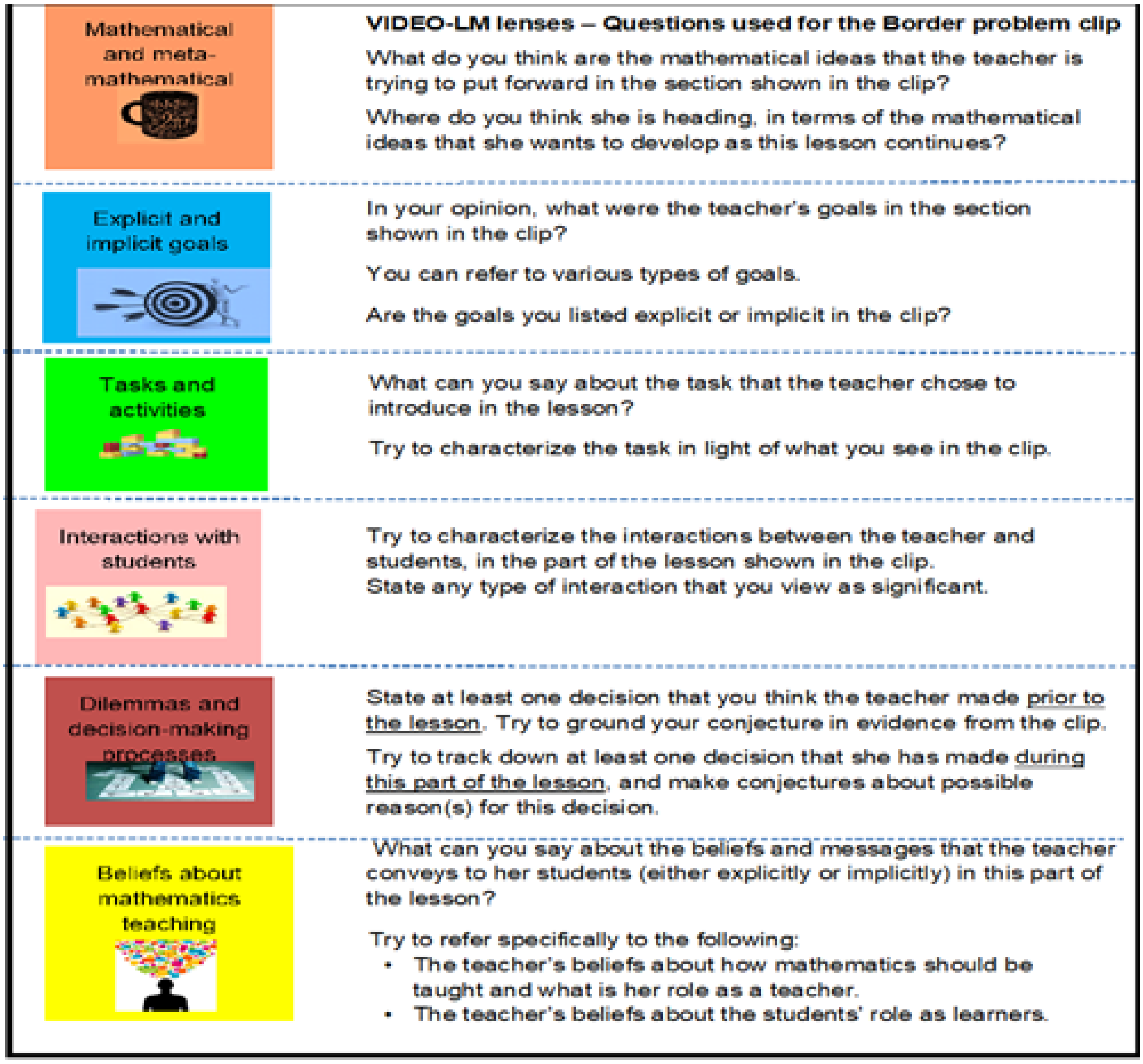
The findings discussed above suggest that PSTs in general reflect mainly at the descriptive level whether reflecting on their own or on another teachers practice. The table above shows that even while the number of reflections increased substantively when reflecting on their own practice there were no major shifts in the percentage of reflections in the other three levels. Next I present the four PSTs' second set of reflections on their own practice written in 2019 after participating in the small group facilitator led reflection sessions. As indicated in Chapter 4, the PSTs used the same video-recordings of their own teaching they used in ROP 1. I therefore refer to the 2019 reflections as ROP 2.

## 6.4 WHAT IS THE NATURE OF PSTS' REFLECTIONS FOLLOWING GUIDANCE BY A SKILLED FACILITATOR IN SMALL GROUP SESSIONS? (RQ5)

This section presents the four PSTs' reflections on own practice after the three reflective practice sessions that were guided by skilled facilitators. Poom-Valickis and Mathews (2013) proposed that "when encouraging teachers to become critically reflective it must be remembered that critical reflection is a skill that needs to be learned and needs the support of mentors to facilitate reflective opportunities" (p. 431). The purpose of this phase of the research was to establish whether the facilitator-guided reflection sessions made any difference to the way in which these PSTs reflected, so as to answer RQ 5: What is the nature of PST reflections following guidance by a skilled facilitator in small group sessions?

Due to electricity power cuts and the PSTs' busy university schedules PSTs were asked to write their reflections independently at their homes at a time convenient to each of them. I gave each PST a copy of a handout used by Ronnie Karsenty (given in Figure 6.2 below) during her 2019 facilitator-guided session to remind PSTs what to consider as they reflected using each of the six lenses of the SLF.

Next I present each PST's 2019 reflections on the video recordings of their own teaching made during their 2018 practicum. As in section 6.2 I present these in alphabetical order of their pseudonyms. The reflections are identified as 2019 Reflections on Own Practice 2 (2019 ROP or ROP 2).



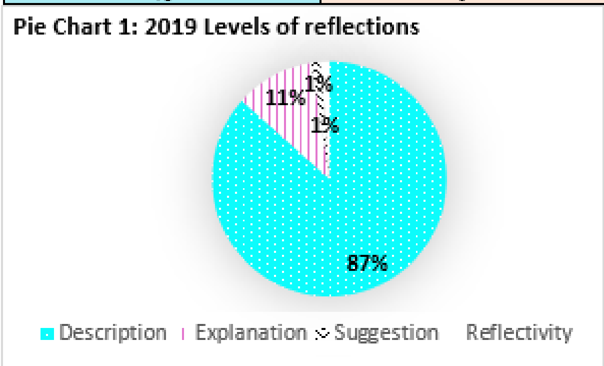
| | VIDEO-LM lenses – Questions used for the Border problem clip |
|---|---|
| Mathematical and meta-mathematical | What do you think are the mathematical ideas that the teacher is trying to put forward in the section shown in the clip?<br>Where do you think she is heading, in terms of the mathematical ideas that she wants to develop as this lesson continues? |
| Explicit and implicit goals | In your opinion, what were the teacher's goals in the section shown in the clip?<br>You can refer to various types of goals.<br>Are the goals you listed explicit or implicit in the clip? |
| Tasks and activities | What can you say about the task that the teacher chose to introduce in the lesson?<br>Try to characterize the task in light of what you see in the clip. |
| Interactions with students | Try to characterize the interactions between the teacher and students, in the part of the lesson shown in the clip.<br>State any type of interaction that you view as significant. |
| Dilemmas and decision-making processes | State at least one decision that you think the teacher made prior to the lesson. Try to ground your conjecture in evidence from the clip.<br>Try to track down at least one decision that she has made during this part of the lesson, and make conjectures about possible reason(s) for this decision. |
| Beliefs about mathematics teaching | What can you say about the beliefs and messages that the teacher conveys to her students (either explicitly or implicitly) in this part of the lesson?<br>Try to refer specifically to the following:<br>• The teacher's beliefs about how mathematics should be taught and what is her role as a teacher.<br>• The teacher's beliefs about the students' role as learners. |

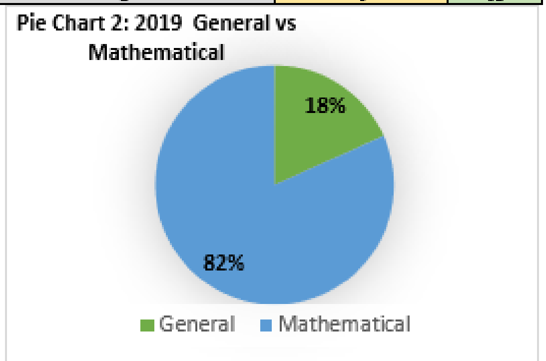
*Figure 6. 2: The six lens framework handout distributed by Karsenty (2019) during her facilitator-led reflective practice session*

### 6.4.1 Bonga’s 2019 reflections on own practice

Bonga’s 2019 ROP with coding is given in Appendix 3.3. The summary of this coding is given below:

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 15 | 0 | 48 | 8 | 0 | 0 | 8 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 82 |
| 15 | | 56 | | 0 | | 9 | | 0 | | 2 | | 0 | 1 | 82 |
| 71 | | | | 9 | | | | 2 | | | | 1 | | 82 |



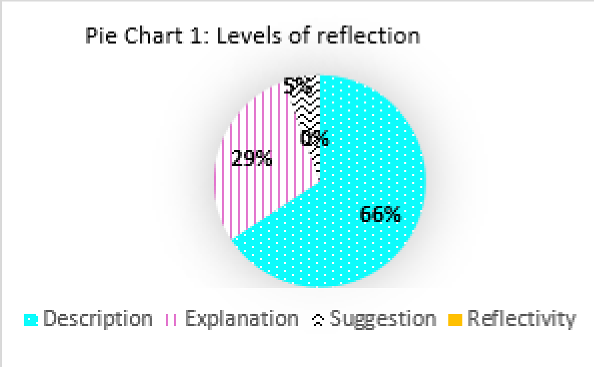



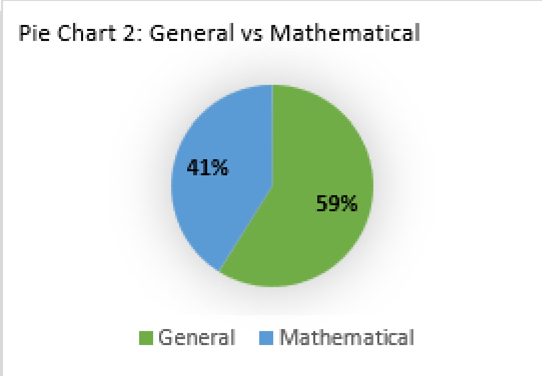

Bonga wrote down 82 coded reflections in 2019, compared to the 102 he had written on the same lesson a year earlier. Of the 82 coded ideas, 71 were descriptions and nine were explanations. He also made one mathematical suggestion and recorded one mathematical reflection that was coded at the level of reflectivity. Fifteen of the 71 descriptions were GDs while 56 were MDs. None of the GDs was followed by an explanation, while eight MDs were followed by explanations. One of these explanations was expanded with two ideas. This time around Bonga wrote one MS that was followed by an expanded explanation with four ideas. He also wrote one MR. Thus, while his reflections spread across the four levels of reflection, they were still mostly crowded at the lowest levels of the FLRM. Eighty-seven per cent of the reflections were at level 1 and 11% at level 2. Levels 3 and 4 had only 1% each. Eighty-two per cent of the reflections were mathematical while only 18% were general.

### 6.4.2. Dumie's 2019 reflections on own practice

Dumi's 2019 ROP with coding is given in Appendix 3.3. The summary of this coding is given below:

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 15 | 10 | 16 | 7 | 6 | 8 | 1 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 73 |
| 25 | | 23 | | 14 | | 7 | | 4 | | 0 | | 0 | 0 | 73 |
| 48 | | | | 21 | | | | 4 | | | | 0 | | 73 |



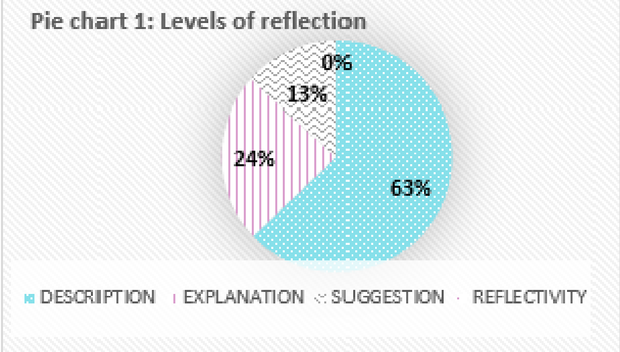



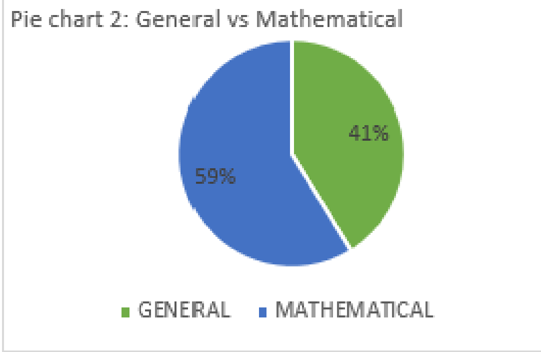

Dumie wrote 73 coded reflections in 2019, compared to the 109 he had written on the same lesson fourteen months earlier. Of the 73 coded ideas, 48 were descriptions, 21 were explanations and four were suggestions. There were no ideas that displayed reflectivity. Twenty-five out of 48 descriptions were GDs while 23 were MDs. Ten of the GDs and 8 MDs were followed by explanations. Eight of the GEs were expanded with two ideas or more, while six out of seven MEs were also expanded. This time around Dumie recorded four GS, two of which were followed by simple explanations. Thus, while his reflections were mainly at the lower levels of the FLRM, he had a greater percentage of reflections at level 2 than any of the other PSTs. Sixty-six per cent of the reflections were at level 1, 29% at level 2 and only 5% at level 3. There were no reflections at level 4. Unlike Bonga's, Dumie's reflections were more general (59%) than mathematical (41%).

### 6.4.3 Joy's 2019 reflections on own practice

Joy's 2019 ROP with coding is given in Appendix 3.3. The summary of this coding is given below:

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE* | ME | ME* | GS | GS→E | MS | MS→E | GR | MR | |
| 15 | 8 | 29 | 9 | 5 | 5 | 8 | 5 | 5 | 2 | 2 | 4 | 0 | 0 | 97 |
| 23 | | 38 | | 10 | | 13 | | 7 | | 6 | | 0 | 0 | 97 |
| 61 | | | | 23 | | | | 13 | | | | 0 | | 97 |



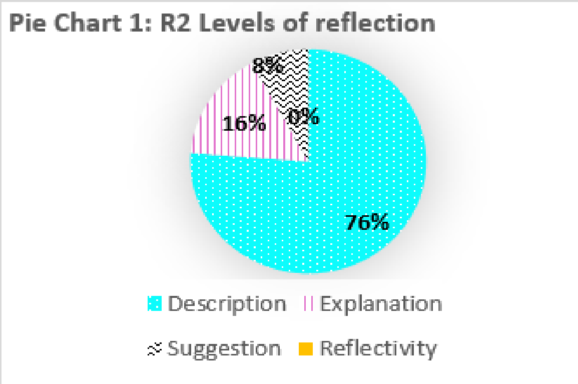



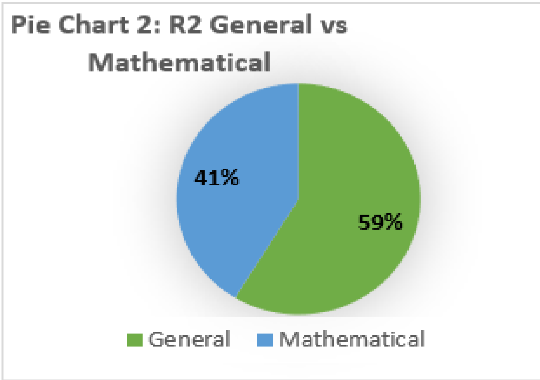

During the second round of reflecting on the video-recorded lesson of own teaching, Joy indicated all the lenses she was reflecting, which she did not do in ROP 1. She wrote 97 coded ideas on the same lesson on which she had written 58 reflections almost a year earlier. Of these 97 coded ideas, 61 were descriptions, 23 were explanations, and 13 were suggestions. There were no ideas that displayed reflectivity. Twenty-three of the 61 descriptions were GDs, eight of them followed by explanations. Three of these explanations were expanded with two ideas each. The remaining 38 descriptions were MDs, and nine of these were followed by explanations. Five of the nine MEs were simple explanations while four were expanded, 3 with two ideas and the other with 3 ideas. Seven of the 13 suggestions were GSs, and only two of these were followed by simple explanations. Six suggestions were MSs, four of them followed by simple explanations. Thus, Joy's 2019 reflections were spread through the first three levels of the FLRM, though the majority were still at the lowest level. As seen in pie chart 1, 63% of the reflections were at level 1 and 24% were at level 2. Joy had the highest percentage of level 3 reflections among the PSTs at 13%. There were no reflections at level 4. On the other hand, 59% of Joy's reflections were mathematical, while 41% were general.

### 6.4.4 Lutho’s 2019 reflections on own practice

Lutho’s 2019 ROP with coding is given in Appendix 3.3. The summary of this coding is given below:

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE^e | ME | ME^e | GS | GS→E | MS | MS→E | GR | MR | |
| 19 | 6 | 19 | 3 | 6 | 0 | | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 63 |
| 26 | | 22 | | 6 | | 4 | | 5 | | | | | | 63 |
| 48 | | | | 10 | | | | 5 | | | | 0 | | 63 |




In the second round of reflecting on her own teaching, Lutho recorded 63 coded reflections compared to the 61 she wrote on the same lesson in 2018. Of the 63 ideas, 48 were descriptions, ten were explanations and five were suggestions. Twenty-six of the descriptions were GDs, six of them followed by simple explanations. The other 22 of the 48 descriptions were MDs and only three of these were followed by explanations. One of the explanations was expanded with two ideas. All five suggestions were GSs, one of them followed by a simple explanation. Thus, Lutho’s ROP 2 reflections spanned the first three levels of the FLRM: 76% at level 1, 16% at level 2 and 8% at level 3. There were no reflections at level 4. On the other hand, 41% of her reflections were general while 59% were mathematical.

### 6.4.5 Conclusion of section

In this section I have presented the four PSTs’ ROP2, written after three sessions of facilitator-guided reflections. Summaries of these appear together in Figure 6.3, below. As apparent in Figure 6.3, all four PSTs’ ROP 2 reached at least three different levels of reflection, although most of the reflections remained at the lower levels of the of the FLRM. All four PSTs reflected up to level 3 of the FLRM. There were more descriptive reflections than any other kind. Interestingly, Bonga had the highest percentage of level 1 reflections (87%) and the lowest percentage of reflections at all the other levels of reflection, yet he is the only one who reached level 4 reflection. He also had the highest proportion of mathematical reflections (82%), while the others had less than 60%.

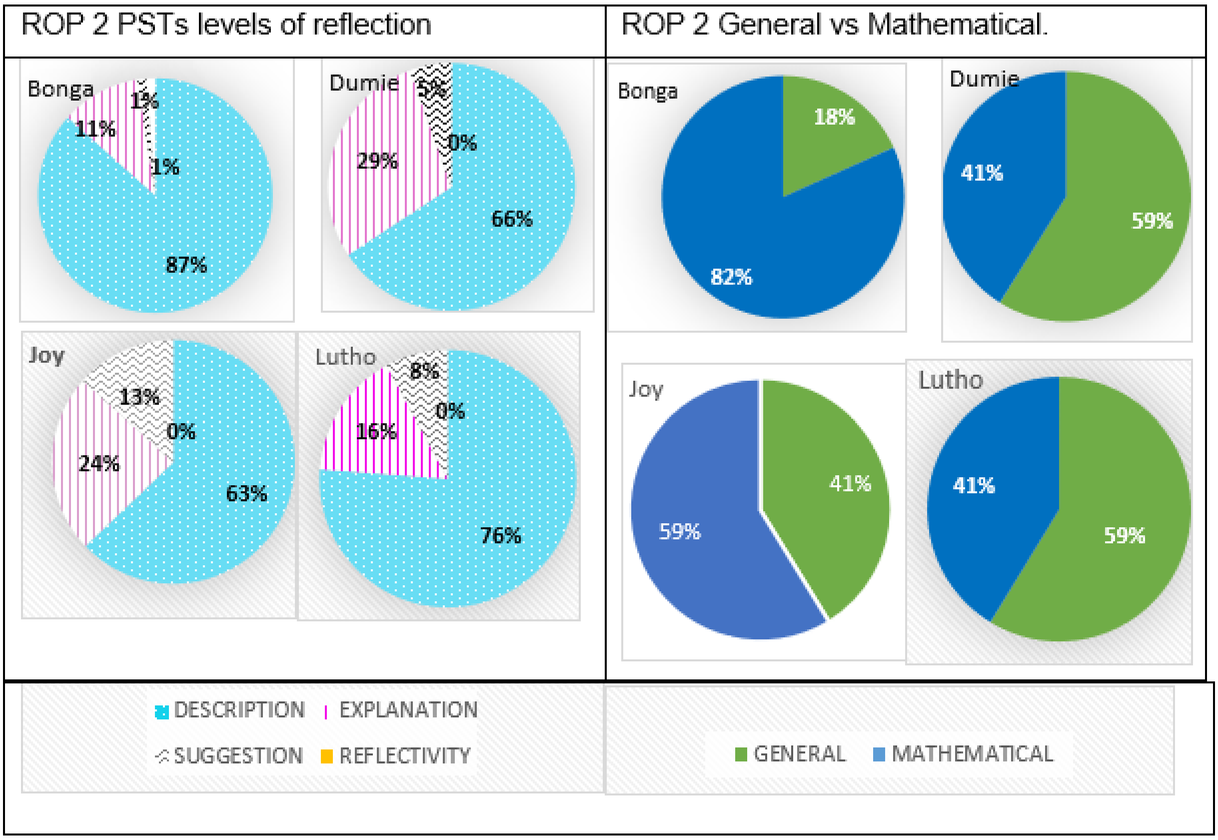



*Figure 6. 3: Summaries of the four PSTs' reflections after the facilitator-guided sessions*

## 6.5 HOW DID THE NATURE OF THE PRE-SERVICE TEACHERS' REFLECTIONS ON THEIR OWN PRACTICE CHANGE FOLLOWING SKILLED FACILITATION, IF AT ALL? (RQ6)

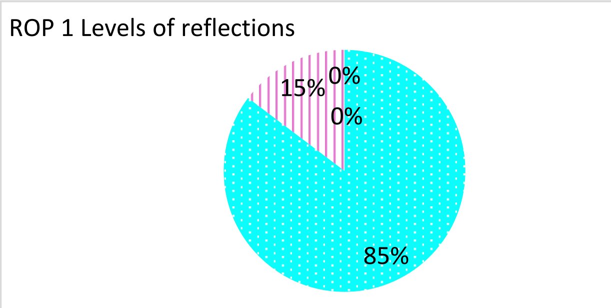
This section compares the four PSTs' 2018 reflections (ROP 1) with their 2019 reflections on their own practice (ROP 2) in order to respond to RQ 6: How did the nature of their reflections on their own practice change following skilled facilitation, if at all? The PSTs reflected on the same the lesson of their practice they video-recorded during their teaching practice in 2018. Below I present for comparative purposes summaries of each of the PSTs' two sets of reflections.

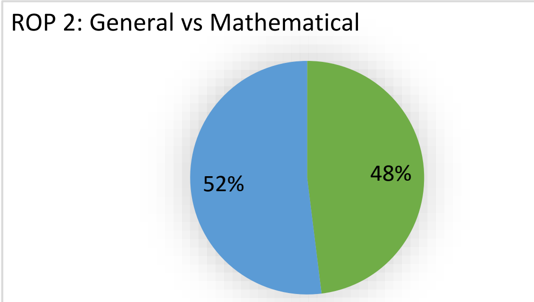
### 6.5.1 Comparing Bonga's 2018 and 2019 reflections on his own practice

Below are summaries of Bonga's ROP 1 and ROP 2 on the same video-recorded lesson of his practice, followed by a comparison of the two.

Summaries of ROP 1

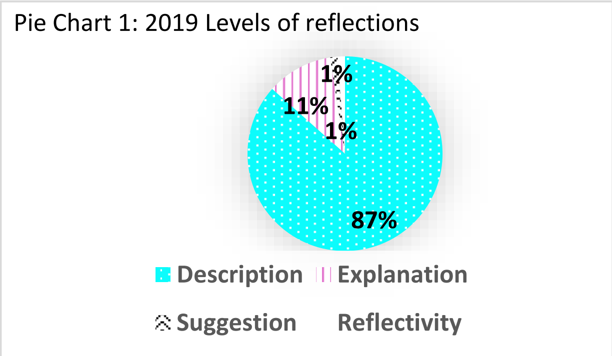
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^e$ | ME | ME$^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 40 | 4 | 34 | 9 | 4 | 0 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 102 |
| 44 | | 43 | | 4 | | 11 | | 0 | | 0 | | 0 | 0 | 102 |
| 87 | | | | 15 | | | | 0 | | | | 0 | | 102 |

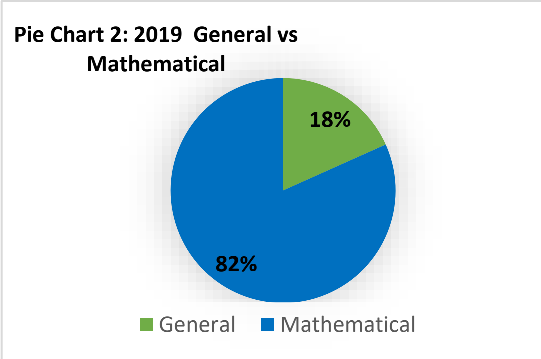



Summaries of ROP 2

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^e$ | ME | ME$^e$ | GS | GS→E | MS | MS→E | GR | MR | | |
| 15 | 0 | 48 | 8 | 0 | 0 | 8 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 82 | |
| 15 | | 56 | | 0 | | 9 | | 0 | | 2 | | 0 | 1 | 82 | |
| 71 | | | | 9 | | | | 2 | | | | 1 | | 82 | |



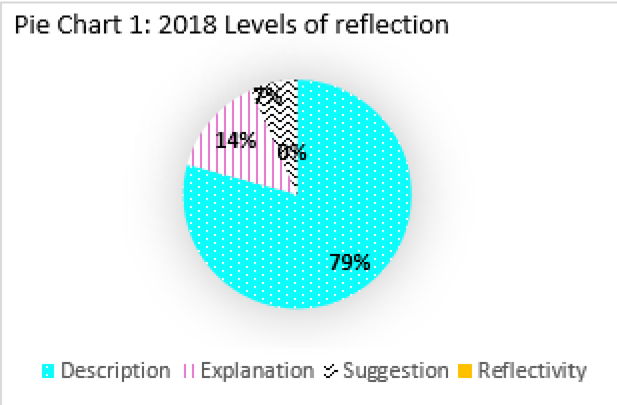

There was a drop in the quantity of Bonga's reflections from 102 in ROP 1 to 82 in ROP 2. Of interest is that the percentage of ideas at level 2 went down rather than up, from 15% to 11% over the intervening year and after Bonga's participation in the facilitator-led reflection sessions. Bonga did nevertheless contribute two ideas that were coded at level 3 and one idea at level 4 after the guided reflection sessions, whereas previously there were no reflections at these levels. Additionally, there is a significant shift towards a focus on mathematical rather than general ideas over the year, from 52% in ROP 1 to 82% in ROP 2. This suggests that the facilitator guided reflection sessions had a positive influence on Bonga's reflections.

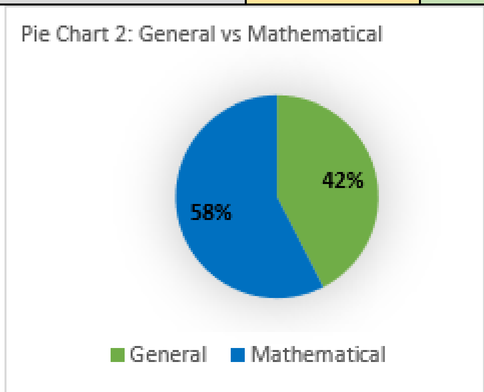
### 6.5.2 Comparing Dumie's 2018 and 2019 reflections on his own practice

Below are summaries of Dumie's ROP 1 and ROP 2 on the same video-recorded lesson of his practice, followed by a comparison of the two.

Summaries of Dumie's 2018 Reflections

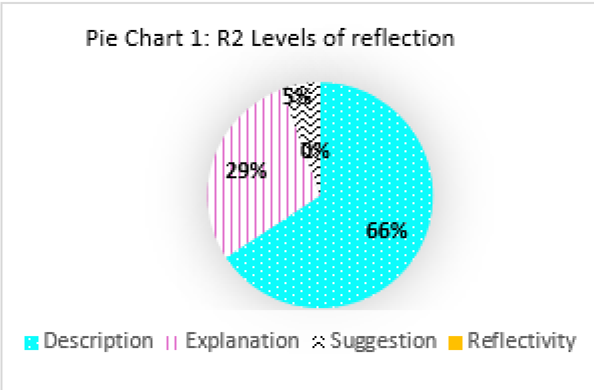
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 27 | 7 | 48 | 5 | 5 | 2 | 6 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 109 |
| 34 | | 53 | | 7 | | 8 | | 4 | | 3 | | 0 | 0 | 109 |
| 87 | | | | 15 | | | | 7 | | | | 0 | | 109 |

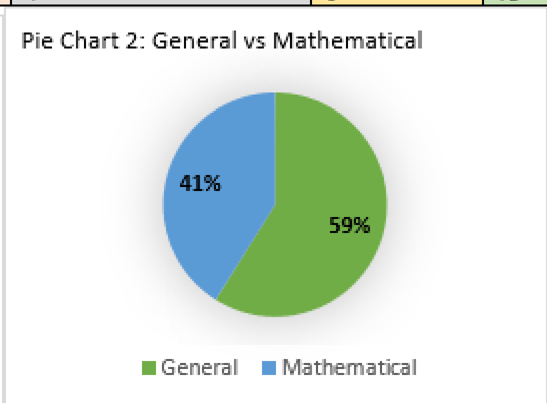



*Summaries of Dumie's 2019 reflections*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{*}$ | ME | $ME^{*}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 15 | 10 | 16 | 7 | 6 | 8 | 1 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 73 |
| 25 | | 23 | | 14 | | 7 | | 4 | | 0 | | 0 | 0 | 73 |
| 48 | | | | 21 | | | | 4 | | | | 0 | | 73 |



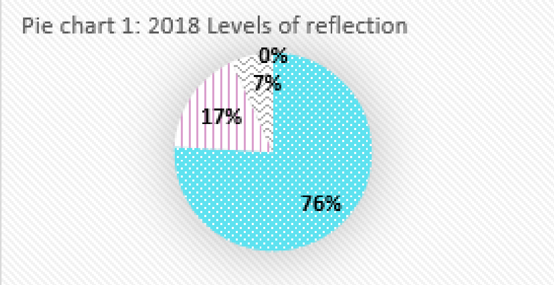

There was also a drop in the quantity of Dumie's reflections from 109 to 73. However, there was a decrease in the percentage of level 1 reflections from 79% in ROP 1 to 66% in ROP 2, complemented by an increase in level 2 reflections from 14% to 29%. The percentage of ideas at level 3 went down rather than up over time, from 7% in ROP 1 to 5% in ROP 2. That is, Dumie wrote fewer suggestions on the same lesson than he did a year earlier. Also, there was a shift of focus from mathematical classroom events towards a focus on general ideas over the year that was not expected. The mathematical reflections decreased from 58% in 2018 to 41% in 2019, while the percentage of general ideas increased commensurately from 42% to 59%. The lapse of a year and participation in the three sessions of facilitator-guided reflections did not shift Dumie's focus to mathematical reflections or increase his suggestions and reflectivity. There was nevertheless an increase in Dumie's level 2 reflections, from 14% to 29% which served to reduce his level 1 reflections by 13%.

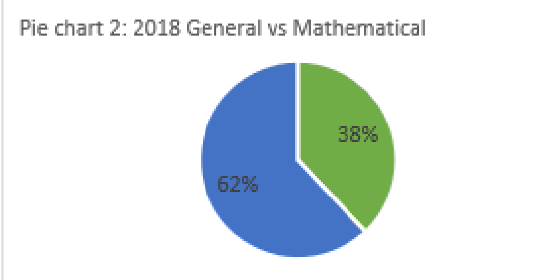
### 6.5.3 Comparing Joy's 2018 and 2019 reflections on her own practice

Below are summaries of Joy's 2018 and 2019 reflections on the same video-recorded lesson of his practice, followed by a comparison between the two.

Summaries of Joy's 2018 reflections

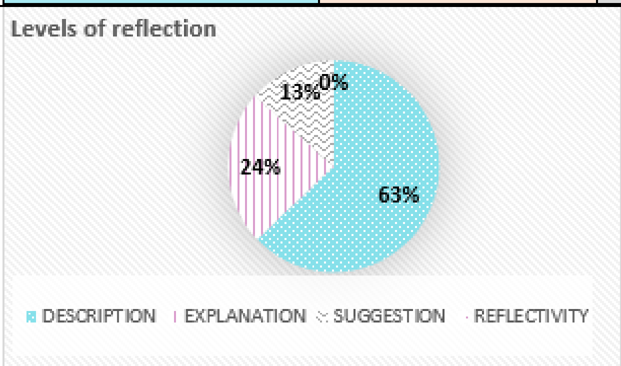
| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | $GE^e$ | ME | $ME^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 6 | 5 | 31 | 3 | 7 | 0 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 58 |
| 11 | | 33 | | 7 | | 3 | | 4 | | 0 | | 0 | 0 | 58 |
| 44 | | | | 10 | | | | 4 | | | | 0 | | 58 |

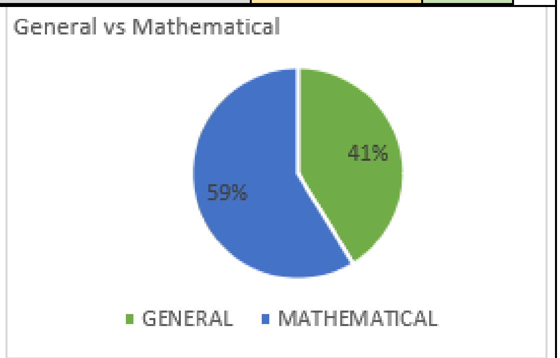



Summaries of Joy's 2019 reflections

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | $GE^e$ | ME | $ME^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 15 | 8 | 29 | 9 | 5 | 5 | 8 | 5 | 5 | 2 | 2 | 4 | 0 | 0 | 97 |
| 23 | | 38 | | 10 | | 13 | | 7 | | 6 | | 0 | 0 | 97 |
| 61 | | | | 23 | | | | 13 | | | | 0 | | 97 |



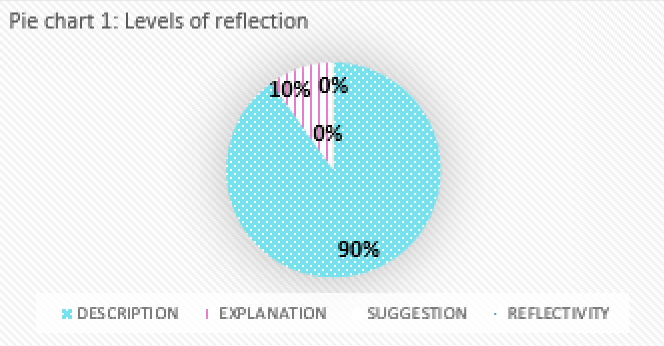
Unlike in the cases of Bonga and Dumie, above, there was an increase in the quantity of Joy's reflections from 58 in 2018 to 97 in 2019. There was a decrease in the percentage of level 1 reflections from 76% in 2018 to 63% in 2019, and a commensurate increase in level 2 reflections from 17% to 24%. The proportion of level 3 reflections also increased from 7% to 13%. In neither case was there a reflection at level 4. While these figures suggest progress in the manner in which Joy reflected between the two years, the proportion of mathematical versus general reflections remained decreased slightly from 62%/38% to 59% / 41%.

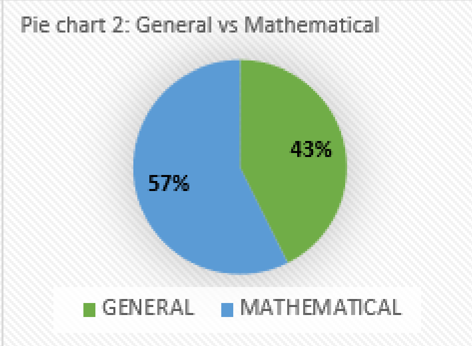
### 6.5.4 Comparing Lutho's 2018 and 2019 reflections on her own practice

Below are summaries of Lutho's 2018 and 2019 reflections on the same video-recorded lesson of his practice, followed by a comparison of the two.

Summaries of Lutho's 2018 reflections

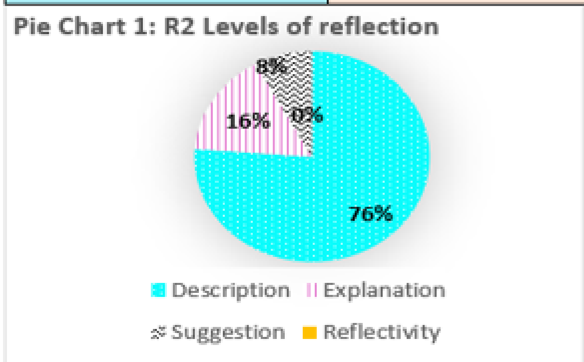
| *Level 1 DESCRIPTION* | | | | *Level 2 EXPLANATION* | | | | *Level 3 SUGGESTION* | | | | *Level 4 REFLECTIVITY* | | *TOTAL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *GD* | $GD^{\to E}$ | *MD* | $MD^{\to E}$ | *GE* | $GE^{e}$ | *ME* | $ME^{e}$ | *GS* | $GS^{\to E}$ | *MS* | $MS^{\to E}$ | *GR* | *MR* | |
| 22 | 2 | 29 | 4 | 2 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 61 |
| 24 | | 31 | | 2 | | 4 | | 0 | | 0 | | | | 61 |
| 55 | | | | 6 | | | | 0 | | | | 0 | | 61 |

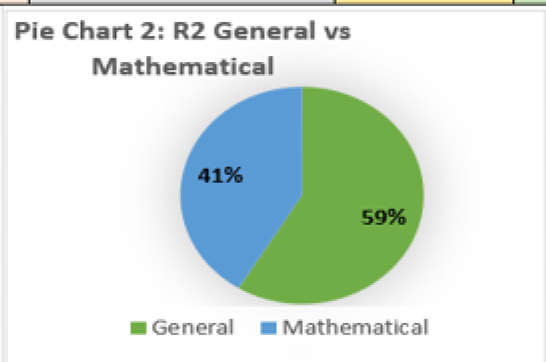


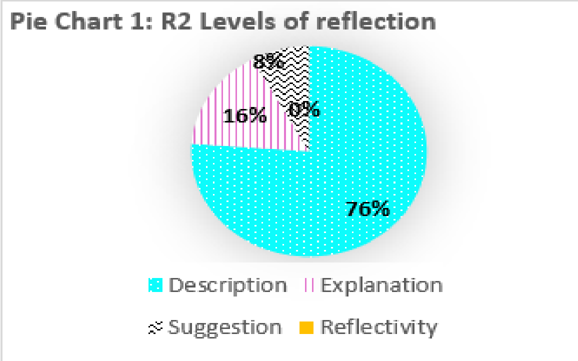

Summaries of 2019 reflections

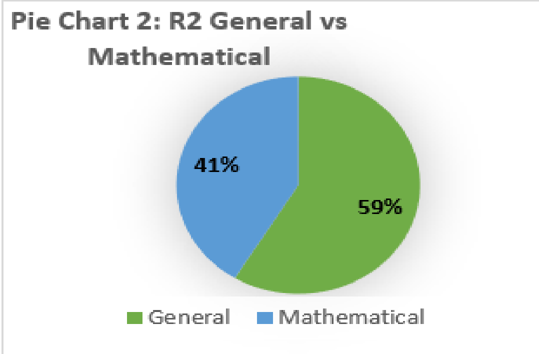
| *Level 1 DESCRIPTION* | | | | *Level 2 EXPLANATION* | | | | *Level 3 SUGGESTION* | | | | *Level 4 REFLECTIVITY* | | *TOTAL* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *GD* | $GD^{\to E}$ | *MD* | $MD^{\to E}$ | *GE* | $GE^{e}$ | *ME* | $ME^{e}$ | *GS* | $GS^{\to E}$ | *MS* | $MS^{\to E}$ | *GR* | *MR* | |
| 19 | 6 | 19 | 3 | 6 | 0 | | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 63 |
| 26 | | 22 | | 6 | | 4 | | 5 | | | | | | 63 |
| 48 | | | | 10 | | | | 5 | | | | 0 | | 63 |



| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\rightarrow E}$ | MD | $MD^{\rightarrow E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GS | $GS^{\rightarrow E}$ | MS | $MS^{\rightarrow E}$ | GR | MR | |
| 19 | 6 | 19 | 3 | 6 | 0 | | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 63 |
| 26 | | 22 | | 6 | | 4 | | 5 | | | | | | 63 |
| 48 | | | | 10 | | | | 5 | | | | 0 | | 63 |




There was a small increase in the quantity of Lutho's reflections between 2018 and 2019, from 61 to 63. As in Joy's case, there were shifts from the lower levels of the FLRM to higher. Level 1 reflections decreased from 90% to 76%, a shift complemented by an increase in level 2 reflections from 10% to 16% and level 3 reflections from 0% to 8%. There was no instance of reflectivity. Running counter to expectations is the shift of focus from more mathematical reflections in 2018 to more general ones in 2019. Mathematical reflections decreased from 57% in 2018 to 41% in 2019 while general reflections increased from 43% to 59%. The shift in Lutho's reflections from lower to higher levels seems to point to the positive influence of facilitator-guided reflection sessions on Lutho's reflective practice.

### 6.5.5 Conclusion of section

This section compared the four PSTs' 2018 and 2019 reflections on their own practice to establish if there were any shifts in the way the PSTs reflected, given that a year had passed and that they had been exposed to a series of facilitator-guided reflection sessions. Table 6.3 provides a summary of ROP 1 and ROP 2 which enables analysis of possible shifts.

*Table 6. 3: Summary of 2018 ROP 1 and 2019 ROP 2 sessions of reflection*

| PST | Session | Level 1 DESCRIPTION | Level 2 EXPLANATION | Level 3 SUGGESTIO N | Level 4 REFLECTIVITY | TOTAL | G | M |
|---|---|---|---|---|---|---|---|---|
| Bonga | ROP 1: Qty | 87 | 15 | 0 | 0 | 102 | 48 | 54 |
| | %age | 85% | 15% | 0% | 0% | 100% | 48% | 52% |
| | ROP 2: Qty | 71 | 9 | 2 | 1 | 82 | 15 | 67 |
| | %age | 87% | 11% | 1% | 1% | 100% | 18% | 82% |
| Dumie | ROP 1: Qty | 87 | 15 | 7 | 0 | 109 | 45 | 64 |
| | %age | 79% | 14% | 7% | 0% | 100% | 42% | 58% |
| | ROP 2: Qty | 48 | 21 | 4 | 0 | 73 | 43 | 30 |
| | %age | 66% | 29% | 5% | 0% | 100% | 59% | 41% |
| Joy | ROP 1: Qty | 44 | 10 | 4 | 0 | 58 | 22 | 36 |
| | %age | 76% | 17% | 7% | 0% | 100% | 38% | 62% |
| | ROP 2: Qty | 61 | 23 | 13 | 0 | 97 | 40 | 57 |
| | %age | 63% | 24% | 13% | 0% | 100% | 41% | 59% |
| Lutho | ROP 1: Qty | 55 | 6 | 0 | 0 | 61 | 26 | 35 |
| | %age | 90% | 10% | 0% | 0% | 100% | 43% | 57% |
| | ROP 2: Qty | 48 | 10 | 5 | 0 | 63 | 37 | 26 |
| | %age | 76% | 16% | 8% | 0% | 100% | 59% | 41% |

The table shows a decrease in the percentage of level 1 reflections for three of the four PSTs. Only Bonga's proportion of level 1 reflections increased from 85% to 87%. The general decrease in level 1 reflections meant an increase in the higher levels of reflection in the FLRM. Level 2 reflections increased by at least 6% for two of the four PSTs, Joy and Lutho (see Table 6.3). Joy's level 2 reflections increased from 7% to 13% while Lutho's increased from 0% to 8%. Bonga's level 3 reflections increased from 0% to 1%, but contrary to expectations his level 2 reflections actually decreased from 15% in ROP 1 to 11% in ROP 2. Bonga is at the same time the only PST who recorded a level 4 reflection (1%). Joy and Lutho displayed significant growth at levels 2 and 3 of reflection, which suggests that the facilitator-guided reflections plus the time factor influenced their reflective practice positively. As far as the mathematical versus general balance among the reflections is concerned, there were few shifts other than for Bonga, whose mathematical reflections increased significantly from 52% to 82% (see Table 6.3). The rest of the PSTs tended to shift focus from mathematical to general reflections, contrasting Goos's (1993) finding that the facilitators guided reflections effectively promoted reflection by directing the focus towards the subject concerned.

In general, it seems, while the PSTs' reflections were still predominantly on the lowest level of reflection (description), they were reflecting more frequently at higher levels of reflection. This suggests that the intense facilitator-guided reflection sessions were helpful in moving their reflective practice to higher levels of reflection. It is possible that more sessions might have helped the PSTs shift more of their reflections to higher levels. The finding is similar to that of Johns (2010), who reported that facilitator-guided reflection assists novice practitioners to improve both the way they reflect and their teaching practice.

## 6.6 CONCLUSION

In this chapter I presented and analysed the data collected during Phase 2 of data collection from the smaller sample of four PSTs. The aim was to explore the phenomenon under investigation more deeply. I began the chapter by presenting the reflections of the participants after they had watched a video-recording of themselves teaching, and found that their reflections, while greater in quantity than those produced in response to the videos of other teachers, were still mostly at the lower levels of the FLRM. Two of the PSTs recorded reflections at level 3, but there were none at level 4. When comparing their reflections on their own teaching to those based on other teachers' teaching, I found that the PSTs reflected deeper on their own practice than on the practice of others. While their reflections were still more on the lower levels of reflection, there was an increase in level 2 reflections for all the PSTs, and two of them reflected at level 3. The chapter concluded by comparing the reflections of the PSTs on their own practice after a year had passed and they had undergone a series of facilitator-guided reflections sessions. Here the data of the four teachers suggested that the facilitator-guided sessions supported shifts towards higher levels of reflection, even though the majority of reflections remained at the level 1 (description). These shifts are captured in Figure 6.3, above. In the next chapter I summarise my findings across the study and discuss both the limitations of the study and the implications of it. Finally, I make certain recommendations for further research.

# CHAPTER 7

# CONCLUSION AND RECOMMENDATIONS

## 7.1 INTRODUCTION

This study explored reflective practice among pre-service teachers (PSTs) in the context of video-based lesson analysis, with the aim of describing and classifying these reflections. Developing pre-service teachers' reflective practice has become an essential element of teacher education. My study was carried out with a focus on the development of PSTs' reflective practice in respect of the teaching of mathematics. The study sought to contribute to the growing body of literature that seeks to equip PTE with knowledge of how to develop reflective practice to improve the practice of mathematics teaching. As discussed in Chapter 1, while mathematics education is an area of concern globally, challenges facing mathematics learning seem to be more pronounced in South Africa, with our learners persistently scoring lower marks than their international (and often regional) counterparts. Because the trajectory of this poor performance in mathematics is said to start from the very beginning of schooling, that is, the Foundation Phase (FP) – it seemed appropriate to focus the study on the acquisition of knowledge and skills to improve mathematics education among FP PSTs. The research was conducted in the context of a mathematics method course programme, with a component devoted to developing both reflective practice and mathematical knowledge for teaching. As discussed in Chapter 4, my study followed an interpretive case study approach aimed at investigating the following research questions:

1. What is the nature of the reflections that PSTs develop as they engage in video-recorded lesson analysis?
2. How does the nature of these reflections change over time, if at all?
3. What role is played by the Six Lens Framework as the reflective tool used to guide pre-service teachers' reflective practice?
4. (a) How do PSTs reflect on video of their own teaching? (b) Are these reflections any different from their reflections on video of other teachers' lessons?
5. What is the nature of PST reflections after receiving guidance from a skilled facilitator in small group sessions?
6. How did their reflections on their own practice change following skilled facilitation, if at all?

In Chapters 5 and 6 I presented and analyzed the data collected during Phases 1 and 2 of the research. Phase 1 data was collected from the larger sample of 19 PSTs who reflected on three video-recorded lessons of other teachers' practice and sought to respond to the first three research questions. Phase 2 data was collected from a smaller sample of four PSTs, who additionally reflected on video-recordings of their own teaching enabling investigation into research questions 4-6. In this chapter I conclude the study by summarizing the key findings of this research and reflect on how they cohere with or depart from the findings of other studies. I also describe the limitations of the study and discuss possible implications for practice.

## 7.2 KEY FINDINGS OF THIS STUDY

There are several key findings that emerge from this study in relation to the six research questions. I have structured the summary of the findings to correspond to each of the research questions, starting with research question RQ 1.

### 7.2.1 What is the nature of the reflections that PSTs develop as they engage in video-recorded lesson analysis?

To address this question, I analyzed three sets of reflections (Sessions 1-3) written by the larger cohort of 18/19 PSTs (Phase 1). The stimuli for these reflections were three video-recorded mathematics lessons given by professional teachers. The analysis of S1 reflections for the group of 18 PSTs showed that the first set of reflections were mainly descriptive and general in nature. For example, most PSTs wrote general comments about the teacher's position in the classroom; what the lesson was about; what the teacher used in the lesson; the general classroom atmosphere, or just described what was happening. Most of the PSTs' reflections had no specific focus on the teaching and learning of mathematics, and there were no suggestions as to how the teaching and learning of mathematics could be improved.

Across the 18 PSTs 88% of the S1 reflections were at level 1, only 11% were at level 2 (providing explanations for the events identified), and only one PST wrote two suggestions (amounting to 1% of the reflections). The reflections were mostly focused on general aspects of teaching and learning such as the environment, the learners, and the teacher's behavior and attitude, or on evaluations of the lesson. A division of the reflections into general versus mathematical showed that 71% of the 18 PSTs' S1 reflections were general, and only 29% were mathematical. What I found during S1 is in line with the findings of several studies that have investigated PSTs' RP (such as Azimi et al., 2013.; Arrastia, Rawls, Brinkerhoff & Roehrig et al., 2014; Arslan, 2019). These studies also report that the initial reflections were mostly at the lowest level of reflection, which is, comprising descriptions of general classroom events. Ward and McCotter (2004) contend that the reason for this is that PSTs do not automatically understand what reflection is, how it should be done, or why it should be done.

Analysis of the second session (S2) of reflections showed the PSTs still mainly describing classroom events, but with the focus shifting to more to mathematical events. And although still dominated by description, in S2 the PSTs' reflections started displaying some reasoning about and analysis of events. There were numbers of reflections that demonstrated reasoning and some PSTs identified weaknesses in the teacher's lesson, yet without being judgmental. The reflections in S2 went beyond describing and providing explanations to making suggestions for improvement. While the suggestions were still sometimes relatively superficial and lacking consistency, there was a sharper focus on mathematics lesson for some PSTs. The S2 reflections demonstrate some growth towards higher levels of reflection even though PSTs displayed challenges with expressing them.

Analysis of the 19 PSTs' S2 reflections showed that the reflections were still mostly descriptive, with 84% of them at that level (level 1). However, a greater percentage of reflections were followed by explanations, which meant that 14% of the reflections were at level 2 in S2, up from the 11% in S1. There was also an increase in the number of suggestions to 2%. Perhaps more significant, 63% of the reflections were mathematical and only 37% were general.

Analysis of S3 reflections showed that although the reflections were still predominantly at level 1. The PSTs' reflections were still mainly descriptive, with few explanations and suggestions. More precisely, 84% of all S3 reflections were at level 1, 15% at level 2, only 1% at level 3 and none at level 4. However, the S3 reflections were becoming more focused, demonstrating analysis of the classroom events and the effects of some of the teacher's actions.

Throughout all the sessions, level 1 reflections were above 80% of the total, level 2 reflections ranged between 11% and 15%, while level 3 ranged between 1% and 2%. In all the three cases, there were no reflections at level 4. Nevertheless, although analysis showed that the PSTs' reflections remained predominantly at the bottom of the FLRM, the overall quality of reflections in each session improved steadily. The reflections were also gradually shifting from lower levels to higher levels. For example, in S1 level 2 reflections accounted for 11%, in S2 they increased to 14% and in S3 they went up again to 15%. This finding concurs with that of Azimi et al. (2019), who investigated Iranian PSTs' reflections and professional development in the context of teacher education practicums. They also found that PSTs' reflections at the beginning of their teaching practice were mostly at the lowest level but improved with each practicum. The PSTs in Azimi et al.'s (2019) study reached higher levels of reflection, at least in part because they were PGCE students who had already completed a degree and thus possibly had previous opportunities to develop RP in their degree. Their reflections reached the critical reflection level. This is contrary to the finding of Meierdirk (2016), however, who also worked with PGCE PSTs to investigate RP and its role in PTE. She found that while RP had helped to develop new teaching standards, the PSTs in her study did not employ critical reflection.

As noted above, not all the PSTs in this study reached level 3 reflection by the end of S3, indicating that PSTs' reflections evolved at different rates. For example, in S1 six PSTs out of 18 exhausted their reflections at L1, meaning that 12 PSTs reached L2 reflections. In S2, only two out of 19 PSTs wrote only L1 reflections, 17 of them reached L2 and only 4 of these 17 wrote L3 reflections. In S3, all the PSTs had at least some L2 reflections, but only four of them recorded L3 reflections. Only one PST had reflections that were growing consistently throughout (see Figure 5.13) as evidenced by movement of reflections to higher levels. In S1 all his reflections were at level 1, in S2 he wrote 13% level 2 reflections and in S3 he wrote 16% level 2 reflections and 6% level 3. This finding echo that of Arslan (2019), who also reported that PSTs' RP does not advance steadily, nor do PSTs develop RP at the same pace (Meierdirk, 2016).

I also found that in S1 of my study the PSTs focused more on the general aspects of the lesson than the mathematical. This finding is consistent with the findings of Maaranen and Stenberg (2017) and Arslan (2019). Maaranen and Stenberg (2017) explored the nature of PSTs' reflections on their practical theories and found that the PSTs' initial reflections generally focused on concrete factors such as environment and behaviour rather than something less tangible like competence. Arslan (2019) argues that it is necessary for PSTs to first reflect on the general aspects of teaching and learning. He remarks: "reflecting on concrete factors such as environment and behaviour should be viewed as significant since it involves the reality of teaching practice. Thus, tacit knowledge might grow and influence action" (p. 122).

### 7.2.2 How does the nature of these reflections change over time, if at all?

To answer this question, I compared summaries of the PSTs' reflections from the three sessions discussed above. I also created summaries for the ten PSTs who were in groups 2 and 4 during S1 and who had reflected on the two same lenses of the SLF (MMI and Tasks). I made summaries of their MMI and Tasks reflections for the other two sessions (S2 & S3) and compared these to assess if there were any shifts. (Some of these shifts have already been discussed in Section 7.2.1, above).

There were no major shifts in the levels of the reflections, which remained mostly at the lowest, descriptive level of reflection. Yet, as discussed above, there was a shift in the quality of reflections, which became more attentive and precise. There was also a major shift of focus from mostly general to more mathematical reflections, particularly between S1 and S2 where mathematical reflections increased from 29% to 63% (although they declined to 55% in S3). This finding echoes Arslan's (2019) finding that PSTs' initial reflections usually attend to the general aspects of a lesson, but when that mode of attention has been exhausted, they focus on the subject-specific elements of teaching and learning. Arrastia et al. (2014) comment that there is no regular pattern in the evolution of PSTs' reflections. In this study this is apparent in the three sessions' level 3 reflections, which were 1% at S1, 2% during S2 and 1% again during S3, when one might have expected the percentage to keep rising. On the other hand, there was a steady increase in the proportion of level 2 reflections, from 11% during S1 to 14% in S3 and 15% in S3. While the reflections shifted between higher and lower levels of reflection and between general and mathematical reflections, I noted that, again, confirming the finding of Arrastia et al. (2014), there was no regular pattern to these shifts. Analysis of the ten PSTs who reflected using the same lenses produced the same result. As seen in Table 7.1, below, there was no regular pattern of shifts in levels of reflection. There was, however, a steady movement in focus from general to more mathematical events.

*Table 7. 1: Shifts in reflections by session when comparing ten pre-service teachers' reflections using the same lenses*

| SESSION | Level 1 DESCRIPTION | Level 1 EXPLANATION | Level 1 SUGGESTION | Level 1 REFLECTIVITY | MATHEMATICAL | GENERAL |
|---|---|---|---|---|---|---|
| S1 | 86% | 12% | 2% | 0% | 39% | 61% |
| S2 | 87% | 10% | 3% | 0% | 64% | 36% |
| S3 | 85% | 14% | 1% | 0% | 68% | 32% |

As set out in Table 7.1, above, in S1 the proportion of mathematical reflections was 39%, which became 64% in S2 and 68% in S3. This finding confirms Meierdirk's (2016) claim that PSTs' reflections become more subject-oriented the more experience they gain in RP. In the next section I discuss the findings on the role of the SLF in influencing the PSTs reflections.

### 7.2.3 What role is played by the Six Lens Framework as the reflective tool used to guide pre-service teachers' reflective practice?

The lecturer employed the six lens framework (SLF) as a reflective tool to guide the PSTs on what to notice as they reflected on the video-recorded lessons. These lenses were: mathematical and meta-mathematical ideas (MMI); tasks and activities (commonly identified as Tasks); teacher's goals (Goals); interactions with the students (Interactions): dilemmas and decision making (DDM) and the teacher's beliefs (Beliefs). The aim of this RQ was to understand how different lenses in the SLF might enable or support different levels of reflection, rather than to judge the usefulness of the framework as a reflective tool. In the university course (and in the research) it was assumed that students would require guidance in conducting their reflections on lessons and that the SLF would be a useful guide. This assumption builds on the literature that supports the use of reflective tools to guide, particularly to guide those who are still in the process of learning to reflect (Poom-Valickis & Mathews, 2013; Karsenty et al., 2015; Azimi et al., 2019). The SLF was intended to support PSTs on how to reflect on a mathematics lesson. I analyzed the S3 reflections of the 14 PSTs who reflected using all six lenses of the SLF and had indicated explicitly or implicitly which lens they were reflecting with. The other five PSTs either did not use all six lenses or did not indicate which lens they were using and so their data did not support analysis of reflections per lens.

I compiled group reflections for each lens and compared the results. Table 7.2, below, presents the percentage of total reflections for these 14 PSTs, according to each level of reflection.

*Table 7. 2: Summary of 14 PSTs' reflections per each of the six lenses of the SLF and per level of reflection*

| LENS | Level 1 DESCRIPTION | Level 2 EXPLANATION | Level 3 SUGGESTION | Level 4 REFLECTIVITY | M | G | Total reflections |
|---|---|---|---|---|---|---|---|
| MMI | 85% | 14% | 1% | 0% | 64% | 36% | 136 |
| Tasks | 84% | 14% | 2% | 0% | 67% | 33% | 153 |
| Goals | 82 % | 19% | 0% | 0% | 78% | 22% | 79 |
| Interactions | 82% | 17% | 1% | 0% | 9% | 91% | 108 |
| DDM | 83% | 13% | 4% | 0% | 37% | 63% | 75 |
| Beliefs | 82% | 14% | 4% | 0% | 38% | 62% | 77 |

In analysis of the reflections per lens, it is interesting to note that very similar proportions of reflections are at the level of description (across all lenses the range is 81%-85%). Similarly, the percentage range for explanations is between 13% and 19% across the lenses – the highest being for the lens of Goals. Suggestions made up less than 5% of reflective utterances across the lenses, with no reflections at the level of suggestions for the Goals lens, which may be because PSTs assume that Goals are given or stipulated by a text or curriculum. At the other end of the spectrum, 4% of suggestions were elicited by the DDM and Beliefs lenses.

In terms of the total number of reflections written I found that Tasks and MMI, on the one hand; and DDM and Beliefs, on the other, share some commonalities. For example, Tasks and MMI had the highest number of reflections, with Tasks taking the lead at 153 reflective ideas, suggesting these two, followed by Interactions, encouraged a lot of discussion. Goals, DDM and Belief had lower numbers with DDM having the least number. In terms of the proportion of mathematical versus general reflections across the lenses, Table 7.2 indicates a much greater range across the lenses than for the levels. Interactions has the highest general reflections (91%) while Goals has the lowest at 22%. Thus, Goals, Tasks and MMI attracted more mathematical discussion, with mathematical reflections at 78%, 67% and 65%, respectively, while Interactions, DDM and Beliefs had the least number of mathematical reflections at 9%, 37% and 38%, respectively.

These findings show that the different lenses seem to steer student reflection towards either more mathematical or more general observations, while they do not particularly influence the level of reflection at which PSTs reflect. In the next sections I discuss phase 2 findings on the four PSTs in the smaller sample in order to answer RQs 4 and 5.

### 7.2.4 How do PSTs reflect on video of their own teaching? Are these reflections any different from their reflections on video of other teachers' lessons?

On analysing the four PSTs' first set of reflections on their own practice, I found that they were generally not that different from the reflections they had recorded in the last session of reflecting on another teacher's practice. The reflections did not follow any trend – such as increasing the proportion of higher-level reflections – that indicated that reflecting on their own practice helped them to improve their reflectivity. Lutho's reflections in fact shifted to lower levels, perhaps validating Poom-Valickis and Mathews' (2013) contention that PSTs tend to find it challenging to reason about their own practice, particularly during their first practicum when they think they have mastered the theory of practice. By contrast, Joy's level 2 reflections decreased while her level 3 reflections increased from 0% to 7%, suggesting that she was able to critique her own work and even propose ways of improving it. Dumie's pattern of reflections was similar, his level

2 reflections decreasing from 22% to 14% and his level 3 increasing from 2% to 7%. What the four PSTs had in common was that their level 1 reflections remained proportionately well above all the other levels, and again as in S3, there was a shift from general towards more mathematical reflections (though one PST bucked this trend). Next I report on how these PSTs reflected on their own practice after a series of facilitator-guided RP sessions and how they changed thus summarising the findings for RQ5 and RQ6 simultaneously.

### 7.2.5 What is the nature of PST reflections following guidance by a skilled facilitator in small group sessions? How did their reflections on their own practice change following skilled facilitation, if at all?

Analysis of the four PSTs' reflections on their video recording of their own teaching, after the facilitator guided reflections, indicated some movement towards higher levels of reflection. Three of the four PSTs increased their level 2 reflections by at least 6% and recorded reflections up to level 3. This finding concurs with Azimi et al. (2019), who found that after more practicums and guidance, PSTs 'reflections shifted from lower levels to higher levels. One PST, Bonga, whose level 2 reflections went down by 3%, had no level 3 reflections, yet wrote two ideas that were coded as level 4 reflections. He is the only PST who displayed reflectivity through those two ideas and the only PST of the four whose reflections after the series of facilitator-guided reflection sessions, shifted in focus from general to mathematical. His mathematical reflections increased from 52% to 82%. The other three PSTs' mathematical reflections shifted downwards, suggesting that they increased their proportion of descriptions of general classroom events. The general shift of PSTs' reflections towards higher levels suggests that the facilitator-guided reflective sessions intended as an intervention to improve their RP yielded positive results. Azimi et al. (2019) claim that "student teachers are rarely able to reach higher levels of reflection during their preparation programmes … [because these levels require] criticising fundamental principles and ethical issues, which is considered a difficult, lengthy and often painful process" (p. 285). The lack of reflection at the highest level in the other three PSTs was therefore not surprising. In the next section I discuss the possible implications of this study to PTE.

## 7.3 POSSIBLE IMPLICATIONS FOR PRACTICE

In response to the first research question, my finding was that PSTs' initial reflections were general descriptions of classroom events of a kind that suggested that they did not understand what reflection is and why it should be done (Ward & McCotter, 2004). They talked about everything that was taking place in the lesson without considering why the event was occurring and what could be done to improve teaching and learning. Ward and McCotter (2004) thus advise teacher educators not to take it for granted that when they ask PSTs to reflect, the students will know what to do:

> We realised that we have often asked our students to reflect on field experiences without ever discussing the qualities of good reflection, often with disappointing results. Students do not automatically know what we mean by reflection; often they assume reflection is an introspective after-the-fact description of teaching. Reflection, meant to make teaching and learning understandable and open, has itself been an invisible process to many of our preservice teachers. (p. 245)

This indicates the necessity for explicit explanation of what reflection is and why as teachers they need to be able to reflect on their practice. Ward and McCotter's (2004) notion that PSTs do not understand what RP is and what it is for was confirmed in Phase 1 of my study.

Ward and McCotter (2004) note that PSTs initially treated the time for reflecting as an opportunity to describe classroom events. The reflections were mostly general and at level 1. However, in the second RP development lecture, the lecturer offered a guiding framework, illustrating with examples how PSTs needed to reflect. In response, the reflections began to shift and incorporate higher levels of reflection, such as explanations and suggestions, as the three RP development sessions unfolded. This finding suggests the need to begin the RP lessons by giving students the opportunity to observe lessons and talk about everything and anything that happens in the classroom, that is, without a specific focus on subject-specific events. This applies most especially to those PSTs who have not yet had an opportunity to teach. Other classroom events such as class management are critical too for teaching and learning to take place successfully, and therefore PSTs need time to acquaint themselves with these before they shift their focus to subject-specific matters.

The fact that the number of higher-level reflections such as explanations and suggestions increased with time and more sessions on RP, may suggest the need for more regular and a greater number of RP development sessions. This could be achieved by starting RP earlier in the courses and across courses so that PSTs get greater exposure to and experience of RP. Ward and McCotter (2004) propose that PTE should aim for PSTs to reach at least level 3 of reflection by the end of teacher preparation, hoping that they will continue reflecting on their practice till they reach reflectivity.

The inconsistency in the development of RP across PSTs may be evidence that the PSTs were taking a while to grasp the purpose of reflection, what it is and how it should be done, and were therefore still in a trial-and-error stage of learning by the time the sessions ended. Giving them a clearly defined tool for how to reflect to meet the demands of teaching may be of help in making more explicit what is expected of them during the process of developing their RP. This suggests that a careful, deliberate and sustained focus on developing RP is needed for PSTs to benefit from reflecting at higher levels. My study suggests that a reflection tool such as the SLF is useful for supporting PST RP but that sustained use of it is necessary, and that small group facilitator-guided RP using the tool is particularly important.

Thus, while the six lens framework seemed useful for getting PSTs to look at different aspects of lessons, the initial reflections do not display evidence of the PSTs' actually employing the framework. The reflections were general and descriptive of anything that happened during the lesson being screened. In Phase 1 I found that PSTs' reflections were at the lower levels of the FLRM across all the sessions. Phase 2, however, which included extended sessions for the small group with a skilled facilitator, evidenced some shifts towards the higher levels of explanation, suggestion and reflectivity, implying that it was necessary to take the PSTs step-by-step on the journey to RP. Working with smaller groups of PSTs could also be useful when resources allow it. Arslan (2019) speaks of the need for careful guidance by facilitators and mentors to nudge PSTs to higher levels of reflection. An implication from the findings of the study is also that we need to make more explicit to PSTs the need to focus on mathematics in the lessons, to model how to reflect on a mathematics lesson for improved instruction. The findings pointed to a leaning towards general pedagogic observations, especially in initial reflections, which resonates with findings previously reported in the literature.

Since the findings of my study point towards a greater investment on the part of students when reflecting on their own lessons (as indicated by far more extensive writing), I would argue that PTE should look to create opportunities to enable all PSTs to reflect on their own lessons as well as on other teachers' lessons. Azimi et al. (2019) indeed suggest that teacher educators should provide training for student teachers to reflect on their own teaching, while Poom-Valickis and Mathews (2013), noting that novice teachers' reflections on their own practice rarely went beyond a description of the events experienced, claim that: "the lack of higher levels of reflection on their own practices probably indicates the need for an external less personalised perspective that could be provided by a mentor" (p. 430).

## 7.4 LIMITATIONS OF THE STUDY

One of the limitations of this study pertained to my participants, who were too few for the results to be generalised. I worked with PSTs from one university, and only with 19 out of a class of 52. Further research can be done with a larger number of participants, perhaps involving more than one university. Another limitation is that I used convenience sampling for the four PSTs who participated as a smaller sample in phase 2 of the study. They were not necessarily representative of the whole cohort. This said, they did represent the diversity of the group in terms of gender, race, linguistic background and academic performance.

Another limitation pertained to limited time for the RP development sessions. During one of the interviews the lecturer indicated that the course needed more time than could be afforded (because of time constraints, RP sessions for the whole class were limited to three sessions only). This forced her to run the course in a different way than she had hoped to. Considering our context in South Africa, where there is not a strong history or culture of reflecting on practice, PSTs needed more sessions to enable them to grasp what reflection is, master how it should be done and understand the reflective tool (SLF) employed as a guide.

## 7.5 CONCLUDING REMARKS

A key aspect of research is the learning of the researcher. Through this research I have deepened my understanding not only of reflective practice and its role in teacher education but also of how to conduct quality research in an ethical manner. The key findings around each of my research questions will guide me in my future work in mathematics teacher education, and I will look to present and share these findings with my colleagues in South African universities as well as colleagues in regional and international mathematics education research communities.

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# APPENDICES

## Appendix 1: Letters requesting for permission

### Appendix 1.1 Letter requesting for permission from the registrar of Rhodes University

RHODES UNIVERSITY
*Where leaders learn*

27 Illchester Rd
Sormerset Heights
Grahamstown

2 November 2017

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT RHODES UNIVERSITY

To the Registrar
Rhodes University
P.O Box 94
Grahamstown

Dear Dr Moodly

My name is Samukeliso Chikiwa and I am a doctoral student at Rhodes University (RU) in Grahamstown, South Africa. The research I wish to conduct for my PhD thesis requires me to observe five mathematics methods course lectures that focus on video-based lesson analysis, over the year with the 2018 third year Foundation Phase Bachelor of Education students here at RU. I will however later interview six students individually at two different times. This research will be conducted under the supervision of Prof Mellony Graven.

This letter serves to seek formal consent to approach the lecturer Dr Lise Westaway for permission to observe her lectures and the 2018 third year Foundation Phase, Bachelor of Education students as participants for this research. Further, I would be grateful if I may access appropriate documents at her discretion. For this reason, I request your permission to conduct my research as outlined in my research proposal. I will observe two lectures in term one, two in term two and another two in term four as shown in the course out line from the lecturer shown in appendix B

I attach a copy of my research proposal which includes copies of the consent forms to be used in the research process. Once I have received ethical clearance from Rhodes University, I will let you know and begin my research. As part of this I undertake to ensure that the name of the university will not be disclosed, and all participants will be replaced with pseudonyms and that all the material I collect as part of the research will be accessible only to myself and my supervisors.

Upon completion of the study, I undertake to provide the university access to the research findings. If you require any further information, please do not hesitate to contact me on 078 358 6781 and samchikiwa@yahoo.com

Thank you for your time and consideration in this matter.

Yours sincerely

Samukeliso Chikiwa (g15c0002)

## Appendix 1.2 Letter requesting for permission from the department of education

RHODES UNIVERSITY
Where leaders learn

27 Illchester Rd
Sormerset Heights
Grahamstown

22 January 2018

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT RHODES UNIVERSITY

To the HOD
Department of Education
Rhodes University
P.O Box 94
Grahamstown

Dear Prof Mgqwashu

My name is Samukeliso Chikiwa and I am a doctoral student at Rhodes University (RU) in Grahamstown, South Africa. The research I wish to conduct for my PhD thesis requires me to observe five mathematics methods course lectures that focus on video-based lesson analysis, over the year with the 2018 third year Foundation Phase Bachelor of Education students here at RU. I will however later interview six students individually at two different times. This research will be conducted under the supervision of Prof Mellony Graven.

This letter serves to seek formal consent to approach the lecturer Dr Lise Westaway for permission to observe her lectures and the 2018 third year Foundation Phase, Bachelor of Education students as participants for this research. Further, I would be grateful if I may access appropriate documents at her discretion. For this reason, I request your permission to conduct my research as outlined in my research proposal. I will observe two lectures in term one, two in term two and another two in term four as shown in the course out line from the lecturer shown in appendix B

I attach a copy of my research proposal which includes copies of the consent forms to be used in the research process. I have received ethical clearance from Rhodes University (attached) and wish to begin my research as soon as the students open. As part of this I undertake to ensure that the name of the university will not be disclosed, and all participants will be replaced with pseudonyms and that all the material I collect as part of the research will be accessible only to myself and my supervisors.

Upon completion of the study, I undertake to provide the university access to the research findings. If you require any further information, please do not hesitate to contact me on 078 358 6781 and samchikiwa@yahoo.com or my supervisor Professor Mellony Graven.

Thank you for your time and consideration in this matter.

Yours sincerely

Samukeliso Chikiwa (g15c0002)

## Appendix 1.3: Letter requesting for permission from the mathematics methods lecturer

RHODES UNIVERSITY
*Where leaders learn*

Participant's Name
Rhodes University
Grahamstown.
6139

Dear participant

Re: Invitation to participate in a research study

You are invited to participate in a research study entitled '*The role of video analysis in developing the Foundation Phase Pre-service teachers' reflective practice and Mathematical Knowledge for teaching'*. The aim of this research is to explore how video analysis can develop the Foundation Phase pre-service teachers' reflective practice and how this can influence their Mathematical Knowledge for Teaching. Your participation is important to help establish a practice-based strategy for developing preservice teachers' reflective practice and mathematical knowledge needed for teaching.

My research will be undertaken through lecture observations, assignments, and interviews. Your participation in the research is anonymous and your identity will not be revealed. The collection of this data will be done during your lectures and I may require 90 minutes of your time if you are selected for the interviews.

If you agree to participate, I will explain in more detail what would be expected of you and provide you with the information you need to understand the research, during the first lecture that relates to research. These guidelines would include potential risks, benefits, and your rights as a participant. Once this study has been approved by the Ethics Committee of the Faculty of Education, and the Registrar, you will be sent the letter of ethical approval.

Participation in this research is voluntary and a positive response to this letter of invitation does not oblige you to take part in this research. To participate, you will be asked to sign a consent form to confirm that you understand and agree to the conditions, prior to collection of personal data (such as reflections and assignments) and commencement of interviews. Please note that you have the right to withdraw at any given time during the study.

Thank you for your time and I hope that you will respond favourably to my request.

Yours sincerely,

Student name signature

Supervisor name signature

## Appendix 1.4: Participants consent form

RHODES UNIVERSITY
Where leaders learn

INFORMED CONSENT FORM

| | |
|---|---|
| Research Project Title: | The role of video analysis in developing the Foundation Phase pre-service teachers' reflective practice and Mathematical Knowledge for teaching |
| Principal Investigator: | Samukeliso Chikiwa |
| **Participation Information** | |
| • I understand the purpose of the research study and my involvement in it.<br>• I understand the risks and benefits of participating in this research study.<br>• I understand that I may withdraw from the research study at any stage without any penalty.<br>• I understand that participation in this research study is done on a voluntary basis.<br>• I understand that while information gained during the study may be published, I will remain anonymous and no reference will be made to me by name or student number.<br>• I understand that audio recording may be used.<br>• I understand and agree that the interviews will be recorded electronically.<br>• I understand that I will be given the opportunity to read and comment on the transcribed interview notes.<br>• I confirm that I am not participating in this study for financial gain. | |
| **Information Explanation** | |
| The above information was explained to me by: Samukeliso Chikiwa | |
| The above information was explained to me in English and I am in command of this language. | |
| **Voluntary Consent** | |
| I,<br><br>hereby voluntarily consent to participate in the above-mentioned research. | |
| | Date: / / |
| **Investigator Declaration** | |
| I, Samukeliso Chikiwa, declare that I have explained all the participant information to the participant and have truthfully answered all questions ask me by the participant. | |
| Signature: | Date: / / |

## Appendix 1.5: Ethical Clearance Certificate

RHODES UNIVERSITY

*Grahamstown • 6140 • South Africa*

EDUCATION FACULTY • PO Box 94, Grahamstown, 6140
Tel: (046) 603 8385 / (046) 603 8393 • Fax: (046) 622 8028 • e-mail: d.wilmot@ru.ac.za

**PROPOSAL AND ETHICAL CLEARANCE APPROVAL**

**Ethical clearance number 2017.12.08.06**

The minute of the EHDC meeting of 05 December 2017 reflect the following:

***2017.12.8*** ***CLASS A RESTRICTED MATTERS***
***DOCTOR OF PHILOSOPHY RESEARCH PROPOSALS***

*To consider the following research proposal for the degree of PhD (Education) in the Faculty of Education:*

**Ms Samukeliso Chikiwa 15C0002**

*Topic: The role of video analysis in developing the Foundation Phase Pre-service teachers' reflective practice and Mathematical Knowledge for Teaching.*

*Supervisor:* [redacted]
*Co-Supervisor: Professor M Graven*

Decision: *Approved*

This letter confirms the approval of the above proposal at a meeting of the Faculty of Education Higher Degrees' Committee on the 5 December 2017.

The proposal demonstrates an awareness of ethical responsibilities and a commitment to ethical research processes. The approval of the proposal by the committee thus constitutes ethical clearance.

Sincerely

Ms Zisanda Sanda
Secretariat of the EHDC, Rhodes University
8th December 2017

# Appendix 2 Framework

## Appendix 2.1: Six Lens Framework handout

| Lenses for observing a videotaped mathematics lesson | The focus of activities around each lens | Examples of questions that direct teachers' discussions |
|---|---|---|
| Mathematical and meta-mathematical ideas | Scanning the space of relevant ideas, concepts, and procedures, as well as meta-mathematical ideas (e.g., one counter example is sufficient to refute a conjecture) that may be associated with the lesson's topic | • Which ideas did the filmed teacher bring forward in the lesson? Which ideas were left out? How can this decision be explained?<br>• Which meta-mathematical notions were evident in the lesson? |
| Explicit and implicit goals | Attributing goals that may underlie the teacher's actions or decisions, on the basis of what was observed in the video. Rather than "scientifically verifying true goals", the aim is to sharpen awareness of different possible goals and negotiate the pros and cons of preferring certain goals over others. | • Try to identify the goals that you think the filmed teacher was attempting to achieve. Show evidence from the video to support your assertion.<br>• Did you notice a moment when the teacher's goals have changed or a new goal was added? Why do you think this happened? |
| Tasks and activities | Conducting an "a posteriori task analysis": discussing features of the task and how it was enacted by the filmed teacher and students. Noticing if and when it develops differently than expected. | • Observe and document how the task is introduced and carried out and how the teacher addresses students' reactions.<br>• What may be the benefits and pitfalls in bringing this task to class? |
| Interactions with students | Observing and analyzing if and how the filmed teacher poses further questions to those of the task; listens to (or ignores) comments or difficulties raised by students; manages discussions; delegates responsibilities in the process of knowledge generation. | • How does the filmed teacher navigate students' responses during the mathematical activity? What kind of questions does the teacher ask? Who gets permission to speak?<br>• Characterize the teacher's feedback to students. |
| Dilemmas and decision-making | Uncovering situations of dilemma (i.e., when there is no evident optimal course of action) that the filmed teacher seemed to have faced during the lesson. Discussing the decisions taken in order to resolve these dilemmas, and their consequent tradeoffs. | • Did you notice a dilemma during the lesson? What did the teacher decide to do? Are there alternatives you can think of for this decision?<br>• What may be the constraints and affordances of the teacher's choice and of the suggested alternative paths? |
| Beliefs about mathematics teaching | Eliciting orientations, beliefs and values that may be attributed to the filmed teacher on the basis of the video. Unpacking implicit messages that may be conveyed to students through the teacher's communications and actions. | • What may be the filmed teacher's views about the nature of mathematics as a discipline?<br>• How does the teacher perceive his or her role? What may be the teacher's ideas about what "good mathematics teaching" is? What does the teacher think about the students' role as learners? |

## Appendix 2.2: The lecturer's Six Lens Framework slides

**Using the Six Lens Framework to analyse teachers' practices.**

[redacted]

TO AVOID BEING JUDGEMENTAL, ALWAYS KEEP IN MIND THAT THE TEACHER ACTS IN THE BEST INTEREST OF THE CHILD.

NOT INTERESTED IN GENERAL PEDAGOGICAL ISSUES SUCH AS CLASSROOM MANAGEMENT. KEEP THE FOCUS ON THE MATHEMATICS THAT IS BEING TAUGHT, HOW IT IS BEING TAUGHT AND THE BELIEFS THAT UNDERPIN THE ABOVE.

### Mathematical and mathematical ideas

Mathematical ideas

- What lies at the heart of mathematics teaching?
- What are the ideas at the heart of the mathematics topic?
- Think to yourself:
  - Which ideas did the teacher bring to the fore in the lesson?
  - Which were left out? How can this be explained?
  - What mathematical ideas did the teacher focus on in her lesson? What could she have focused on? Why?

### Mathematical and mathematical ideas

Meta-mathematical ideas

- What are the mathematical processes being developed(i.e. reasoning, justifying your thinking, testing a conjecture etc.)?
- Think to yourself:
  - Which processes were evident in the lesson?
  - Was there evidence of developing children's mathematical process skills in the lesson? Justify your answer.

### Task and activities ("task in action")

- The focus is understanding how the goals are developed in doing particular tasks.
- Think about:
  - What are the features of the task?
  - What are the affordances and constraints with the task?
  - How was it introduced and carried out by both teacher and learners?
  - Did the task change in the course of the lesson? Why?
  - What were the tasks the teacher employed? What were the benefits / weaknesses of the tasks?

### Goals (explicit and implicit)

- What were the possible ideas (goals) underlying the teachers' actions or decisions?
- Were there any moments where her goals shifted? Why do you think this happened?
- Think about:
  - What were the possible reasons for her actions or decisions?
  - Why did the want the children use the ten frames and dot cards?

### Interaction with students

- Questions asked / posed (wait time) and evaluated through feedback
- Think about
  - How does the teacher initiated, navigated and responded to student responses in the lesson?
  - How does she promote discussion?
  - Who does (not) get permission to speak?
  - Where the some comments she ignored? Why?

### Dilemmas and decision-making ("thinking on your feet"

- Dilemmas are linked to the interactions that take place in the classroom. How the teacher responds will have benefits and weaknesses.
- Think about:
  - What decisions does the teacher make to solve/resolve any dilemmas she may confront?
  - What would be the benefits/weaknesses of her choices?
  - Are there different ways to deal with this?

### Beliefs

- Beliefs relate to the messages teachers convey when teaching.
- These beliefs tell us about how the teacher views mathematics, teaching and learning mathematics, and children.
- Think about:
  - What is her view on the nature of maths as a subject?
  - How does she see her role? and What are her views about 'good teaching'?)
  - What does she think the roles of learners are?

# Appendix 3. Samples of unpresented participants reflections

## Appendix 3.1: The participants' Session 2 reflections

The following are the samples of Session 2 reflections written by the four selected PSTs

**Bonga S**

**Mathematical and meta-mathematical ideas**

1.The mathematical idea in the video was getting the learners to be able to recognise number dots. MD. 2 The teacher was showing the learners the cards with dots MD. 3. and the children had to determine how many dots were on the card MD. 4.and justify their answers, to how they got to the answer. MD

**Tasks and activities**

5.The task that the children had was to count. MD. 6 The task was introduced to them by the teacher asking how many dots on the card MD. 7 and they had to count MD 8. and tell their results MD. 9. The task did not change during the lesson GD. 10 The teacher had to get the learners to count MD$^{\rightarrow E2}$ 11 **to be able** to assess learners 11b and [so that learners can] recognise more numbers ME$^{e}$

**Goals**

12. The mathematical goal was for the learners to be able to justify MD 13 and give a reason to how they got their answers MD 14. and there were moments when the goal shifted GD$^{\rightarrow E}$ 15 **because** the children could not reason their answers, GE 16. therefore this is when they can just recognise a number of dots. MD

| DESCRIPTION | | | | EXPLANATION | | | | SUGGESTION | | | | REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^e$ | ME | ME$^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 1 | 1 | 11 | 1$^E$ | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| 2 | | 12 | | 1 | | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| 14 | | | | 2 | | | | 0 | | | | 0 | | 16 |

**Dumie S2**

**Mathematical and mathematical ideas**

1.The teacher was teaching the learners to compare numbers MD, 2. the learners were counting MD, 3 adding and subtracting to find the answer. MD. 4. They were free to use any strategy MD. 5. They were able to give reason why they chose their answer GD$^{\rightarrow E}$. 6 ***By doing*** that they are able to correct themselves GE. 7 The teacher is developing their strategies for counting. MD

**Tasks and activities**

8. The task was the fact that she kept on asking questions to the learners, GD$^{\rightarrow E}$ 9 i.e. how can they do it differently GE. 10. She also made them explain how they got the answer GD. 11. What the learners were doing was familiar to them GD$^{\rightarrow E}$ 12 ***because*** some of them did something similar at home GE

| DESCRIPTION | | | | EXPLANATION | | | | SUGGESTION | | | | REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD→E | MD | MD→E | GE | GE$^e$ | ME | ME$^e$ | GS | GS→E | MS | MS→E | GR | MR | |
| 1 | 3 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 4 | | 5 | | 3 | | | | | | | | | | |
| 9 | | | | 3 | | | | 0 | | | | 0 | | 12 |

## Joy S2 reflections

**Mathematical and meta-mathematical ideas**

1 She made use of dominoe images/ pictures GD. 2 She kept on asking children for their reasoning GD. 3 The children were asked of different ways of calculating MD$^{\to E}$ 4 ***so that*** they understand that there is not only one way of calculating ME

**Task and activities**

5 The features were pictures of dominoes that represented numbers MD. 6 the questioning done GD$^{\to E}$ 7 ***was a way of*** involving and engaging the children GE. 8 The action taken GD$^{\to EE}$ *9* ***was just for*** the children to answer questions GE$^{e}$ 9b and to think clearly 10 which the children did GD. 11 It wasn't clear on how the lesson was introduced GD 12 but it seemed like the children are already used to such lessons GD

**Goals**

13 It seemed like the goal was reached GD$^{\to E}$ 14 ***as*** the children were participating well GE. 15 I don't see any areas where the goals shifted GD.

| DESCRIPTION | | | | EXPLANATION | | | | SUGGESTION | | | | REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 6 | 3 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 9 | | 2 | | 3 | | 1 | | 0 | | 0 | | 0 | | 15 |
| 11 | | | | 4 | | | | 0 | | | | 0 | | 15 |

## Lutho S2 reflections

**Mathematical and Mathematical ideas**

1 The mathematical ideas in the video was getting the learners to be able recognize the number dots. MD 2 The teacher was showing the learners the cards with dots MD 3 and the children had to determine how many dots were on the card MD 4 and justify their answers, to how they got the answer. **GD**

**Tasks and activities**

5 The task that the children had to do was to count. MD 6 The task was introduced to them by the teacher asking how many dots are on the card. MD 7 and they had to count MD 8 and raise their results. **GD** 9 The task did not change during the lesson **GD** 10 The teacher had get the learners to count MD 11 and recognise the numbers MD$^{\to E}$ 12 **in order to** be able to assess the learners **ME**.

**Goals**

13 The ***mathematica***l goal was for learners to be able to justify and give a reason as to how they got their answers MD 12 and there were moments when the goal shifted because the children could not reason their answers, **GD** 15 this is when they can just recognise a number of dots. **GD**

| DESCRIPTION | | | | EXPLANATION | | | | SUGGESTION | | | | REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 5 | 0 | 8 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 5 | | 9 | | 0 | | 1 | | | | | | | | |
| 14 | | | | 1 | | | | 0 | | | | | | |

## Appendix 3.2: The participants' Session 3 reflections

Samples of Session 3 (S3) reflections from selected pre-service teachers

***Bonga L3***

***Introduction***

*1 She asked what is mental maths MD 2 then she gave a sum from previous day MD$^{\to E}$ 3 For progression purposes ME 4 She used their prior knowledge MD. 5 She gave the sum to learners MD 6 then they told her their strategy MD 7 using number lines MD. 8 She explained this again to them GD.*

***[GOALS]***

*9 Her goals were to work with the tens MD. 10 She first did simple sum of 7 to 10 MD 11 She asked them to make 10. For example she would give a number like 7 then they will say 3 to make 10 MD. 12 She moved to 30 from 20 MD 13 and continued to more difficult numbers MD.*

***[Tasks and activities]***

*14She carried the task well GD 15 learners were responding well GD 16 but the learners were chorusing the answer most of the time GD. 17This could easily leave other learners behind without them understanding what was going on GD. 18 Children are good at just chorusing pretending to be talking GD 19 but her last assessment was good to check if they can really bridge through ten in other difficult sum MD*

***Mathematical ideas***

*20 She makes it fun for her learners GD. 21 She makes sure they understand GD , 22 she gives a lot of examples GD$^{\to E}$ 23**to** try to make them understand GE. 24 She start with simple sum she knows they know already and build up from that MD. 25 Role of learners to her is to do calculations MD 26 and be able to explain how they got to that conclusion MD. 27 She picked on random learners GD 28 asking questions GD$^{\to E}$ 29 **to make** them engage GE. 30 She gives them enough time to calculate a sum in their head MD, 31 she waited until she noticed people were done GD 32 then she asked them to explain how they did the sum MD.*

***Dilemmas and decision making***

*33 Leaners at the back were quiet GD. 34 She also picked learners from the front desk GD 35 other learners were kind of ignored at the back GD. 36 Another dilemma [was] when the learner was explaining how he calculated 29+9 MD 37 another learner interrupted GD, 38 [He] wanted to give answer GD 39 and she signed blocking with a hand for that learner to be quiet GD 40 and continued with that learner GD. 41 But lesson was great GD. 42 I loved how she questioned the learners to justify their answer GD 43 and stressing 10s **like** during the time the learner was explaining 78+5, borrowing 2 from 5 to make 80 on the 78 MD. 44 The way she did it was nice GD 45 then carried on working with them with nearest 10 MD.*

| LEVEL 1 DESCRIPTION | | | | LEVEL 2 EXPLANATION | | | | LEVEL 3 SUGGESTION | | | | LEVEL 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\to E}$ | MD | MD$^{\to E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\to E}$ | MS | MS$^{\to E}$ | GR | MR | |
| 20 | 2 | 19 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| 22 | | 20 | | 2 | | 1 | | 0 | | 0 | | 0 | | 45 |
| 42 | | | | 3 | | | | 0 | | | | 0 | | 45 |

Dumi S3

***Mathematical ideas***

*1 The mathematical idea that the teacher is trying to put across is addition MD 2 using number line MD. 3 She wants the learners to be able to use the number lines MD 4 and be able to round to the nearest number MD. 5 She also wants them to be able to give reasons on how they got to the final answer GD. 6 She is giving opportunity to learners to come up with different ways of solving problems GD. 7* ***She asks*** *learners questions GD 8 and to justify their answers* $GD^{\to E}$ *9* ***so that*** *they can learn from each other GE. 10 She also wants to develop number recognition MD 11 She wants them to be able to use bonds of numbers MD 12 and be able to recognize numbers MD.*

***Goals***

*13 The goals of the teacher she wants the learners to be able to count on* $MD^{\to E}$*. 14* ***so that*** *they calculate faster. ME. 15 She asks learners to do mental maths* $MD^{\to E}$ *16* ***so that she can*** *be able to see the progress of the learners 16b and to see which learners are able to count using the head ME. 17 Develop number sense MD 18 and number recognition MD. 19 She also assist them to be able to justify the answer that they got from the number line MD. 20 She then ask them questions one by one* $MD^{\to E}$ *21* ***to make sure*** *that they all know what is expected from the maths problem on the board ME. 22 Another goal is to develop bonds MD*

***Tasks.***

*23 The teacher starts with mental maths* $MD^{\to E}$ *24* ***so that*** *the learners can use a bit of their prior knowledge to carry on with the next math problem ME. 25 She precedes by giving them different numbers MD 26 but applying the same method they used the day before MD. 27 Once the teacher noticed that the learners are comfortable at using different numbers to solve number-line, MD 28 she gave them a problem to solve in their maths books MD. 29 Learners were able to justify and give reasons on how they solved the problem MD. 30 For example 29+9. they were able to borrow 1 to add to 29 and carry on adding their remaining number to 30 in the number-line MD.*

***Interaction.***

*31 The teacher keeps using questions* $GD^{\to E}$ *32* ***so that*** *learners can be able to engage with her GE. 33 She can also tell when the learners struggle to answer a question from the interaction between them GD. 34 It is also easy to notice a child who is struggling with this method or strategy* $GD^{\to E}$ *35* ***because*** *the interaction is between the teacher and the whole class GE. 36 The teacher can see that learners are able to count on MD 37 or able to use one to one concept* $GD^{\to EE}$ *38 by imposing a question that will make them engage 38b or think harder* $GE^{e}$*. 39 The teacher also asks how they did it GD, 40 and why they did it they do it that way GD. 41 Those are sort of questions she asks* $GD^{\to E}$ *42* ***to*** *keep the environment positive GE.*

***Dilemmas***

*43 The learners are giving answers at the same time. GD 44 Some learners are very good at listening to others GD 45 and copy on what they are doing GD. 46 So the teacher might think that the learner is on the right lane until the learner starts writing individual work GD. 47 The teacher is sort of using a strategy of adding the number to the existing number MD 48 which could be a problem* $MD^{\to E3}$ *49* ***because*** *what about those who want to come up with different strategies. For example some student might notice that the possible to count in 2s in same maths problems.* $ME^{e}$

***Beliefs.***

*50 I believe that mathematics is supposed to be for everyone to engage in especially in the foundation phase MD. 51* ***I would have used*** *the mental math strategy for teaching* $MS^{\to E}$ *52* ***because*** *it is very useful to develop number sense, 52b and problem solving* $ME^{e}$*. 53 They [learners] are independent in terms of giving reasons and justifying on how they got to the answer* $GD^{\to E}$*. 54* ***It leads*** *the learners to the next level of solving problems GE. 55 She wants to hear the learners' views on what the next step should be after calculating a math problem MD.*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | $GD^{\to E}$ | MD | $MD^{\to E}$ | GE | $GE^{e}$ | ME | $ME^{e}$ | GSS | GES | MSS | MES | GR | MR | |
| 9 | 6 ($1^{E}$) | 22 | 5($1^{E3}$) | 5 | 1 | 4 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 55 |
| 15 | | 27 | | 6 | | 6 | | 0 | | 1 | | 0 | | 55 |
| 42 | | | | 12 | | | | 1 | | | | 0 | | 55 |

Joy S3 reflections

**Joy**

**Mathematics and mathematical ideas**

*1 The teacher appears to think of maths as an easy subject MD$^{\rightarrow E}$ 2 by making it friendly for learners ME. 3 In this lesson she uses the friendly numbers MD$^{\rightarrow E}$ 4* ***to*** *assist the learners in solving an addition problem ME. 5 She uses the next ten's technique MD$^{\rightarrow E}$ 6* ***to*** *encourage the friendly number method ME. 7 The use of language appears not to be a challenge GD 8 therefore she seems to be aware of the use of the good language GD$^{\rightarrow E}$ 9* ***because*** *it makes clear instruction GE.*

***Tasks and activities***

*10 Using the number line MD$^{\rightarrow E}$ 11* ***to*** *solve addition problems ME 12 Pop fiz game MD$^{\rightarrow E}$ 13 [for] - quick mental calculations ME 14 Revising on previous lesson GD 15 Development to pop fizz game MD 16 bonds increase from 10 to 30 MD$^{\rightarrow E}$. 17* ***This is done*** *for the learners to progress ME 18 The benefits of using these tasks number line MD 19* ***is that*** *the learners can visualise what is required of them ME*

***Goals***

*20 She firstly wants to revise on the previous lesson, GD 21 then progress from that lesson.GD 22 Adding a single digit number to a double-digit number MD 23 Addition using the next ten method MD 24 Know the bonds of ten spontaneously MD 25 Learn the bond of 30 MD 26 Learn the next 10 counting technique instead of rounding off MD*

***Interaction with students***

*27 The teacher use of language is at the correct level, GD 28 and she uses encouraging language and compliments GD 29 She asks learners questions GD 30 to have the learners take part in the lesson GD 31 The type of questions she asks require the learners to provide reasoning to their answers GD$^{\rightarrow E}$ 32 because she ask them "why" GE. 33 The teacher is learner centred GD. 34 She allows the learner to explain their way of thinking GD*

***Beliefs***

*35 The teacher appears to believe the learners various opinions matter GD; 36 the learners could learn from others GD; 37 no need to be perfect GD*

***Dilemmas***

*38 During the fiz pop game, the learners are initially don't understand what the teacher requires of them when she says 17-… then jump to the bonds of 30 GD. 39 She then stops and explains what she would like them to do GD. 40 They then get it correctly GD. 41 When she asks them for the next 10 0f 64, the learners round off instead moving to the next 10 MD. 42 She then explains the difference between rounding off a next 10 MD*

| Level 1 DESCRIPTION | | | | Level2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | |
| 16 | 2 | 7 | 7 | 2 | 0 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 42 |
| 18 | | 14 | | 2 | | 7 | | 0 | | 1 | | 0 | | 42 |
| 32 | | | | 9 | | | | 1 | | | | 0 | | 42 |

Lutho S3 reflections

***Mathematical ideas and Meta-mathematical ideas***

*1 Completing 10s MD 2 through a number-line MD. 3 Other strategies such as using a spider diagram GS 4* ***could have*** *made her lesson more interesting 4b and easier GE. 5 The teacher asks questions GD 6 and the children are expected to answer GD 7 and justify their thinking GD. 8 There was a development on children's thinking GD, 9 the teacher started the lesson by recapping on what was done the previous day GD. 10 the teacher scaffolds the lesson GD 11 and starts from easy questions to complex ones as the lesson progresses GD.*

***Tasks and activities:***

*12 Questions and answers are the main features used GD 13* ***so that*** *the teacher can achieve the completion of goals GD.* ***14*** *The children are then given a problem to solve by themselves as the lesson progresses GD .* ***15*** *The game of "pop quiz" stimulates the learners brain activity GD 16 and reinforces prior knowledge ,GD 17 hence conditioning the learners to greater understanding of what is happening in the lesson GD. 18 The teacher gave the children a task to complete at the end of the lesson GD$^{\rightarrow E}$. 19* ***to*** *check for their understanding GE 20* ***benefits-*** *understanding children's uncovered weaknesses GD. 21 The weakness is that only two tasks were given GD$^{\rightarrow E}$. 22* ***because that will not allow*** *for their assessment to occur GE.*

***Goals***

*23 Learning the completion of tens through building on what the learners already know MD. 24 The goal shifted when the teacher changed from completing tens to rounding off to the nearest 10 MD*

***Interactions with students***

*25 The teacher works with the whole class GD. 26 She poses questions to the whole class GD 27 and does not acquire [require] individual answer accept [except] if a question is posed on the board GD*

***Dilemmas and decision making***

*28 The weakness is that there is only one strategy that the children are allowed to use GD$^{\rightarrow E}$. 29* ***because that*** *hinders their multiple intelligences GE. 30 She uses easy numbers when asking questions MD 31 and poses a complex problem on the board MD. 32 Children chant their answers GD 33 and* ***in that*** *there is possibility of others imitating others GD. 34 The teacher asked the children to round off to the nearest ten MD, 35 then she posed the questions- 64 rounded to the nearest ten MD 36 and the children completed a ten by answering 70 instead of rounding off MD. 37 She then used a number line MD$^{\rightarrow E}$ 38* ***so as to*** *rectify this problem ME*

***Beliefs***

*39 The teacher believes in interacting with the children GD 40 and actively involving them during the lesson GD. 41 She also believes in teaching in hierarchy GD. 42 That is building up from a foundation that has already been laid GD.*

| Level 1 DESCRIPTION | | | | Level 2 EXPLANATION | | | | Level 3 SUGGESTION | | | | Level 4 REFLECTIVITY | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GD | GD$^{\rightarrow E}$ | MD | MD$^{\rightarrow E}$ | GE | GE$^{e}$ | ME | ME$^{e}$ | GS | GS$^{\rightarrow E}$ | MS | MS$^{\rightarrow E}$ | GR | MR | |
| 23 | 3 | 9 | 1 | 4 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 42 |
| 26 | | 10 | | 4 | | 1 | | 1 | | 0 | | 0 | | 42 |
| 36 | | | | 5 | | | | 1 | | | | 0 | | 42 |

## Appendix 3.3: The Four PSTS 2019 Reflections on own practice

### Bonga 2019 Reflections on own practice

***Meta and mathematical idea***

*1 In this lesson I planned to teach learners bonds of 15 MD. 2 I wanted learners to come up with two numbers that can be added to make up the number 15 MD. 3 Each learner would raise a hand GD 4 and give the two numbers MD, 5 explain to the class how they calculated it MD. 6 Learners had to justify their answers by explaining to the class MD$^{\to E}$. 7* ***This was*** *for helping them to have number sense, 7b to help them with addition ME$^{e}$. 8 Aims of this lesson was to equip my learners with 'adding on' instead of starting from 1 when adding MD. 9 As learners were explaining to how they arrived at making 15 with two digits MD, 10 I helped them to start with the larger number instead of small number to do so MD.*

***Explicit and implicit***

*11 The goals of this lesson was to equip learners with different strategies of adding without using counters MD 12 but use the mind and hands MD$^{\to E}$. 13* ***This was to help*** *learners to be able to use easy ways to calculate instead of long processes ME. 14 The 1$^{st}$ activity I asked learners to give me two digit numbers that will make up number 15 MD. 15 Learners gave me these numbers MD 16 and explained how they got it MD$^{\to E}$. 17 Through this I was able to introduce 'counting on' ME 18 Some learners however, already knew the strategy MD, 19 I had to explain it further more MD 20 and try to make it as simple as I can for other learners MD.*

***Task***

*21 In this lesson plan, my introduction was a song learners sang GD. 22 This song had action with it GD. 23 Learners had to stamp their feet GD 24 when they call a number MD 25 and move forward GD. 26 Learners were counting from 1 to 20 MD. 27 Then counted backwards from 20 to 1 while moving backwards MD$^{\to E5}$. 28* ***because*** *I wanted this to be fun 28b and active 28c rather than just doing mental maths the old fashion way of just asking questions, 28d I wanted learners to engage 28e and play ME$^{e5}$. 29 I believe learners learn through play GD, 30 and in a good atmosphere GD. 31 The 1$^{st}$ activity in my lesson development, dealt more with what I needed to help the learners know GD. 32 I was able to make them do the maths on their own MD 33 and I had to help explain further MD. 34 I developed my lesson plan from what they know GD$^{\to E}$. 35* ***Through this*** *activity I was able to explain the counting on strategy, 35b and help them use it ME$^{e}$. 36 The second activity during my lesson development was the number grid MD. 37 In this grid, learners first add two number that are given MD 38 and they have to find out what is the number left to make the total number 15 MD$^{\to E}$. 39* ***This develops*** *problem solving skills ME. 38 Learners have to count MD 40 and think MD 41 and workout the number needed to make the total MD. 42 I used this game MD$^{\to E}$ 43* ***to*** *help learners gain the skill of adding on ME. 44 The third activity was number line MD$^{\to E}$, 45* ***this also helped*** *me in emphasizing the above skills ME. 46 In this activity learners had to come to the board GD 47 and write on their own GD. 48 The tasks I did with these learners were good for their level GD. 49 They were not difficult GD 50 but a bit challenging GD, 51 they needed learners to think GD. 52 I focused on number bonds MD, 53 learners adding MD, 54 I wanted to expose learners to different [ways of adding] MD 55 and easy ways of adding MD. 56 My goals did not shift GE 57 because I had to be more explicit with other learners 57b and explain more GD. 58 I came up with three different activities GD$^{\to E}$ 59* ***in order to*** *try and help them GE. 60 Some learners do* not grasp new information or skills quickly therefore GD 61 I wanted them to practice these skills in different activities GD$^{\rightarrow E}$ 62 **so that** they can know they can take one skill they learnt from other activities and apply it to another in order to solve a problem GE.

**Interaction with learners**

63 My teaching approach was questioning using constructive theory GD. 64 Learners doing things by themselves GD 65 and teacher guiding them GD 66 At the same time it [the teaching approach] was learner centered MD$^{\rightarrow E}$ 67 **because** I asked learners to solve a sums 67b and they solved it ME$^{e}$. 68 Learners had to explain how they got to their answer MD$^{\rightarrow E}$, 69 this allowed learners to think about the calculations 69b and they had chance to correct themselves if they were wrong ME$^{e}$. 70 Learners who behaved were selected to talk GD. 71 When I ask a question GD 72 learners jumped calling 'teacher teacher!' I would look for the quiet learner and say "I'm picking her because she is behaved, s/he not talking or shouting". GD 73 I also selected learners who were quiet for too long, I would just say "Lisa you been quiet, what do you think?" GD$^{\rightarrow E}$ 74 because I was trying to get them to participate GE.

**Dilemmas**

75 Thinking on our feet is our daily bread as teachers GD, 76 learners do not always do what you ask GD, 77 or give right answers GD, 78 they often make mistakes GD 79 and as teachers we must use those opportunities for learning GD. 80 During my lesson some learners gave me numbers that were more than what we needed to make 15 MD. 81 When they were explaining it to the class, MD 82 they notice that their number was wrong MD 83 and they think of another number MD. 84 Another mathematical dilemma was when I asked learners to give me two numbers to make 15 MD. 85 One of the learners gave me 3 numbers, MD 86 I allowed it MD$^{\rightarrow E}$ 87 because she wasn't wrong 87b and it linked to the next activity ME$^{e}$, 88 Some learners are more intellectual than others GD.

**Beliefs**

89 Any discipline can be made fun by a teacher GD, 90 it's all just a time needed to be taken by the teacher GD 91 and willingness to allow the children play as they learn GD. 92 I believe young children learn best when they are doing things by themselves GD, 93 playing GD, 94 manipulating the numbers MD 95 or whatever the teacher is teaching GD. 96 Involving the learners in the lesson GD 97 than just explaining to them can be a waste of time GD. 98 I think the atmosphere of the classroom matters GD, 99 and it's all up to how one starts their day GD 100 or introduce the lesson GD. 101 I think how one introduces a lesson, sets the how the lesson will be carried out GD. 102 Therefore for me, the introduction is important GD.

**Dumie's 2019 Reflections on own practice**

***<u>Mathematical and Meta-mathematical idea</u>***

1 The idea of the lesson was to teach the learners about addition MD 2 and different ways or strategies of adding MD 3 or subtracting numbers through solving different sums with two digit number. For example, 34-20= or 12+11=. MD 3 I also used resources MD$^{\rightarrow E}$ 4 in order to help the learners count ME. 5 Learners need to understand that adding is putting together MD 6 and subtracting is taking away from MD. 7 They must also relate the whole concept with their real life situation MD. 8 However, learners were expected to invent or create different strategies of addition MD 9 and subtraction MD. 10 They found some of the ways during mental maths MD. 11 But now they were given an opportunity to use counters to calculate MD. 12 The language use could have been more developed during the lesson MS$^{\rightarrow E}$. 13 because in grade one they use isiXhosa to learn math ME. 14 I could have put

*more emphasis on making them to master the basics of how to count rather than mixing the language with English using such as: one instead of 'Inye' MS. 15 However, I did saw the development during the lesson development GD[→E]. 16 Learner getting the answers correct MD 17 and understanding the addition MD, 18 subtraction MD 19 and the different strategies.*

***Explicitly goal and implicitly goals***

*20 The explicit goal of the lesson was to teach addition MD 21 and subtraction, using different sums MD. 22 The evidence is that, I used flash cards that had the sums MD. 23 It was variety of sum with addition MD 24 and subtraction MD. 25 Along the way I discovered that they also found different strategies of calculating the same sum MD. 26 They also found ways of understanding the sum differently MD. 27 I also discovered this through asking questions such as: tell me how did you calculate the sum? Which other ways would you have done it? Would you like to explain it to the next person or learner sitting next to you? Why did you add 13 instead of 10? MD 28 Some of these questions were mainly based on the students who more advanced MD. 29 Some of the interesting implicit goals were that they used number lines MD 30 and counting on. For example, 13 +8=14, 15, 16, 17…21 MD, 31 but, I was expecting them to use strategies I gave them MD. 32 At the same time, I did not want to limit them GD. 33 In addition, I think this shifting of the goals occurred MD[→E] 34 because of the fact that, I did not limit them to use my strategies 34b but to find ways of counting by themselves ME[e].*

***Task and activity***

*35 The learners were grouped GD[→E] 36* ***so that*** *the activity could be interesting 36b and inviting to learners GE[e]. 37 Each group was given an activity according to their groups GD. 38 These groups were also created according to their level of fluency in math MD. 39 They were divided into three groups GD. 40 These groups were made to challenge the learners in maths MD. 41 Each group was given an activity on the black board to calculate MD 42 and once they finish, they are getting another sum that is challenging them a little bit MD. 43 I introduced this lesson by explaining what is needed GD 44 and how it will work GD. 45 Learners were also given different resources or counters to work with MD[→E] 46* ***So that*** *they can show different strategies of calculating their maths problem ME. 47 They were using different counters such as Dice, dominos and slate MD 48 Learners were able to exchange the counters MD[→E] 49* ***so that*** *they can use the ones they are comfortable with ME. 50 The resources were also arranged according to their level of fluency in problem solving. For example, the slate, was meant for those who can write and solve the maths quick MD. 51 The purpose was for them to find different ways of calculating different problems MD, 52 using different strategies MD, 53 and be able to learn from others GD. 54 Furthermore, to understand that there are different ways of solving maths problems MD 55 and there is always a solution. For example some of the problem were 12+7= was on board in a flash card could be solved by learners differently 10+2+7 or 10 +9= MD.*

***Interaction with the student***

*56 First of all, I was walking around the classroom GD, 57 helping learners who had questions GD 58 and those who were stuck GD. 59 I was addressing them as a group since, I grouped them GD,60 but I noticed that some of them were confused GD, 61 I decided to sit with them one on one GD. 62 The time was a problem GD[→E] 63 because, I ended up spending lot of time with some students GE 64 while others were struggling GD 65 and I couldn't finish all of them to see whether they were following the activity GD. 66 The questions that, I was asking to students, some of they were questions like: if you have 12 dominos and added 7 dominos, how many of them in total MD 67 I also told them that addition means putting together MD 68 and subtraction means taking away MD. 69 Some* *of the students had questions revolving around on how to use the counters MD. 70 Some they were not familiar on how to use them [counters] MD. 71 I also had a rule that, when I speak they should listen GD 72 and when someone wants to speak must raise their hands GD$^{\rightarrow E}$, 73 so that I can give there is order in class GE. 74 Even though the class was a little bit chaotic GD 75 when I was busy with a group of students GD 76 some would make noise GD.*

***Dilemmas and decision making.***

*77 The use of counters did not go as, I expected for example in the situation of the dominos MD. 78 Instead of counting the dots they were counting the whole dominoes MD$^{\rightarrow E}$. 79 It is because they did not understood how they [the dominos] worked ME. 80 It was something that I have observe at that moment GD$^{\rightarrow E}$, 81* **so that** *next time, I can bring games that have dominos, 79b so they can learn how to use them formally ME$^{e}$. 82 Learners were confused by the sums MD. 83 They were supposed to complete sums that were under their group name MD 84 but they were doing every sum that was on board MD 85 these sums were difficult for most of them GD. 86 However, next time, I will give each table rather than putting it on board GS*

***Beliefs about mathematic teaching.***

*87 That mathematics is around us MD, 88 and learners can be able to do it. MD 89 Encouraging them all the time GD. 90 Positive reinforcement should be a priority GS$^{\rightarrow E}$ 91* **so that** *learners can be empowered all the time GE. 92 As teacher it is very important to integrate math with everyday life MS. 93 I should have used things they know in my sums For example, if I have 5 bananas and I need ten in total, how many bananas should, I add to make ten? MS$^{\rightarrow E}$ 94 Because learner learn easy when we relate what they know to any subject ME. 95 As a teacher, I should be reflecting on the lesson every time GS$^{\rightarrow E}$ 96* ***so that****, I can see my pitfalls 96b and achievements in the lesson GE$^{e}$. 97 Lesson evaluation is very important to me GD$^{\rightarrow E}$ 98* **because** *it guides me GE. 99 Lesson evaluation also helps know where to fix my lesson GD$^{\rightarrow E}$ 100* **so that***, it can be improved GE. 101 My role as teacher is to guide learners to develop in mathematics GD. 102 To also apply constructivism theory that learners construct knowledge GD 103 and meaning from their own experience GD. 104 I should not to spoon feed them by knowledge GD. 105 I understand that learners learn differently in class GD 106 and [that] Mathematics needs different ways to explain it MD. 107 In addition, student's role is to try more and practice more GD. 108 They have to investigate GD, 109 generate and give reasons for every problem that they solve MD.*

**Joy's 2019 Reflections on own practice**

***[Mathematical and meta- mathematical ideas]***

*1During this lesson I was trying to get the learners to think about using non-metric tools to measure bigger items using smaller items MD. 2 I started the lesson off with some rote counting MD 3 and a mental maths exercise MD. 4 The aim of the rote counting was to ignite their number sense MD 5 and connect their thinking to numbers MD. 6 Because the rote counting was done in a chorusing manner MD, 7 I was not able to pick up the learners who were miming MD 8 or not even attempting to count MD, 9 they were therefore left out of that exercise MD. 10 Also, the way they were counting sounded more like them reciting a memorized grid of numbers MD. 11 During the counting I would ask them to start at a random number MD$^{\rightarrow E,}$12* **this was to** *promote their awareness 12b and to engage them in the lesson ME$^{e}$. 13 They would need to have listened to me to be able to know where to start and stop GS. 14 The mathematical ideas that were brought forward in my lesson were measurement using a non-standard unit MD, 15 count in tens backwards and forward MD*

16 and develop their understanding of the relationship between addition and subtraction MD. 17 The idea of having a set starting point when measuring MD 18 and keeping the measuring tools steady were left out MD.

***[Goals]***

19 I was trying to connect what I was about to teach them to what they already know GD$^{\rightarrow E}$ 20 because by doing so, they will be able to understand and remember it better GE. 21 I did this by asking them what they think we can use to measure things MD, 22 but I first found out whether they knew what concept of measuring is about MD. 23 I had initially planned to use blocks to carry out this exercise MD 24 but using pencils connected more with the idea of using known tools to measure bigger items MD. 25 I also changed to pencils GD$^{\rightarrow E}$ 26 **to** maintain the control in the classroom GE, 27 the blocks would have been more distracting GS.

***[TASKS AND ACTIVITIES]***

The tasks were in the following order:

28.Rote counting in 10s MD. 29 Mental maths activity – number plus 2 MD, 30 Measuring desks using pencils MD, 31 Writing down their measurement observation in their workbooks MD 32 I asked the learners leading questions GD$^{\rightarrow E}$ 33 so as to scaffold them GE. 34 Sometimes the learners would not understand what answer I was looking for GD. 35 In rote counting, as mentioned before some of the learners were not counting correctly MD 36 or even counting at all MD. 37 But that was difficult for me to pick up MD. 38 By doing the mental maths activity MD$^{\rightarrow E}$, 39 they got to revise on their addition skills ME. 40 They did the measuring activity MD$^{\rightarrow E}$ 41 so that they got to see how many pencils can fit into the length of their desk ME. 42 They should have written their observation in their workbooks GS$^{\rightarrow E}$. 43 The benefits of this are they get to connect what they observe with writing it down, a form of report GE.

***[Interactions]***

44 When it comes to getting answers from the learners, it is usually the same learners that respond GD. 45 So, what I would do I would ask the learners who seldomly answer GD$^{\rightarrow E}$, 46 this is to help them gain confidence of giving answers even if what they think is right is not GE. 47 I always give them positive feedback GD 48 and their favourite "hi-five" GD$^{\rightarrow E}$ 49 **to** try to encourage them GE

***Dilemmas and decisions making***

50 A dilemma I had was in the mental maths where they could not fully understand what I required from them MD. 51 I abstractly asked them GD, 52 and they could not make the connection GD. 53 I therefore had to use the count on strategy MD 54 or the addition strategy MD. 55 The constraint to that could be my scaffolding GS$^{\rightarrow E}$ , 56 may cause them to be too dependent GE.

***Beliefs***

57 My mathematical beliefs that are displayed in this video are that maths is a fun learning area MD. 58 It can be easily integrated into our everyday life GD.

**Lutho 2019 Reflections on own practice**

***[Mathematical and meta- mathematical ideas]***

1During this lesson I was trying to get the learners to think about using non-metric tools to measure bigger items using smaller items MD. 2 I started the lesson off with some rote counting MD 3 and a mental maths exercise MD. 4 The aim of the rote counting was to ignite their number sense MD 5 and connect their thinking to numbers MD. 6 Because the rote counting was done in a chorusing manner MD, 7 I was not able to pick up the learners who *were miming MD 8 or not even attempting to count MD, 9 they were therefore left out of that exercise MD. 10 Also, the way they were counting sounded more like them reciting a memorized grid of numbers MD. 11 During the counting I would ask them to start at a random number MD[→E,] 12* ***this was to*** *promote their awareness 12b and to engage them in the lesson ME[e]. 13 They would need to have listened to me to be able to know where to start and stop GS. 14 The mathematical ideas that were brought forward in my lesson were measurement using a non-standard unit MD, 15 count in tens backwards and forward MD 16 and develop their understanding of the relationship between addition and subtraction MD. 17 The idea of having a set starting point when measuring MD 18 and keeping the measuring tools steady were left out MD.*

***[Goals]***

*19 I was trying to connect what I was about to teach them to what they already know GD[→E] 20 because by doing so, they will be able to understand and remember it better GE. 21 I did this by asking them what they think we can use to measure things MD, 22 but I first found out whether they knew what concept of measuring is about MD. 23 I had initially planned to use blocks to carry out this exercise MD 24 but using pencils connected more with the idea of using known tools to measure bigger items MD. 25 I also changed to pencils GD[→E] 26* ***to*** *maintain the control in the classroom GE, 27 the blocks would have been more distracting GS.*

***[TASKS AND ACTIVITIES]***

*The tasks were in the following order:*

*28.Rote counting in 10s MD. 29 Mental maths activity – number plus 2 MD, 30 Measuring desks using pencils MD, 31 Writing down their measurement observation in their workbooks MD 32 I asked the learners leading questions GD[→E] 33 so as to scaffold them GE. 34 Sometimes the learners would not understand what answer I was looking for GD. 35 In rote counting, as mentioned before some of the learners were not counting correctly MD 36 or even counting at all MD. 37 But that was difficult for me to pick up MD. 38 By doing the mental maths activity MD[→E], 39 they got to revise on their addition skills ME. 40 They did the measuring activity MD[→E] 41 so that they got to see how many pencils can fit into the length of their desk ME. 42 They should have written their observation in their workbooks GS[→E]. 43 The benefits of this are they get to connect what they observe with writing it down, a form of report GE.*

***[Interactions]***

*44 When it comes to getting answers from the learners, it is usually the same learners that respond GD. 45 So, what I would do I would ask the learners who seldomly answer GD[→E], 46 this is to help them gain confidence of giving answers even if what they think is right is not GE. 47 I always give them positive feedback GD 48 and their favourite "hi-five" GD[→E] 49* ***to*** *try to encourage them GE*

***Dilemmas and decisions making***

*50 A dilemma I had was in the mental maths where they could not fully understand what I required from them MD. 51 I abstractly asked them GD, 52 and they could not make the connection GD. 53 I therefore had to use the count on strategy MD 54 or the addition strategy MD. 55 The constraint to that could be my scaffolding GS[→E], 56 may cause them to be too dependent GE.*

***Beliefs***

*57 My mathematical beliefs that are displayed in this video are that maths is a fun learning area MD. 58 It can be easily integrated into our everyday life GD.*

# Appendix 4: Other

## Appendix 4.1 The facilitator guided sessions summary

There were three sessions of facilitator guided reflections that were done with the four pre-service teachers in the smaller sample after I conducted the semi-structured interviews with each one of them to understand their reflective practice deeper. The video-recorded lesson of each PST's own teaching was a stimulus for each interview. The three sessions were conducted by two experienced facilitators using different video-recorded lessons as stimuli for reflections. The sessions were video recorded. However, since these are not part of my data, I did not share them but are available in my hard drive that is safely kept in the university offices.

The first session after the interviews was facilitated by a guru in developing teachers' reflective practice. She runs project for developing mathematics teachers' reflective practice in her country and is the one who developed the SLF, the tool the PSTs were using for reflecting. She began the session by highlighting the DOs and DON'Ts of reflecting and making sure PSTs understand what reflecting all is about as Postholm (2008) claim that teachers do not know what reflection is and therefore do not know how to reflect. She played a selected video-recorded mathematics lesson and took the four PSTs through a session of reflection, asking questions and probing for more ideas. Below I share some snippets of her questions and probing extracted from the transcript of her session to give the reader a feel of this session:

*"What can you say about the task that the teacher chose to introduce in the lesson? Try to characterise the task in light of what you see in the clip. What can you tell us there?....*

*Yes, these were the instructions. What do you think about that? I mean why did she give the instruction? ... why did she write and not count one by one?...*

*What I would like to challenge you to do Lutho is to concentrate on the task, what is special on the task, not in how she introduced it, but why she chose this task, for example why did she not choose three on three or thirty on thirty? Why ten on ten? What is there about the task that you think is good to get in all the things that we were talking about mathematically and... Why is this a good task? Or maybe, you think it is not a good task?*

The last two sessions were facilitated by their mathematics methods lecturer who was leading the lectures during Phase 1 data collection. Like in Karsenty's session, these two sessions also were based on the video-recorded lessons of the practice of other teachers. Like Karsenty, the lecturer played the video-recorded lessons, asked PSTs to reflect on the lesson, asked questions and probed for deeper or more elaborate responses. I also share a few of the lecturer's questions and probing.

*Who is going to start us off with the maths and meta-mathematical ideas? Has anyone got something to add or something different? So, was it only numbers on their cards? Were there only numbers? : Okay, what else was there? So why would she want to have both the numbers and the words written down? Both the number or the numeral and the number word, why would she want both? Okay. Interesting. Anyone got anything else to add in terms of mathematical ideas that she was developing?*

The PSTs reflected on the video-recorded lessons as they responded to these questions and probing.

## Appendix 4.2 The initial codes used in Session 1 data

| LEVEL OF REFLECTION | CODES | | INDICATORS | EXAMPLES |
|---|---|---|---|---|
| Level 1: DESCRIPTION | General Factual Description | **GFD** | The description is general and observable | 1 She asked learners questions.<br>2 She used the children to correct each other |
| | Mathematical Factual Description | **MFD** | The description is mathematical and observable | 3. The teacher was showing the learners the cards with dots<br>4. The third one [task] is when the children are asked to bring the number 5 and 0 |
| | General Subjective Description | **GSD** | The description of the classroom event is general and subjective, evaluative/ judgmental | 5. 1. The children were familiar with the story<br><br>6. The teacher is encouraging learners to be critical thinkers |
| | Mathematical Subjective Description | **MSD** | The description is mathematical and subjective to feelings, thoughts or evaluative/ judgmental | 7. Subitizing was the heart of the lesson<br><br>8. The time was limited therefore (this) could have disadvantaged the learners who are slow counters<br><br>They [learners] have a sense of number operations |
| LEVEL 2: EXPLANATION | General Simple Explanation | **GSE** | A general description is accompanied a simple explanation (no justification for the explanation). Explanation is evidenced by such words/phrases as: So… So that…, because…, So as to…, to…, this was to in order to…, which made…, this was done to…, got learners to…<br>This way she can … | 9. the teacher asked the learners on the mat questions so that they may be involved in the lesson<br><br>10. She used the umbrellas so the learners could visually see the concept |
| | Mathematical Simple Explanation | **MSE** | The mathematical description is accompanied by an analysis/ a reason/ explanation. Explanation is evidenced by such words/phrases as: So…<br>So that…, because…, So as to…, to…, this was to in order to…, which made…, this was done to…, got learners to…<br>This way she can | 7. Using dice pattern also got the children to recognize the amount of dots.<br><br>8. The key cards got more and more difficult as the order of the dots changed, this way she can see at what standard the learners are at. This way she can see if learners understand counting. |

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| | General Analytical Explanation | **GAE** | A general description is accompanied an analytical explanation (justification for the explanation provided) Explanation is evidenced by such words/phrases as: So… So that…, because…, So as to…, to…, this was to in order to…, which made…, this was done to…, got learners to… This way she can | No examples from S1 data |
| | Mathematical Analytical Explanation | **MAE** | A mathematical description is accompanied an analytical explanation (justification for the explanation provided) Explanation is evidenced by such words/phrases as: So… So that…, because…, So as to…, to…, this was to in order to…, which made…, this was done to…, got learners to… This way she can | No examples from S1 data |
| **Level 3: SUGGESTION** | General Simple suggestion | **GSS** | The reflection comprises of a description that is general; accompanied by a simple suggestion(suggestion with no justification) | She may had to explain the role of rain in our lives and why we should not get wet, as to why there were umbrellas in the story |
| | Mathematical Simple suggestion | **MSS** | The reflection comprises of a description that is mathematical; accompanied by a simple suggestion (suggestion with no justification) | 12. As the teacher, I would use the numbers as well, as she only gave the dots and asked for numbers, but not the numbers to ask how many dots |
| | General Analytical suggestion | **GAS** | The reflection comprises of a description that is general; accompanied by an analytic suggestion (suggestion with justification) | No examples from S1 data |
| | Mathematical Analytical suggestion | **MAS** | The reflection comprises of a description that is mathematical; accompanied by an analytic suggestion (suggestion with a justification) | 11. I could have focused on one number e.g. 10 then show learners cards with different dot formation but all add up to 10. That way they will also learn bonds of 10 |
| **Level 4: REFLECTIVITY** | General Reflectivity | **GR** | Reflection displays deeper engagement with the non-mathematical identified event. The PST engages in a dialogue with self, analyzing the event from different perspectives to come up with better ways of dealing with similar events in the future. | No examples from S1 data |

| | | | | |
|---|---|---|---|---|
| | Mathematical Reflectivity | **MR** | Reflection displays deeper engagement with the mathematical identified event. The PST engages in a dialogue with self, analyzing the event from different perspectives to come up with better ways of dealing with similar events in the future | No examples from S1 data |